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New Mexico's Nuclear Enchantment: Local Politics, National Imperatives, and Radioactive Waste Disposal in the Desert

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NEW MEXICO'S NUCLEAR ENCHANTMENT: LOCAL POLITICS, NATIONAL IMPERATIVES, AND RADIOACTIVE WASTE DISPOSAL

by

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For Timothy Moy

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ABSTRACT

The use of nuclear technologies has left an indelible mark on American society. The environmental, political, economic, and social costs of creating, producing, and utilizing technologies such as nuclear weapons and nuclear energy have left a legacy of radioactive waste. To date, there is no comprehensive path for disposing of the different kinds of waste produced by the nuclear industry, including spent nuclear fuel that is now held on site at nuclear power plants. The question of how to deal with nuclear waste has plagued the nuclear industry, governmental agencies, and the concerned public for most of the nuclear era.

There is one permanent geologic repository in the U.S., called the Waste Isolation Pilot Plant (WIPP), located in the salt beds outside of Carlsbad, New Mexico. Presently, WIPP is only allowed to hold low-level transuranic waste produced by military installations during the Cold War. This project looks at the ways that federal attention has turned to this remote site in the Chihuahuan Desert as a potential solution for storing high-level nuclear waste as well. Using ethnographies, archival research, and the ideas expressed at numerous public meeting held in the region, this project shows how nuclear communities are framed in discourses surrounding nuclear waste through the concept of nuclearism, which posits that

nuclear technologies are wholly beneficial to society. Specifically, this project examines how concepts involving the immutability of nature and science interact to form problematic assumptions regarding the behavior of the environment in relation to nuclear waste. Furthermore, conversations that focus solely on the production of "sound science" ignore the political and social consequences of creating and moving nuclear waste across the country, ensnaring more communities into the web of potential nuclear consequences. Nuclear issues also intersect different scales, troubling the idea of local consent, the idea of a homogenous public, and whether nuclear technologies can be tools of democracy. The events at the Fukushima nuclear power plant on March 11, 2011 underscored the delicate balance of technology and nature, and showed the inherent vulnerabilities of complex technological systems. By connecting the complex natures of the desert, salt, radiation, and time together with questions of political representation, this project looks at how the nuclear future is being shaped in the desert of New Mexico.

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Introduction: New Mexico's Nuclear Enchantment

Nuclear energy production has an indisputably controversial history in the United States, marked by competing claims from different stakeholder groups over the safety and risks stemming from nuclear technologies. Nuclear power is an energy source that enjoys the continuing optimism of supporters who have pushed for an increase in nuclear energy production and call for its increased usage in the future. This optimism is a recurring theme for nuclear projects, and since the inception of nuclear projects in the 1940's, nuclear energy has been continually branded by political and corporate interests as synonymous with social progress and economic security.[1] It is often represented by proponents as the next major energy source to supplant fossil fuels, and who insist that it will save America from a multitude of evils directly tied to energy use, including energy shortages, expensive energy production, and deadly pollution from the emission of greenhouse gasses.[2] These arguments for nuclear energy are typical of the ideal of nuclearism, which "is the belief that nuclear weapons and nuclear power are essential forms of progress that in the right hands will protect the peace and further the human condition."[3] The theory of nuclearism underlies nuclear projects from the inception of the atomic age to the present, and is continually used by industry and federal proponents to rationalize the use of nuclear technologies as wholly beneficial to society. Nuclear energy currently provides 20% of electricity in the U.S.[4], and several policies introduced by recent federal and state agencies in the last five years have pushed for an increase in the production and use of nuclear energy, based on the ideals of

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[1] Richard G. Hewlett and Jack M. Holl, *Atoms for Peace and War 1953-1961: Eisenhower and the Atomic Energy Commission* (Berkeley: University of California Press, 1989), 183-208. See also J. Samuel Walker, *Three Mile Island: A Nuclear Crisis in Historical Perspective* (Berkeley: University of California Press, 2004), 4-7.
[2] Robert C. Morris, *The Environmental Case for Nuclear Power: Economic, Medical, and Political Considerations* (St. Paul: Paragon House, 2000), 89-125.
[3] David Krieger, "Nuclearism and Its Insecurities," in *Worlds Apart: Human Security and Global Governance*, ed. Majod Tehranian (New York: St. Martin's Press, 1999), 109.

nuclearism. These policies have met with bipartisan support for increasing nuclear energy output and building new conventional and experimental reactors.

A stumbling block that continues to trouble nuclear idealists, however, is the lack of a comprehensive method to deal with the nuclear waste produced by nuclear technologies. The rationale behind nuclearism ignores or dismisses a host of economic, political, and environmental issues that have never been resolved. A major contribution to the unease and controversy that continues to plague the production of nuclear energy is a failure on the part of the federal government to address the environmental, social, and political issues that accompany any discussion of how to permanently deal with nuclear waste. In brief, these issues include the storage of spent nuclear fuel, as well as the detritus from seven decades of nuclear weapons, energy, and medical technologies that also produced radioactive waste. Other contentious issues concern the safety of the public and the environment from exposure to radiation, both in the present and in the future, as well as recognizing and addressing mistakes in the past that have led to the exposure of myriad communities across the United States and beyond to radioactive elements. While many solutions have been explored for dealing with nuclear waste, no long-term solution has been found and implemented for the thousands of tons of waste lingering at nuclear power plants, national laboratories, and military sites. To address these issues, several federal nuclear programs proposed over the last five years have focused on finding solutions for radioactive waste. Currently the only way that federal agencies have found to deal with nuclear waste is to categorize radioactive waste into different classifications, and then find appropriate methods on a case-by-case basis.

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[4]U.S. Energy Information Administration, *Energy in Brief*, http://www.eia.gov/energy_in_brief/ article/ nuclearindustry.cfm. Accessed November 8, 2011.

But even this method is complicated by the unclear and labyrinthine definition used bu the Department of Energy (DOE) to classify waste. For instance, the DOE is currently searching for a permanent home for "Greater-Than-Class-C," or GTCC, waste[5]. GTCC is specific category of radioactive waste that "requires isolation from the human environment for a longer period of time than do Class A, B, and C LLRW [low level radioactive waste]."[6] The DOE describes GTCC waste in physical terms as "activated metals from the decommissioning of nuclear reactors, disused or unwanted sealed sources, and Other Waste" including "contaminated equipment, debris, scrap metal, filters, reins, soil, and solidified sludges."[7] The specific characterizations of waste are defined not only by the radioactive nuclides they possess (such as uranium or plutonium elements), but how long-lived that radioactivity is, how it is absorbed by the human body, and how these waste elements are produced. For instance, GTCC LLRW waste is also defined by what it is not: "LLRW is radioactive waste that is not high-level waste, transuranic waste (TRU), spent nuclear fuel, or by-product tailings from the processing of uranium or thorium ore."[8] To make matters more complicated, GTCC LLRW is a category that only applies to waste produced by licensed operators under the Nuclear Regulatory Commission (NRC), which means that radioactive waste is classified not only by its level of radioactivity, but also how it is produced, and who has produced it. Another category, "GTCC-Like Waste," is also

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[5] Amongst other federal bodies, the DOE is responsible for finding sites to store nuclear waste. Two other important agencies are also involved. Generally speaking, the Environmental Protection Agency (EPA) sets the criteria for radiation safety and protecting the public, and the Nuclear Regulatory Commission (NRC) is responsible for regulating nuclear power plants and other nuclear facilities.

[6] U.S. Department of Energy. "Summary: Draft Environmental Impact Statement for the Disposal of Greater-Than-Class-C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste (DOR/EIS-0375-D). Washington D.C.(February 2011), p. S-3.

[7] U.S. Department of Energy. "Summary: Draft Environmental Impact Statement for the Disposal of Greater-Than-Class-C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste (DOR/EIS-0375-D). Washington D.C.(February 2011), p. S-3. Capitalization of "Other Waste" in text.

[8] U.S. Department of Energy. "Summary: Draft Environmental Impact Statement for the Disposal of Greater-Than-Class-C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste (DOR/EIS-0375-D). Washington D.C.(February 2011), p. S-1.

included in this discussion, though it is used to describe DOE- produced waste that is classified as both LLRW and "non-defense generated TRU waste, which have characteristics similar to those of GTCC LLRW."[9] These characterizations produce unwieldy and vague descriptions of radioactive waste, where GTCC waste seems to provide a catch-all for waste that does not fit into A, B, or C waste categories[10], but they are the definitions that the DOE uses to make waste streams definable and manageable. It is an odd mixture of the prosaic and material (filters and reins), and the more vague substances (sludge and sealed sources). But one absolute characteristic separates GTCC waste from other LLRW; it cannot be stored in shallow land disposal, but instead must be stored in a geologic disposal site, deep underground and sequestered from humans.

The DOE currently has no place to store GTCC waste, and as such, GTCC waste joins several other kinds of nuclear waste in the American pantheon of undisposed radioactive materials, including spent nuclear fuel from power plants and liquid radioactive wastes. But it is a notable category, because unlike spent nuclear fuel from power plants or defense related waste, it was referenced explicitly in the 2005 Energy Policy Act (EnPA) put forward by the federal government as a means of forecasting and directing energy solutions for the nation. The EnPA mandated that the DOE has "the responsibility of completing activities needed to provide a facility for safely disposing of all greater-than-Class-C low-level

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[9] U.S. Department of Energy. "Summary: Draft Environmental Impact Statement for the Disposal of Greater-Than-Class-C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste (DOR/EIS-0375-D). Washington D.C.(February 2011), p. S-9 and S-10.

[10] Class A waste is defined as "waste containing the lowest concentration of short-lived and long-lived radionuclides." Class B is "an intermediate waste classification that primarily applies to waste containing either short-lived radionuclides exclusively, or a mixture of short-lived and long-lived radionuclides in which the CRS-19 long-lived concentration is less than 10% of the Class C concentration limit for long-lived radionuclides." And Class C consists of "wastes containing long-lived or short-lived radionuclides (or mixtures of both) at the highest concentration limit suitable for shallow land burial." Source: Anthony Andrews, "CRS Report for Congress: Radioactive Waste Streams: Waste Classification for Disposal." (December 13, 2006).

radioactive waste."[11] While this is a very specific directive, in following the trail of GTCC waste, it is evident that finding a permanent home for GTCC waste is just one step of a much larger federal project to find a final resting place not only for GTCC waste, but for all radioactive waste produced in the U.S., encompassing past, present, and future waste streams.

The difficulties surrounding the storage of GTCC waste offer an allegory of the ways that federal policies reflect national nuclear goals, which are then materially expressed in practices at different political and geographical levels. These practices shape how nuclear technologies are understood by residents and stakeholders in the places where these projects are proposed. In this dissertation, I focus on how practices and struggles over nuclear waste storage are embodied at a local level, specifically in the town of Carlsbad, New Mexico. Carlsbad is located in southeastern New Mexico, a region where several nuclear projects proposed by the federal government have been concentrated materially and physically. The possibility of finding a permanent storage facility for nuclear waste makes southeastern New Mexico an increasingly important and central site, because the need for a permanent nuclear waste storage site is necessary for the possibility of a nuclear future in America. I focus on this locale because of the ways it is being politically constructed as an appropriate resting place and future model for nuclear waste projects, a priority evident in the recent and numerous public meetings the DOE has held to both educate the public and gather public opinions on GTCC and other kinds of nuclear waste.

Carlsbad is an important site to examine for another reason. It holds a unique place in the nuclear portfolio of the United States as host of the only permanent, geologic

[11] *Energy Policy Act of 2005*. Sec. 631, p. 196, http://www.gpo.gov/fdsys/pkg/PLAW-109publ58/pdf/PLAW-109publ58.pdf

repository for nuclear waste, which is located 26 miles outside of Carlsbad. Dubbed the Waste isolation Pilot Plant, or this facility has been open and operational since 1999, when it accepted its first shipment of radioactive waste.[12] The waste is contained in a rare geologic feature, stored inside of naturally occurring salt beds that lie about 2000 feet underground, which are expected to isolate the radioactive waste from the surrounding environment for the next 10,000 years. Presently, the parameters of WIPP are limited to military-produced waste held at different facilities around the nation, including national laboratories. It is also limited to holding transuranic, or TRU waste, which is waste that is weakly radioactive but will remain so for long periods of time. Because it has successfully contained waste since it began accepting shipments in 1999, WIPP is now being touted by local boosters of the project and explored by federal bodies as a permanent solution to other kinds of waste, including GTCC waste, as well as monitored retrievable storage sites, interim storage for nuclear waste, permanent geologic repositories, and spent nuclear fuel.

This dissertation explores how nuclear national nuclear projects embody local histories, geographies and communities, where local residents are actively shaping the very idea of whether nuclear is possible as a continual and future energy source for the United States. The contested nature of nuclear projects manifested in GTCC meetings held for the public in New Mexico demonstrates how narratives around nuclear energy production and radioactive waste continue to evolve. Local residents, politics, economics and ecosystems are all implicated in creating and contesting new federal narratives that see the potential of the geologic salt beds of Carlsbad as a naturally ideal place to store nuclear waste permanently. It is equally important to understand how other places outside of the locale of

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[12] Chuck McCutcheon, *Nuclear Reactions: The Politics of Opening a Radioactive Waste Disposal Site* (University of New Mexico Press: Albuquerque, 2002).

Carlsbad, like Albuquerque and Santa Fe in central and northern New Mexico, are also inextricably linked to the history of New Mexican nuclear politics, as well as the potential negative effects of nuclear technologies and waste repositories. Regional concerns regarding nuclear technologies are influenced by a larger framework of economic, political, and environmental understandings that draw from a longer history of nuclear activity in the state.

The concern of stakeholders throughout the state illustrates how political and environmental ramifications of nuclear waste disposal cannot be limited to a local/national binary. Scales of geography are important to consider in this project because nuclear issues blur the binary of national and local, showing how the two are not only co-constitutive of each other, but how different scales are created and framed in the pursuit of new nuclear technologies and sites. National nuclear projects cannot work without specific locales in which to materially locate and enact nuclear projects; simultaneously, local and regional identities are created around the effects of nuclear projects in their backyards. Federal agencies like the DOE prefer to emphasize the positive benefits of nuclear projects for communities like Carlsbad, such as an influx of nuclear capital from the federal government, which for local nuclear boosters translates to economic stability. But these nuclear projects also create connections for existing communities that are detrimentally affected by nuclear technologies to find ways to band together in order to resist and oppose local projects as well. Neil Smith has called this effect the "'politics of scale,' where the territorial requirements of capitalism articulate extensions of power at the same time that these manifold scales provide openings to resist that power." Sallie Marston, in describing Smith's approach to the politics of scale, says that these different superimposed scales actually create "multiple opportunities for resistance or opportunities for to create linkages across and

among scales."[13] Applying this to Carlsbad as a present site for storing nuclear waste, and as a potential future site for waste like GTCC and spent nuclear fuel, Carlsbad becomes a place where the abstracted and theoretical ideals of national nuclear projects are made material. These projects necessarily, by the very nature of threats from radiation exposure, implicate other sections of the state and the nation, showing how nuclear threats complicate ideas about the local.

Moving across scales, Carlsbad is also a place marked by resistance and opposition to nuclear projects, as other areas of New Mexico are drawn into nuclear debates because of concerns over safety and risks from an expansion of nuclear projects in the state, particularly in the Carlsbad area. WIPP is a continual site of contestation over science, trust, democracy and ecological understandings regarding nuclear technologies. Finding a permanent solution for nuclear waste is seen as absolutely central by federal agencies and programs looking to increase nuclear production in the U.S., and in this search, different scales of involvement and risk from nuclear projects are constructed through national imperatives. The problem of nuclear waste on a national scale is an abstract one, but the proposed solutions are always necessarily local, in that a specific site for nuclear waste is proposed, considered, and then chosen by federal agencies. It is therefore necessary to examine how local and regional concerns are shaped in relation to national nuclear imperatives in order to understand how these nuclear geographies are created through different scales.

The Centrality of New Mexico to National Nuclear Plans

At first glance, the geographic region of southeastern New Mexico appears to be an unremarkable area. Sparsely settled, the area's population of about 100,000 is spread across

[13] Both quotes from Sallie Marston, "The Social Construction of Scale," *Progress in Human Geography* 24, no.2 (2000): 228.

a dusty and remote corner of the state, which borders Texas to the east and the south. Carlsbad is one of the largest cities in the area, with a population of 25,000. Yet this region of the country has emerged as an integral component crucial to the future of America's high-tech nuclear energy industry. Over the past 20 years, southeastern NM has become the focus of federal programs designed to kick start a new era of nuclear production in the nation, enmeshing the state's future with that of the nuclear hopes and dreams of the federal government and nuclear industry as well. New Mexico has emerged as the alpha and omega of nuclear technologies in the U.S., as a place where the first atomic weapon was designed, built and tested in 1945[14] and the site of the only permanent geologic repository for nuclear waste at WIPP. The GTCC waste hearings emphasize this central role of New Mexico in national nuclear plans.

In 2011, the DOE presented the Draft Environmental Impact Statement (DEIS) on GTCC waste in hearings in Carlsbad, Albuquerque, and Santa Fe, demonstrating the regional scope of nuclear projects. Of the nine meetings held nationwide, it is significant that a third of those meetings were held in New Mexico, a pattern repeated with other nuclear waste programs developed by the DOE in the last ten years. During these meetings, arguments erupted over whether there was a site in New Mexico that could safely hold GTCC waste, with pro- and anti-nuclear factions arguing for or against the suitability of different locations and environments in New Mexico, including a storage facility in Los Alamos National Laboratories (LANL), or in the geologic salt beds of WIPP.

I focus on GTCC waste here not only as a specific example of the DOE's quixotic quest to find a permanent solution for nuclear waste, but also as an allegory for other kinds

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[14] For two excellent historical descriptions of how New Mexico played a part in the making of the first atomic bomb, see: Richard Rhodes, *The Making of the Atomic Bomb* (New York: Simon and Schuster, 1987) and Ferenc Szasz,*The Day the Sun Rose Twice: The Story of the Trinity Site Nuclear Explosion* (Albuquerque: UNM Press, 1984).

of waste, such as TRU waste, high-level radioactive waste, and spent nuclear fuel (SNF), as well as facilities to reprocess SNF. As a case study, GTCC waste exemplifies several of the themes present in this dissertation, which examines the GTCC waste meetings held in New Mexico, but also a host of other public meetings that were held in the state over the last five years regarding the implementation of nuclear technologies and new waste storage sites and facilities. One such meeting for the GTCC DEIS was held at the Pecos River Conference Center in Carlsbad, New Mexico on April 26, 2011. This kind of meeting is demonstrative of how the DOE engages the public with the process of siting of nuclear facilities, and also how they identify and cultivate relationships with communities that seem receptive to hosting nuclear waste repositories and facilities. Yet these meetings are also a rote exercise in mind-numbing predictability. Richard White has noted that, "Planning is an exercise of power, and in a modern state much real power is suffused with boredom…Power does not have to be exercised behind the scenes. It can be open. The audience is asleep. The modern world is forged amidst our inattention."[15] The GTCC public meetings, which were also occurred in Albuquerque and Santa Fe, were held because the DOE has to hold meetings in places that could potentially host or be affected by the DEIS. They followed a pattern that is well-established for federal projects, where information is given by federal experts, and then comments are given by the public, with little interaction between the two groups. But the information presented, as seen above with the description and characterizations of GTCC waste, is highly technical in nature, and the dissemination of information to the public offers a view into the difficulty on the part of the DOE to communicate nuclear concepts to the public.

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[15] Richard White, *The Organic Machine: The Remaking of the Columbia River* (New York: Hill and Wang, 1995), 64.

Walking into this particular public hearing in Carlsbad was like walking into a high school science fair. Poster boards set up on easels around the entry way of the illustrated the point of the meeting, the definition and characterization of GTCC waste, and offered information on radiation and waste streams. Using photos and graphs, the posters reduced the complexity of GTCC radioactive waste to concrete sources, such as nuclear reactor parts, diagnostic and medical equipment, and debris from contaminated sites such as West Valley in New York, the site of a facility that reprocessed nuclear fuel in the 1960's. The ubiquitous "football field" metaphor was also used, where nuclear waste is measured in terms of filling up a football field and then comparing the height of the waste. In this case, if all the GTCC waste in America was to be placed on a football field, it would be 7.1 feet tall.[16] These pictorial representations of nuclear waste are meant to make the volume of waste more comprehensible to the layperson by using recognizable and popular images. Representatives from the DOE stood scattered about the room next to the easels, ready to answer questions from the few members of the public regarding the nature of radioactive waste.

The meeting itself opened with statements from moderator Holmes Brown, who described the point of the meeting, which was to present the DEIS to the public and to gather comments from the public in turn. About ten government representatives were present, to the twenty members of the public. DOE document manager, Arnold Edelman, presented the information in the DEIS via a powerpoint slideshow, including the reasons that it was important to close this waste stream. Among other issues he mentioned were its potential use in "dirty" bombs by terrorists, and finding a way to dispose of isotopes that have been used in medical diagnoses. Using the above descriptions to characterize GTCC

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[16] Argonne National Laboratory, *Waste Inventory*, www.gtcceis.anl.gov (handout given at meeting).

waste, Edelman also noted that the DOE had no preferred alternative plan for GTCC waste, but that it was required to submit one with the final Environmental Impact Statement to Congress, and was therefore looking to elicit suggestions and ideas for this alternative plan from the public.

After Edelman finished his prepared remarks, it was time for public comments. As evidenced in the numerous public meetings on nuclear facilities and programs, local politicians and businesses in Carlsbad are very welcoming of having more waste and other nuclear facilities in the area, a feeling that has spread to neighboring towns that have seen Carlsbad became the focus of federal funds and contractors. The opinions expressed at the GTCC meeting in Carlsbad are indicative of this support, and on this particular evening, it quickly became evident that if the DOE was looking for a place to permanently dispose of GTCC waste, then local proponents of waste storage felt strongly that Carlsbad should be its home. While a few members of the public expressed concerns over transportation and environmental impact, most public commenters expressed ardent and enthusiastic support for GTCC waste. Notably, almost all of these were local politicians and business leaders, who seemed to speak representatively for the whole community. Representatives of the Eddy County Commissioners Office spoke first, and commented that they were very excited that the DOE was there, appreciated the "impressive track record" of WIPP, that Carlsbad has "community willingness and understanding" of nuclear waste and that "you won't get a lot of disgruntled people protesting this."[17] A former mayor of Carlsbad, John Heaton, spoke next, commenting that the WIPP site is "the most studied in the world" in regards to

[17] Department of Energy, *Public Hearing Draft Environmental Impact Statement for the Disposal of Greater-Than-Class-C (GTCC) Low-Level Radioactive Waste and GTCC-Like-Waste Full Commission Open Meeting,* Carlsbad, NM, April 26, 2011 (Statement by Roxanne Lara and Jack Volpato).

nuclear waste, and that "there would be no impact." He also noted that "WIPP is 30 miles from any population center and therefore has no environmental justice issues."[18] Other speakers stressed the safety record of WIPP and the benefits to the community that WIPP has brought, and the assumption that more waste would increase these benefits. Additionally, they also noted that the success of WIPP had led to other communities in southeastern New Mexico opening their arms to various nuclear projects. These include a commercial uranium enrichment facility in Eunice, a depleted uranium deconversion plant in Hobbes, and a LLRW repository in Andrews, Texas (five miles across the border from Eunice). The Eddy and Lea Energy Alliance (ELEA) supports plans for an interim storage site for nuclear waste in the area as well. The construction of these myriad facilities demonstrates that Southeastern New Mexico has become a local nexus for national nuclear plans.

The GTCC meetings exemplify certain aspects of how national nuclear projects are made local, but perhaps most importantly, they show the centrality of Carlsbad to future nuclear possibilities. This centrality is evident in the confluence and sheer number of public meetings held in New Mexico regarding various nuclear program goals aimed at finding a central storage site for commercial nuclear waste, as well other nuclear projects outlined above. Furthermore, while these meetings demonstrate the centrality of New Mexico as a host state, they also solidify Carlsbad and WIPP as specific locations where governmental agencies and corporate interests are focused in order to find a place to permanently store nuclear waste. The number and location of GTCC meetings are one piece of evidence of how the region is being shaped- politically, socially, environmentally, and economically- by

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[18] Department of Energy, *Public Hearing Draft Environmental Impact Statement for the Disposal of Greater-Than-Class-C (GTCC) Low-Level Radioactive Waste and GTCC-Like-Waste Full Commission Open Meeting,* Carlsbad, NM, April 26, 2011 (Statement by John Heaton).

federal imperatives that aim for an expansion of nuclear energy in the future. But this expansion can only occur if a solution for storing commercial nuclear waste is found, in order to be able to claim that the nuclear fuel cycle can be closed. A focus on the GTCC meetings is useful because the issues raised at the meetings, as well as the ways that those are actually addressed through public education and comments, reveal the particular ways in which federal-mandated priorities are expressed at more regional and local levels. The GTCC meetings exemplify the ways that a federal need to deal with nuclear waste in turn necessitates the creation or addition of local nuclear sites in New Mexico. But they also demonstrate that the local and national are not separate and easily identifiable levels of governance, with the national coercing or determining how localities react to nuclear projects.

Rather, examining these themes of local acceptance of national nuclear projects shows how the actual practices of planning nuclear waste sites are co-constituted by national nuclear goals and more local imperatives of environment, policies and history. They demonstrate how nuclear narratives are shaped, formed, and shared with the public by the federal government and industry officials, and how public forums become a place for the general populace to express their hopes, fears, opinions, and ideas about nuclear technologies in the present era. The GTCC meetings are therefore an instructive look into the process by which current nuclear facilities are being proposed and sited, and as such, will have an incredible impact on the places they are sited. Exploring each of these themes is crucial to understanding how the nuclear future is shaped by local understandings of the ecologies, histories, and politics of nuclear places in New Mexico, both past, present and far into the future.

Another important theme raised in discussions over radioactive waste disposal is how positions of resistance, acceptance, consent, and even enthusiasm for nuclear waste are produced through local familiarity with radioactive waste. Positions concerning resistance and consent to nuclear projects remain contested fields of knowledge involving trust in science, faith in the predictability of nature, and ultimately, who is allowed to make claims regarding possible environmental futures. These positions were reflected in in the response to storing GTCC waste in Carlsbad. While most commenters were generally positive about GTCC waste, others contested bringing more nuclear waste to the region, because of New Mexico's particular history with nuclear projects dating back to the Manhattan Project. These speakers' did not trust federally-produced science and information regarding nuclear waste, or the ways that science has been used to define appropriate natures for containing radioactive threats. Issues with federal assessments of geology and hydrology stemming from environmental characterizations of the sites in the 1980's and 1990's fueled speculation about whether geologic features such as karst, a porous rock formation located directly below the surface of the area but above the WIPP site, could affect the way that water moves through WIPP.[19] Betty Richards, a "totally independent citizen of Carlsbad" noted that a scientist who had said that karst existed at WIPP "was told that if he said the word karst one more time, he would be fired." She also described how scientists "gerrymandered WIPP [section] 33 from the Land Withdrawal permit because it was a sinkhole" and that "they totally dissolved EEG [Environmental Evaluation Group], who was standing up [for]

[19] Department of Energy, *Public Hearing Draft Environmental Impact Statement for the Disposal of Greater-Than-Class-C (GTCC) Low-Level Radioactive Waste and GTCC-Like-Waste Full Commission Open Meeting,* Carlsbad, NM, April 26, 2011 (Statement by Janet Greenwald).

the public, because their numbers were not acceptable to the DOE's numbers."[20] Others questioned more local issues, such as wind patterns and road conditions and the safety of transport.[21] This lack of trust in the science produced in relation to WIPP, coupled with the belief that independent science had been suppressed, were also expressed at GTCC meetings in Albuquerque and Santa Fe. Public commenters consistently brought up the fact that the DOE had promised that once WIPP was opened, no other kind of waste would be brought in. They accused the DOE of going back on its word, and of using the convoluted definitions of GTCC waste and GTCC-like waste to sneak different kinds of waste into WIPP.

Ultimately, a study of the process by which Carlsbad and WIPP have become so central to national nuclear plans reveals how nuclear technologies are entering a new era of discussion over the appropriate method of applying and siting nuclear facilities, as well as the overall role that nuclear energy will play in emerging social, political, and environmental narratives in relation to energy technologies. While many concerns regarding nuclear practices stemming from past historical experience remain central to these narratives, including mistrust in government science and the motives of the nuclear industry, new concerns about climate change debates and environmental justice discussions are also contributing to how nuclear energy is presently being shaped in national narratives and at local levels like Carlsbad. By examining these narratives more closely, it becomes evident that the nuclear waste issue is central to all of these discussions, which necessarily puts Carlsbad at the center of this nuclear web. It is therefore important to understand how

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[20] Department of Energy, *Public Hearing Draft Environmental Impact Statement for the Disposal of Greater-Than-Class-C (GTCC) Low-Level Radioactive Waste and GTCC-Like-Waste Full Commission Open Meeting,* Carlsbad, NM, April 26, 2011 (Statement by Betty Richards).

WIPP is being framed as an appropriate solution for nuclear waste on both federal and local levels. It is equally important, though, to understand how resistance to using WIPP as a solution reveals the biases and political imperatives among politicians and the nuclear industry, for quickly moving forward with a solution to store more radioactive waste in the salt beds of the Chihuahuan desert. By problematizing the decision to store more waste at WIPP-like facilities in the area of Carlsbad, as well as siting nuclear facilities in the region of Southeastern New Mexico, narratives that challenge waste disposal also raise the specter that the nuclear future of America may be impossible to achieve, despite the dreams of an industry and government hopeful for a perpetually imminent nuclear resurgence.

A New Beginning for Nuclear

In order to understand the context and impetus for the GTCC meetings, it is necessary to understand how a new era of nuclear is purportedly underway in the U.S. Beginning in the early 2000's, the term "nuclear renaissance"[22] has been used to describe a renewed industrial and federal interest in using nuclear technologies to solve a variety of federal concerns, including those addressing climate change and carbon dioxide emissions and also producing a more secure form of domestic energy .[23] The Energy Policy Act (EnPA) of 2005 was part of this rekindling of federal interest in reviving and enlarging the scope of America's nuclear energy program and while it detailed several different federal

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[21] Department of Energy, *Public Hearing Draft Environmental Impact Statement for the Disposal of Greater-Than-Class-C (GTCC) Low-Level Radioactive Waste and GTCC-Like-Waste Full Commission Open Meeting,* Carlsbad, NM, April 26, 2011 (Statement by Doyle Smith).

[22] According to the World Nuclear Association, the term has been in use "since about 2001." World Nuclear Association, "The Nuclear Renaissance," http://www.world-nuclear.org/info/inf104.html. Accessed August 1, 2012.

[23] Department of Energy, *Energy Policy Act,* 2005 (Washington, DC: GPO, 2005). Some of the other headings in the Act are for coal, petroleum, natural gas, and renewables. The number of sections devoted to each category reflects 2005 levels of interest in each form, with natural gas emerging as the most discussed type of energy. Nuclear energy is second in the amount of sections, though it still remains only 20% of the electricity portfolio of the U.S.

initiatives, one major aspect of the Act was devoted to a general category entitled "Nuclear Matters."

Under this heading, the EnPA promised increased incentives and rate protections for the nuclear industry, as well as production tax credits. It also extended the indemnity of nuclear power plants against accidents until 2025. The Price-Anderson indemnity clause for nuclear power production has been in effect since the original Atomic Energy Act passed in 1954 by President Eisenhower, meaning that nuclear plants will have enjoyed federal protection against paying for nuclear accidents for over 70 years. However, the EnPA also increased the amount that a nuclear authority can be charged for a nuclear accident, from $10 million to $15 million.[24] These exemptions for the nuclear industry were accompanied by other goals for the growth of the industry. Under the section of "Nuclear Energy," the EnPA also pledges to work towards "enhancing nuclear power's viability as part of the United States energy portfolio," "[s]upporting technology transfer and other appropriate activities to assist the nuclear energy industry," "[m]aintaining a cadre of nuclear scientists and engineers," "[d]eveloping, planning, constructing, acquiring, and operating special research equipment/facilities," and finally, "[r]educing the environment impact of nuclear energy-related activities. "[25] To pay for these goals, the EnPA offered $330 million in 2007, to $495 million in 2009.[26] It also ensures that the DOE will cover any cost of delays in licensing and construction, even if those delays are scheduling issues caused by the NRC's litigation or hearing process.[27]

This category of "Nuclear Matters" can therefore be read in two ways. Conventionally speaking, it meant simply anything pertaining to nuclear energy regulation

[24] Department of Energy, *Energy Policy Act,* 2005 (Washington, DC: GPO, 2005), 188.
[25] Department of Energy, *Energy Policy Act,* 2005 (Washington, DC: GPO, 2005), 292.
[26] Department of Energy, *Energy Policy Act,* 2005 (Washington, DC: GPO, 2005), 292.

and production. The subheadings under this category indicate the "Price-Anderson Act Amendments," "General Nuclear Matters," "Next Generation Nuclear Plant Project," and "Nuclear Security." But more provocatively, the heading can also be read as an assertion. After several decades of living under a negative political and social cloud, nuclear energy emerges in this federal document as an important source of energy, worthy of federal support. The generous dispensations of federal funding in the EnPA for nuclear projects shows a level of support for nuclear energy, research, and experimentation that the industry has not enjoyed for 30 years, and the reasons behind this renewed interest in nuclear energy stem from several evolving national interests. There is concern over climate change and fossil fuel use, making nuclear energy an attractive element to pursue an energy source that is ostensibly "green", in the sense that it does not produce carbon emissions nor does it use fossil fuels. The ideas laid out in the EnPA are important to note because they are also the foundation of two major programs put forth by the federal government: The Global Nuclear Energy Partnership (GNEP) introduced in 2007, and the Blue Ribbon Commission for America's Nuclear Future (BRC) in 2010. Each program introduced different methods for dealing with nuclear waste, but one overarching ideal was similar: nuclear waste is a pressing issue requiring immediate and permanent solutions. Both programs are an acknowledgement that if nuclear energy is to enjoy a greater percentage of the energy production pie, nuclear waste must first be dealt with. This imperative is now shaping the arguments about nuclear waste in New Mexico, an especially important site since the WIPP project is the only successful long-term nuclear waste program in the U.S.

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[27] Department of Energy, *Energy Policy Act,* 2005 (Washington, DC: GPO, 2005), 199.

From the Global Nuclear Energy Partnership to the Blue Ribbon Commission

I focus on three sets of federal meetings (GTCC, GNEP, and BRC) as well as the WIPP Recertification meetings in 2009, to show that New Mexico in general, and Carlsbad in particular, are now playing a central role in creating a new path for a nuclear future for the U.S. The federal programs that have emerged in the last few years to deal with nuclear technologies indicate the federal government's evolving position on the need to educate, inform and reassure the public as to the methods and rationales behind nuclear projects. The GNEP and BRC programs reveal the ways that national nuclear programs need regional and local acceptance to be successful, and how federal programs respond to the different reactions from these interconnected scales of governance. Notably, both programs held numerous public meetings in New Mexico to introduce the ideas of these programs to the public, which also demonstrated a continued concentration on the region as the focus of nuclear waste solutions. First introduced in 2007, GNEP was designed to address several different gaps in the nuclear energy cycle, in order to close the nuclear fuel cycle and make the United States less dependent on other countries, and more self-sufficient in terms of producing its own nuclear energy from cradle to grave.

The goals stated for GNEP by the DOE revolved around hopes that the U.S. would use and increase nuclear energy output in order to ensure the security and prosperity of the nation, and to achieve securing specific national goals. As stated by the Infrastructure Development Working Group for GNEP, these objectives were to "to facilitate the development of the infrastructure needed for the use of clean, sustainable, nuclear energy worldwide in a safe and secure manner, while at the same time reducing the risk of nuclear

proliferation."[28] This last idea, of non-proliferation, showed an international aspect of GNEP. Because of a hiatus in federal investment in new nuclear power plants since the 1980's, the status of the U.S. as a leading nuclear power could be questioned due to a perceived lack of knowledge, expertise, and drive to close the nuclear fuel cycle. GNEP was created as a framework for addressing these issues by focusing on supplying nuclear fuel to partner countries so that they would not have to produce their own, and by reprocessing spent nuclear fuel.[29] If successful, GNEP would position the U.S. once again as preeminent international leader in nuclear technologies.

The GNEP program was therefore tasked with the responsibility of figuring out how the U.S. will produce nuclear energy throughout the nuclear fuel cycle, which includes the mining of uranium, enriching nuclear fuel for reactors, and producing energy with new kinds of reactors. Other notable functions of GNEP were to revert the mining and processing of uranium back to the U.S., which currently gets the majority of its uranium from overseas suppliers and Canada. It also sped up the licensing and construction timeline for the first domestic commercial uranium enrichment facility. Finally, GNEP was also supposed to find a way to safely and responsibly deal with nuclear waste. While many federal programs and acts have mandated solutions, this last step was a notable departure from past iterations because GNEP not only focused on a geologic repository, but also revived the possibility of reprocessing spent nuclear fuel (SNF). Reprocessing has not been used in the U.S. since the 1970's when President James Carter vetoed it because the process produces plutonium that

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[28] The Infrastructure Development Working Group of GNEP, http://www.gneppartnership.org/. Accessed October 8, 2009.

[29] GNEP operated on two different levels, an international level and a national level. At the international level, GNEP had similar overtones to the Atoms For Peace program first proposed by President Eisenhower in 1953. It would make nuclear technologies easier to use and access by approved nuclear states, but also allow for the supervision of these nuclear technologies to prevent proliferation for nuclear weapons use. The U.S. would be able to engage at a "supplier" level, as a country that could demonstrate control and expertise at all levels of the nuclear cycle.

can be used in nuclear weapons, as well as other radioactive chemicals in liquid form. By pushing for reprocessing as a means of closing the fuel cycle, GNEP would begin a new era of nuclear activity for the U.S., one with highly charged political ramifications on an international level, since the U.S. would be developing this technology in order to eventually reprocess the SNF of other countries in order to control the production of weapons-grade plutonium produced in the reprocessing cycle.[30] Ambitious in scope, GNEP would allow for the growth and expansion of the nuclear industry, and "help provide reliable, emission-free energy with less of the waste impact of older technologies."[31]

The idea of reprocessing nuclear fuel quickly became one of the most controversial and widely disputed aspects of the GNEP program, because reprocessing presents new risks for the environment as well national security issues. The meetings were also controversial because so many of the GNEP meetings were in New Mexico, which gave credence to the idea that New Mexico was being targeted as the main site for a reprocessing facility. Similarly to the GTCC hearings, GNEP officials scheduled thirteen public hearings in 2007 to discuss the Draft Programmatic Environmental Impact Statement (PEIS). Of these thirteen meetings, four of these were held in small towns in New Mexico: Hobbes, Roswell, Carlsbad, and Los Alamos. GNEP focused attention on communities that would be most impacted by hosting a federal nuclear project, as well as sites where nuclear research and national laboratories were already established. New Mexico was the only state to hold more than one meeting, and other states, such as Idaho, Washington, Tennessee, and Illinois held meetings because of the nearby existence of national nuclear laboratories. This makes the

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[30] Department of Energy, *Draft Global Nuclear Energy Partnership Programmatic Environmental Impact* Statement, October 2008, (Washington D.C.), 1-2. The only country that presently engages in reprocessing SNF is France. This process is also erroneously called "recycling" nuclear fuel. However, the chemical process is very different than simply using the same materials that were in the fuel in the first place.

[31] The Infrastructure Development Working Group of GNEP, http://www.gneppartnership.org/. Accessed October 8, 2009.

inclusion of the three sites in Southeastern New Mexico more notable, as they do not have the long history of sustained federal nuclear activity that these other locations had.

After the 2007 meetings, the DOE released a new version of the PEIS. In this document, the DOE put forth the decision that they were no longer focused on SNF recycling, and were instead moving in the direction of advanced reactor technologies. However, some of these new designs for plants, such as the Fast Reactor Recycle Alternative, would still produce two kinds of waste, one destined for geologic disposal and the other for reuse in the reactor, a process similar to reprocessing SNF.[32] In another major departure from the 2007 draft, which was directed at several potential sites, including the four in New Mexico, the 2008 PEIS backed away from specifically naming sites, and instead proposed the plan for "generic sites." However, the reality of holding so many meetings in New Mexico yet again made public commenters suspicious about the intent of GNEP to host a facility in the region, and many critical comments made during the public scoping meetings pointed out that it was a thinly veiled attempt to target New Mexico again for more nuclear waste. Supporters of the GNEP program, however, still spoke hopefully of having the chance to host the site.[33]

The GNEP meetings are an important point of discussion concerning the future of national nuclear aspirations. The program itself is an acknowledgement that the U.S. has fallen behind other nations in terms of nuclear technologies and in dealing with radioactive waste. But it was also a clear indication that even though the program had national goals, it was firmly grounded in the localities where those facilities would be constructed. GNEP was an ambitious program, and it ultimately fell short of achieving its lofty goals. While

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[32] Department of Energy, *Draft Global Nuclear Energy Partnership Programmatic Environmental Impact Statement*, October 2008 (Washington D.C.), 2-9.

funding was secured for research projects and exploratory and experimental nuclear designs, the actual function of GNEP was limited by the long timelines and extreme expense of most of GNEP's proposed programs. In 2008, when Barack Obama was elected president, the assumption was that GNEP would soon be cancelled, and in 2010, funding was pulled from the program. However, the new administration also pledged support for the nuclear industry, and President Obama assembled a separate group to explore options for nuclear waste, called the Blue Ribbon Commission for America's Nuclear Future (BRC). The BRC recognized the shortcomings of the GNEP program, and decided to narrow the focus of their inquiry on the back-end of the fuel cycle. The BRC also departed from GNEP by fully examining the process by which nuclear facilities are established in the U.S.

The BRC also paid close attention to Carlsbad as a specific locale for nuclear projects because the Commission recognized the positive attitude that local industry and political leaders have for nuclear projects, as well as the uniqueness of the WIPP project. The main focus of the BRC is to "recommend a new strategy for managing the back end of the nuclear fuel cycle." It sees the lack of a comprehensive strategy for dealing with waste as "damaging to prospects for maintaining a potentially important energy supply option for the future, damaging to state-federal relations and public confidence in the federal government's competence, and damaging to America's standing in the world – not only as a source of nuclear technology and policy expertise but as a leader on global issues of nuclear safety, non-proliferation, and security."[34] These sentiments are similar to GNEP's in some ways, and are also ostensibly non-site specific. Yet the focus on the back end of the fuel cycle led

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[33] See Chapter 3 for more details about the GNEP public scoping meetings.

[34] Blue Ribbon Commission, "Executive Summary," *Draft Report of the Blue Ribbon Commission*, July 2011. (Washington, D.C.), iii.

the BRC back to New Mexico, much as GNEP's programs focused on the state, specifically on the southeast region.

For the BRC, Carlsbad represented a unique and attractive space in the United States political sphere. Though the BRC comes from a different federal administration than GNEP, it continues to demonstrate the centrality of New Mexico in its plans, and held meetings in Albuquerque, Santa Fe, and Carlsbad in 2010. The BRC sent representatives to the 2012 Carlsbad National Nuclear Fuel Summit as well, in order to explain how sites like Carlsbad were essential to the nuclear future of America, not only because the town has WIPP and the salt beds, but also a welcoming attitude to nuclear waste. Because of WIPP, the only geological nuclear waste repository to be approved, constructed, and utilized in the U.S. to date, Carlsbad is being positioned as the ideal place to site nuclear facilities, especially those related to waste. But perhaps as important as its geographic features, the BRC noted the process by which WIPP was facilitated. Though it took over 20 years from inception to construction of WIPP, the BRC noted in its 2011report that the process that led to the establishment of WIPP could be streamlined, and the BRC recognized that community acceptance was a major aspect of gaining support for nuclear projects.

Historical Context of Nuclear Carlsbad

The first chapter of this dissertation explores the historical context of nuclear activity in Southeastern New Mexico. Present efforts to make Carlsbad into a repository for nuclear waste are rooted in a much longer history of making nuclear technologies acceptable to the public, a project that commenced after the end of WWII, when the destructive power of atomic weaponry shocked the American public even as many extolled the virtues of having

the bomb.[35] For the American government, two political aspects of having atomic weapons quickly became clear. First, the secrets of creating an atomic bomb must never become public, and any information concerning atomic weapons, including testing, experimentation, environmental effects, and health effects were kept from the public, hidden behind a wall of federal and military secrecy justified by national security concerns. Secondly, the government had to convince the public that atomic weapons were not a necessary evil, but rather a benefit to humanity in general. In order to alleviate concerns over the destructive power of nuclear weapons, the federal government needed to create a constructive narrative to make the pursuit of nuclear technologies acceptable to the public.

As mentioned earlier, the concept of nuclearism drives the ideology of those who support the expansion and growth of nuclear technologies. Robert Lifton and Richard Falk developed this term to describe an American attitude towards nuclear technologies developed during the Cold War which was typified by a "psychological, political, and military dependence on nuclear weapons, [and] the embrace of the weapons as a solution to a wide variety of human dilemmas, most ironically that of 'security.'"[36] This dependence led to the production of thousands of nuclear weapons based on the rationale that the more nuclear weapons the U.S. had, the more protected it would be from attack or retaliation from other nuclear-capable countries, namely the U.S.S.R. This became a lynchpin of the theory of Mutual Assured Destruction (MAD), which was the idea that if either country decided to attack the other, both would be annihilated.

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[35] See both Spencer Weart, *Nuclear Fear: A History of Images* (Cambridge: Harvard University Press, 1988) and Paul Boyer, *By the Bomb's Early Light: American Thought and Culture at the Dawn of the Atomic Age* (Chapel Hill: University of North Carolina Press, 1985). Both authors point out that fear and distrust of atomic technologies emerged as major aspects of nuclear discussions immediately after the detonations of atomic bombs over Hiroshima and Nagasaki, and that this strain of anti-nuclear sentiment may have ebbed and flowed, but was never entirely ameliorated at any time in American history.

Thus, the logic of nuclearism dictated that neither country would instigate a nuclear war. By arming the country with a large and powerful nuclear arsenal, U.S. leaders felt that the country was protected militarily and politically. According to historian Sheldon Ungar, nuclear technologies "seemed capable of securing the future, of assuring historical continuity to Western democracies and values [and it] afforded the promise of a utopian future, one based on (nothing more than) cheap and abundant energy."[37] While Lifton and Falk focused on the ways that weapons technology led to a dominant philosophy of nuclearism as a means of rationalizing the rapid increase of bomb production, Ungar shifts the focus to a different nuclear technology- that of producing energy to fuel the American economic juggernaut after WWII. This shift stemmed from a need by the federal government to create a more constructive, instead of a purely destructive, association with nuclear technologies for the American public, manifested by a refashioning of the ideal of nuclearism. The development of nuclear technologies such as medical radiology, agricultural applications, and nuclear energy were seen as a means of separating violent nuclear technologies from those that could be embraced by the public as wholly beneficial for society. Nuclearism emerges as a dominant political policy, military stratagem, and philosophy that ultimately proposes a rationale for the continued use and experimentation of nuclear technologies in public life by linking nuclear technologies to social progress.

The AEC attempted to materially carry out the goals of nuclearism during a unique occurrence in 1961 in Carlsbad. Setting the tone for its future forays into nuclear politics, the area was chosen by the Atomic Energy Commission (AEC) to host the first public

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[36] Robert J. Lifton and Richard Falk, *Indefensible Weapons: The Political and Psychological Case Against Nuclearism* (New York: Basic Books, 1982), ix.

[37] Sheldon Ungar, *The Rise and Fall of Nuclearism: Fear and Faith as Determinants of the Arms Race* (University Park: Pennsylvania State University Press, 1992), 5.

nuclear detonation in the nation.[38] Bringing together the destructive applications of nuclear weapons with the constructive goal of making a radioactive steam-driven turbine to create electricity, "Project Gnome," as the experiment was called, was also a means of establishing how nuclear technologies could serve a greater social good. This public experiment was part of the Project Plowshares program, which was developed in the 1950's and carried into the early 1960's. During this era, the definition of nuclearism expanded to not only embrace nuclear weapons as a means of protection for American interests, but also nuclear energy to secure American economic interests and growth. By producing a power source "too cheap to meter,"[39] nuclear energy would fuel the post-WWII American boom in production and housing, allowing for the speedy modernization of the entire nation. Though the specifications of the weapons remained a secret, planners for Project Plowshares hoped that the effects of these bombs for civic purposes would "create a climate of world opinion that is more favorable to weapons development and tests" according to Lewis Strauss, chairman of the AEC.[40]

The Atoms for Peace program introduced the tenets of nuclearism to Carlsbad in a physical sense, although nationwide, support for nuclear energy was widespread. Joop van der Pligt noted that in 1960, "64 per cent of the US public was in favor of nuclear power as a source for electricity,"[41] and this widespread public support for nuclear power is demonstrative of an era of implicit trust in the federal government to control and wield the

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[38] Other demonstrations had been held in the Nevada Proving Grounds (now Nevada Test Site), but were classified. See Constandina Titus, *Bombs in the Backyard: Atomic Testing and American Politics* (Reno: University of Nevada Press, 2001), 55-85.

[39] This phrase, commonly used to describe the major benefit of nuclear power reactions, was used in several different speeches by Lewis Strauss in 1954-1955.

[40] Richard Hwelett and Jack M. Holl., *Atoms for Peace and War, 1953-1961: Eisenhower and the Atomic Energy Commission (*Berkeley: University of California Press,1989), 529.

[41] Joop van der Pligt, *Nuclear Energy and the Public* (Cambridge: Blackwell Publishing, 1992), 12. Van der Pligt also notes that "6 per cent was against" while "30 per cent had no opinion or was undecided."

atom in responsible and progressive ways. Atoms for Peace laid out theoretical ways to do this, but Project Plowshares grounded those theories in specific experiments and places. Project Gnome, which occurred on December 10, 1961, was meant to introduce the public to the peaceful side of the atom, and in this case, the residents of Carlsbad stood in proxy for the national public. This chapter examines why Carlsbad was chosen, and how Gnome was indicative of this shifting definition of nuclearism, where nuclear energy would also be a guarantee of prosperity, unfettered growth, and modernity for America. It also looks at the local response to the Gnome shot, and how it was received as well as celebrated as an event that would put Carlsbad on the national map as a site akin to Los Alamos.

Ultimately, though, Gnome was not a successful experiment, since it did not create a viable nuclear energy source. However, it did establish the ideals of nuclearism in Carlsbad, which would affect how future nuclear projects were perceived. Specifically, these ideals included "selling" nuclear energy to the public on the grounds that it would be a way to show patriotism to U.S. projects, to show the effectiveness and superiority of American science, and to bolster local economies. It also set the precedent of siting nuclear projects in remote geographical locations with little political clout and few economic reasons to resist government projects couched in the language of nuclearism. The experience of Carlsbad with Project Plowshares and the Gnome shot is an important piece of over-looked New Mexican nuclear history because it established these trends in a way that would influence future nuclear projects in the next few decades, nationally, regionally, and locally.

A New Era of Nuclearism

The second chapter of this dissertation expands on the ways that nuclearism emerges again in Carlsbad and New Mexico to shape discussions of nuclear waste storage ten years after the Gnome shot. Nuclearism as a military and political policy fell out of favor in the

late 1980's, with the dissolution of the Soviet Union and the seemingly ceaseless information leaking out from federal labs and nuclear sites about radioactive pollutants inflicted secretively and carelessly on local populations and environments near these sites. Sheldon Ungar notes that nuclearism, at least for nuclear weapons, became "a tarnished faith. The concern with the bomb as a reflection of American civil religion, grace, and moral superiority declined, as one would expect when people are trying to obliterate nuclear realities."[42] Anti-nuclear activism grew in the 1970's largely in response to the strict government control of information regarding the use and effects of nuclear technologies on a domestic front. But even as the toxic fallout of secret nuclear projects emerged, nuclearism rose from the ashes of its military context to become more explicitly connected to the production of nuclear energy.

In our present moment, industry and government are combining to stress only the positive aspects of nuclear energy in a modern context, where greenhouse gas emissions and concern about global climate change have pushed the profile of nuclear energy into the national energy mix once again. Touted as both a need and an ideal, nuclear energy rhetoric is less bombastic that it was in the 1960's, but is still portrayed as a necessary part of maintaining social and technological progress. This is reflected in the rationale of industry groups such as the Nuclear Energy Institute, which says that, "Even with conservation and efficiency measures, the United States will need hundreds of new power plants from a diverse portfolio of fuel sources to supply electricity for a high standard of living and to promote domestic economic growth. Maintaining nuclear energy's nearly 20 percent share of generation would require building about one reactor per year starting in 2016, or 20 to 25

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[42] Sheldon Ungar, *The Rise and Fall of Nuclearism: Fear and Faith as Determinants for the Arms Race* (University Park: Penn State University Press, 1992), 152-153.

new units by 2035."[43] The need for expansion is framed as a cold hard fact, one that is indisputable and obvious, and it is reflected in the EnPA, as well as the GNEP and BRC programs. From 2008-2012, the Nuclear Regulatory Commission had received 26 applications for nuclear plant licenses, which signified interest from industry manufacturers to build more nuclear power plants and seemed to herald a that the "nuclear renaissance" had finally arrived.

However, the expansion of nuclear power raises questions about the waste that will be produced by these new power plants. This makes WIPP and the area of Carlsbad the focus of a new version of nuclearism in order to justify the expansion of nuclear energy production. Specifically, both the GNEP and BRC programs recognized that without a complete and comprehensive plan to deal with nuclear waste, the future of nuclear energy production itself is thrown into question. The second chapter of this dissertation examines how a push to find a permanent solution for radioactive waste is shaped by the philosophy of nuclearism in our current moment. Nuclearism emerges again in discussions regarding the appropriateness of WIPP (or a WIPP adjacent structure, as it is termed in the GTCC publications) as a permanent repository for other kinds of radioactive waste rather than just the military-produced transuranic waste it is legally allowed to hold currently. By looking at how the WIPP project is viewed in the present, it becomes clear that the tenets of nuclearism are still at work in Carlsbad and New Mexico, shaping the reception of nuclear projects in the state. Elements of trust in science and government, patriotism, and economic incentives are notable in the positive reactions to WIPP and new nuclear institutions,

[43] Nuclear Energy Institute, "Resources & Stats: Reliable and Affordable Energy," http://www.nei.org/resourcesandstats/documentlibrary/reliableandaffordableenergy/factsheet/usneedsnewplants/. Accessed March 14, 2013.

although WIPP had a controversial start, and remains a controversial project for many in the state and beyond.

I argue in this chapter that the contrast in attitudes between WIPP supporters and activists against WIPP stems from widely divergent cultural constructions of nuclear waste. For supporters of geologic repositories in the Carlsbad region, nuclear waste is reduced to a completely controllable *technological artifact*, one with concrete physical parameters and predictable behaviors, produced during a specific time period. Nuclear waste becomes a product divorced from its origins of production, its intended uses (such as nuclear weapons) and is instead remade into a simple problem of storage. Educating the public has also been part of this attempt to resituate nuclear waste and other nuclear projects as benign and controllable. By delimiting the features and physical characteristics of waste, it is not only possible to store nuclear waste in the salt beds of WIPP, but such storage becomes the only logical solution, one stalled only by "politics" and fear-mongering.

Anti-nuclear groups and those who resist bringing more waste to WIPP see nuclear waste in a different light. For them, it is akin to a *cultural problem*, one that cannot be separated from the secretive and anti-democratic conditions under which it was produced during the Cold War, or the degrading effects its production has had on the environment and human populations that were affected without their consent or knowledge. They view it as a continuing threat to the environment and human health as well, and ultimately the risks presented by nuclear technologies in the present and future, based on problems and issues on the past, doom all nuclear projects as failures. Anti-nuclear activists connected to regional and national political groups propel this viewpoint, but uncertainty over whether WIPP can ultimately be successful emerges in local populations near Carlsbad as well. However, the technological artifact/cultural problem views of nuclear waste are not simply

dually opposed viewpoints; rather this latter view resists reducing nuclear waste into scientific categories, and acknowledges how nonhuman actors can affect social and political attitudes towards nuclear projects. Risk theory and environmental justice movements are integral to assessing and exposing the unique threats of radiation in the human body and the environment for citizen groups opposed to the expansion of nuclear programs in New Mexico.

These divergent views, collected during interviews with local community members and from comments made at public meetings held by federal agencies, are indicative of different challenges for the future of implementing nuclear projects like the GNEP and BRC programs. They show the difficulty of negotiating different views over nuclear waste, as well as the limitations of nuclearism as a theory for rationalizing more nuclear production in the face of the inevitable production of more nuclear waste. Ultimately, treating nuclear waste as a technological artifact divorces nuclear technologies and radioactive waste products from the rationales behind their production, and ignores the creation of nuclear communities that must live with the ramifications of radiated and contaminated landscapes while also drawing more communities into the web of potential nuclear risks. For anti-nuclear activists, finding a repository does not solve or negate those effects, and concentrating them in New Mexico runs the risk of creating an ecosystemic and social wasteland.

The Science and Nature of Salt

Scientific disciplines are key to rationales of nuclearism, and the third chapter of this dissertation explores how the social construction of nature is intimately tied to the ways that science is used to justify projects like WIPP in desert landscapes. I examine how scientific discourses regarding the storage of nuclear waste are informed by, and in turn shape, ideas about desert natures, and how these discourses are challenged by local knowledge of nature,

as well as independent science. Characterizations of nature frame nuclear debates through the concept "sound science," as the DOE terms the use of federally supported science claims.

The history of land-use practices in the region and formation of local expertise are both grounded in and supported by the ways that science is used to inform these different attitudes towards the nature of the desert landscape of Carlsbad. This chapter delves more fully into the ways that scientific information is gathered and used to categorize and characterize the natures involved in storing nuclear waste in the desert. The practice of storing nuclear waste in the salt beds is based on the seemingly inherent stability of the region, and on it perpetual aridness and lack of change in the salt beds over a long geologic time span. The creation of local expertise and knowledge of local landscapes offers up different views of the various natures at play in the desert, and science in the context of WIPP is also a site of contestation. Scientists outside of the federal system argue that the knowledge of nature is not fully known in the area, and that other variables, including the nature of aquifers, brine pools, and karst rock formations that lie near the site, must be part of the calculations of WIPP. The nature of the radioactive substances stored in WIPP is also a variable. By delving into these different arguments over the natures present in WIPP and how they are known and quantified, a study of the sciences around WIPP shows that the creation of seemingly incontrovertible facts about nature are contested spaces. They are refracted through the ideas of local expertise and familiarity and the creation of knowable and quantifiable aspects of nature through objectively produced science

Siting nuclear waste repositories in the Chihuahuan Desert, which encompasses much of Southeastern New Mexico, fits in with a longer historical narrative of using desert areas as both experimental areas and dumps for the untested technologies and unwanted

refuse of the nuclear age. This narrative is dependent on scientific characterizations of the geography and geology of the region, and allows for a discourse that reduces desert landscapes to one principle feature: the aridity of the desert, which has been used to define the geography as an essentially unproductive place. Because of the lack of resources, especially water, to contaminate, and the generally remote and sparse populations that dwell here, the deserts of Southeastern New Mexico are further constructed as not only as appropriate but also ideal. This environmental rationale for storing nuclear waste in the desert builds on seeing waste as a technological artifact, and is supported by local residents who posit that their local knowledge of mining in the region makes them experts in knowing the landscape and its limitations. In this framework, WIPP becomes a productive place in the desert, as it produces a safe and permanent storage area for the offal of modern science. The creation and assertion of local expertise over nuclear waste storage is a crucial but overlooked aspect of debates about WIPP and other nuclear projects in Southeastern New Mexico, and I argue that it is a fundamental aspect of WIPP's acceptance in the region. In these different conversations, the nature of the desert is simultaneously characterized as an ideal location for nuclear experimentation, projects, and radioactive waste dumps as science is used to characterize nuclear by-products as relatively harmless and completely controllable.

In addition to local expertise, other factions counter local acceptance of nuclear waste sites by expanding the idea of local and by creating a different narrative of Western desert wastelands. Challenging the idea of the desert as an appropriate location for nuclear waste by asserting their knowledge of the environment and their historical presence, commenters at public meetings spoke against the idea that more waste should be brought to New Mexico, claiming that the water resources in the region are too rare to risk to nuclear

radiation. Going beyond the boundaries of WIPP, they bring into play the larger ecosystemic conditions of the region's waters and soils as a means of expanding the potential effects of nuclear waste seeping out of the area. They also question the ways that other communities have been affected disproportionately by nuclear technologies in New Mexico and across the nation, expanding on how these small, seemingly disparate communities are separated geographically, but intimately connected by nuclear contamination. By countering the desert-as-wasteland trope and making connections across New Mexico and the U.S. environmentally and historically in regards to nuclear effects on different communities, these speakers raise the specter that nuclear projects never stay as localized as they are supposed to, and consistently escapes the boundaries of science by creating unexpected and unpredictable nuclear geographies.

The final section of this chapter examines another kind of nature that complicates the WIPP project and other ideas about locating a permanent repository in the desert. In examining attempts to mark the WIPP site for the next 10,000 years, as mandated by the Environmental Protection Agency (EPA), the DOE must contend with time periods that trump human knowledge. The sheer difficulty of this cultural project calls into question how well scientific disciplines can "know" nature, in terms of predicting how the landscape and nuclear products will behave in the far future. Marking WIPP shows that the responsibility of dealing with nuclear products is always displaced onto future generations. Nuclear waste is the ultimate "wicked problem" from a policy standpoint, as the problem can never be fully solved but instead must be perpetually managed. The unknown aspects of the effects of time bring in another kind of nature that remains unquantifiable as well: the nature of human curiosity and how to counter human interference on a site that will remain toxic for hundreds of millennia. Ultimately, marking WIPP and other nuclear waste sites

becomes a cultural problem that demonstrates the limits of science as a means of finding solutions for radioactive waste that has already been produced and will be produced in the future.

The Public Process of Nuclear Technologies

But if underground storage of nuclear waste is a seemingly simple solution complicated by the inherent unknowns of the future, another immediate solution raises much more problematic social and cultural issues in the present. Langdon Winner has argued that nuclear technologies are inherently authoritarian in design and practice,[44] but federal programs aiming to site new nuclear facilities seem to think otherwise. Much of this dissertation is based on the various and numerous public meetings held in New Mexico by the federal government. These meetings are meant to both educate the public on the goals of different programs and to offer a space for the public to make comments about what they think should be the path forward. But in a larger sense, these meetings also point to the difficulty of remaking nuclear technologies that were born during the Cold War and conceived in secrecy and an authoritarian manner into more transparent and democratic technologies. Public distrust in governmental programs is still a formidable obstacle to finding sites for nuclear projects, and in response to this distrust, an emphasis on transparency and public input has emerged from both GNEP and BRC documents and public meetings. By explicitly linking democracy and nuclear technologies together, departments like the DOE and NRC are trying to make new connections in the mind of the public regarding nuclear waste and other technologies.

The fourth and final chapter of this dissertation examines how democratic intentions and the public process are handled in public meetings concerning nuclear

projects. The public process is touted as a principal part of the BRC's focus on the back end of the nuclear fuel cycle, and they view obtaining public consent from local communities as critical to the success of any future nuclear projects. An example of this democratic push is evident in the GTCC examples described earlier, where the moderator of the meeting emphasized how important public comments are to the project and that the DOE was looking for alternative plans from the public. A goal of this chapter, therefore, is to complicate this transference of responsibility onto the public, making them complicit in the process and also the end result. This approach has the potential effect of shifting responsibility for these sites onto the public, who are expected to make informed decisions based on the information in public documents and at hearings. The democratic process is therefore fraught with risks that in an attempt to democratically site a nuclear facility, it may not ensure the appropriate conditions environmentally, and may exacerbate political and social differences across local, regional, state, and national scales of governance.

By looking closely at how the GNEP and BRC public hearings explained their goals for making this process more transparent and democratic, and by examining how public comments responded to these explanations, the problems and issues that continue to plague nuclear projects become clearer in a contemporary context. Beyond a legacy of secrecy and authoritarianism, other issues include a concern that a perceived need for expediency may trump responsibility and ethics in siting new facilities. This chapter also looks at examples from these meetings where the goal of presenting information to the public is complicated by the reaction form members of the public to that information, where clear answers are not forthcoming, and there is no back and forth between the members of government on the

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[44] Langdon Winner, "Do Artifacts Have Politics?" in *The Whale and the Reactor: A Search for Limits in an Age of High Technology* (Chicago: University of Chicago Press, 1988), pgs. 19-39.

dais and members of the public in the floor. Frustrating even those efforts are instances where unruly members of the public disrupt this ideally "rational" presentation with emotional responses. How the federal government handles those cases shows the limits of democratic action, as authoritarian control introduces itself immediately. In accounting for the public in federal documents, certain comments and critiques are omitted from the public record or left unconsidered in the government review process because federal agencies consider them outside the scope of the discussion at hand. This process actually brackets out dissenting voices, corrupting the idea of a democratic forum for nuclear discussions. One of the main issues that is always outside of the scope of discussion is whether nuclear should continue to be an option at all.

From Carlsbad to Fukushima

The concern that members of the public expressed at those public meetings for GNEP and BRC programs came into sharp focus on March 11, 2011, when an earthquake in the Pacific Ocean triggered a tsunami that hit the Eastern coast of Japan. One of the hardest hit areas was the Fukushima prefecture, which contains two nuclear power plants. The Fukushima Daiichi plant was submerged by tsunami waves, cutting out electricity to the plant and swamping the underground backup generators. As power to the plant was lost, all systems pertaining to containment were also compromised, and one by one, the four operating reactors at the Daiichi plant experienced severe operational failures of the worst kind. Radiation seeped from the reactors, and three over-pressurized reactors actually exploded. Workers at the plant struggled to understand what few readings they could glean from semi-operational equipment and flashlights in the dark, and finally, in desperation, straight sea-water was used to provide coolant for the reactors, ensuring that none would ever be operational again.

The epilogue of this dissertation discusses how the events at the Fukushima Daiichi plant began as a natural event but quickly escalated into a human disaster. Compounding the physical problems of the plant was the mixed information that the local and international public received over the successive hours following the tsunami. The situation deteriorated as members of the public searching for missing loved ones in the wreckage of the tsunami were ordered to evacuate the area, amidst Japanese utility authorities trying to evacuate the plant as well. As more information came to light, radioactive plumes were traced over the Pacific Ocean, and the direness of the situation at Daiichi became clearer. The seemingly absolute safety of a nuclear power plant was ultimately undone by a "black swan"[45] event, a one-in-a-million occurrence that seems to occur all too frequently with nuclear technologies, in different degrees of severity. After the Tohoku Earthquake, all nuclear power plants in Japan were shut down, and forced to undergo heavy scrutiny for safety and security issues, costing the country billions of dollars.[46] This epilogue traces some the corollaries between the Fukushima plant and themes prevalent in this dissertation, in order to demonstrate that nuclear disasters are inherently unpredictable and stem from cultural factors far outside the scope of technoscientific solutions.

The situation in Fukushima raised international concerns as well, and this chapter also focuses on the response of the American government and local utilities. Carlsbad and Japan collided at the Carlsbad National Nuclear Fuel Summit, held in April 2012, where an official from the Japanese utility company TEPCO spoke to industry and local government officials about the issues that TEPCO faced after the tsunami and steps that they needed to

[45] Nassim Nicholas Taleb, "The Black Swan: The Impact of the Highly Improbable" in *The New York Times*, April 22, 2007, http://www.nytimes.com/2007/04/22/books/chapters/0422-1st-tale.html. Accessed April 15, 2009.

take to avoid this kind of problem in the future. TEPCO assumes that the issues facing nuclear power safety issues are engineering issues at their core, and that they can be fixed by re-engineering safety protocols and human responses to accidents, even as they stem from somewhat predictable natural events. But the tensions that the Fukushima nuclear disaster raises pertain to more than engineering issues. The epilogue of this dissertation looks more closely at the ways that stochastic events are unimaginable for nuclear technologies, because they are outside of the realm of human imaginations and preparedness. The cost of building nuclear facilities to withstand any and all types of natural events (not to mention human events such as terrorism) draws into focus how all of the accidents that have occurred since the inception of atomic technologies are human error accidents- the one type of accident that can be engineered out of the system. By using the Fukushima disaster as a jumping-off point for examining the ways that new and unpredictable natures are created after nuclear accidents, I hope to show that there is no certainty about nuclear energy except for the long half-lives of the radioactive materials that it needs and produces.

Conclusion

The stakes are high for the "nuclear renaissance." Currently, new uranium mines are being licensed and constructed in New Mexico, Colorado, and other state in the Southwest, mirroring the uranium boom of the 1950's. The uranium enrichment facility in Eunice is still waiting to run at full capacity, since the expected orders for more nuclear fuel to power the newly licensed plants have yet to come through. One new plant is being constructed in South Carolina, with three more waiting for funding. And the BRC is looking for a place to store commercially produced nuclear waste, with a close eye on Carlsbad.

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[46] For an overview of the events of Fukushima, see Sarah Fecht, "1 Year Later: A Fukushima Nuclear Disaster Timeline," *Scientific American*, March 8, 2012, http://www.scientificamerican.com/article.cfm?id=one-year-later-fukushima-nuclear-disaster. Accessed March 9, 2012.

To return to the beginning of this introduction, the GTCC meetings can be seen as an isolated event, a set of meetings to decide one aspect of one kind of waste produced in specific conditions with a specific history. But taken in context with the history of nuclearism in the region and in the present, and with the plethora of other meetings regarding the recertification of WIPP, the GNEP program, and the ideas behind the BRC panel's suggestions for finding sites for nuclear waste in Southeastern New Mexico, the GTCC meetings are suggestive of a new era of nuclear activity that on a federal level, seen the region as the solution to the peculiar problem of nuclear waste.

With all of these different nuclear facilities and programs trying to push forward America's nuclear future, it is imperative to take a step back and look at the nuclear present. By evaluating how different conditions and prerogatives affect how different cultural groups, from scientists to government officials, citizens and activists, business leaders and local politicians, view nuclear technologies, it becomes clear that there are several different goals, hopes and fears at play. Concerns over safety, economics, political imperatives, and the environment all play a role, as does a deep-seated need to make something productive out of a technology whose origins lie in utmost destruction, and in a geography that is seen as historically as a wasteland. By tracing these roots to and from Carlsbad and Southeastern New Mexico, it becomes clear that these national goals are rooted in local perceptions and ideas about the potential benefits and risks of nuclear technologies, which will ultimately shape their acceptance. But the future of nuclear is inextricably tied to its past, and any attempts to site new waste repositories must acknowledge these myriad issues emerging in public forums. The acceptance, refutation, and contestation of ideals of nuclearism, science and nature, and the democratic process are reverberating across the Chihuahuan desert of

Southeastern New Mexico, and will shape nuclear debates in the foreseeable, and well into the unknown, future.

Chapter 1: A Gnome in New Mexico

During the early Cold War era of the 1950's, the Atoms for Peace program became a key ideological battlefield for the U.S. government. The threat of communism spreading from the U.S.S.R., and the detonation of Russia's first thermonuclear device in 1949, had ratcheted up the tension between the U.S. and its Cold War nemesis. The U.S.S.R was accusing the U.S. of hoarding nuclear materials, and of hypocritically hiding its own intentions regarding the production nuclear weapons. In retaliation, and to stave off anxiety and quell the fears of allies and the U.S. public alike, Atoms for Peace was a means of reshaping nuclear weapons into tools of peace, not war.

President Dwight D. Eisenhower first proposed the Atoms for Peace program during an international speech delivered to the General Assembly of the United Nations on December 8, 1953. Atoms for Peace was a crucial point for clarifying American intentions to the world for securing international security and prosperity through the judicious application of nuclear technologies. The overarching goals for the program were to control how atomic technologies would be harnessed by the U.S. in years to come, and also to inform the world of the future intentions of the U.S. regarding nuclear technologies.

Eisenhower's main political goal was to assure both foes and allies that the U.S was committed to openness, transparency, and peaceful intentions regarding nuclear technologies. This was especially evident in the non-violent ways that Eisenhower described for the future of nuclear technologies, specifically the shift from weapons to energy. He proclaimed in his speech that:

> "Peaceful power from atomic energy is no dream of the future. That capability, already proved, is here, now, today. Who can doubt, if the entire body of the world's scientists and engineers

had adequate amounts of fissionable material with which to test and develop their ideas, that this capability would rapidly be transformed into universal, efficient, and economic usage?"[1]

This dream of "universal, efficient and economic usage" continues to define the ideal of nuclearism today. At its most basic definition, nuclearism describes the belief that nuclear weapons and energy are crucial aspects of maintaining national security and creating energy independence.[2] Nuclearism posits that nuclear weapons deter wars and invasions without having to be deployed, while the production of nearly unlimited energy is key to supporting industrial and economic growth. Eisenhower's speech stressed the need for communication concerning nuclear technologies and information; one of the main goals described was to "encourage world-wide investigation into the most effective peace time uses of fissionable material, and with the certainty that [other countries] had all the material needed for the conduct of all experiments that were appropriate."[3] Through the judicious use of nuclear weapons, peace could be achieved and maintained. This ideal remains a central tenet of nuclearism.

In order to further establish the tenets of nuclearism as central to political philosophies about the appropriate uses for nuclear weapons, the Atoms for Peace speech also became the basis for a program that would establish nuclearism as a physically practical and practicable theory. Dubbed "Project Plowshares," this program used the Biblical passage from Isaiah 2:4 as the basis for finding peaceful applications for nuclear weapons: "They shall beat their swords into plowshares, and their spears into pruning hooks; nation shall not lift up sword against nation, neither shall they learn war anymore."[4]

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[1] Dwight D. Eisenhower, Atoms for Peace Speech delivered to the General Assembly of the United Nations, December 8, 1953.
[2] David Krieger, "Nuclearism and Its Insecurities," in *Worlds Apart: Human Security and Global Governance*, ed. Majod Tehranian (New York: St. Martin's Press, 1999), 109.
[3] Dwight D. Eisenhower, Atoms for Peace Speech delivered to the General Assembly of the United Nations, December 8, 1953.
[4] Is 2:4 Revised Standard Edition.

Under the aegis of the Atomic Energy Commission (AEC), Project Plowshares became an integral part of America's domestic and international nuclear program. It was the material application of the ideals of Atoms for Peace.

Under the rationale of nuclearism, Project Plowshares would demonstrate globally that the U.S. was interested in pursuing atomic technologies not only for maintaining military superiority during the Cold War, but also for increasing peace and prosperity by using atomic technologies to drive domestic economic and civic growth. Civil engineering projects were a major part of Project Plowshares, which focused on detonating nuclear[5] bombs in order to create radioactive steam beds to produce energy, excavate canals and tunnels for shipping routes, and stimulate oil and gas production by fracturing the geology of the Earth.[6] Another goal of Plowshares was for gaining scientific knowledge about the behavior of radioactive isotopes in the environment. Until the mid-1950's, the only information that the U.S. had regarding the behavior of radioactive isotopes in the environment was from studies done in Japan after WWII. These types of projects were meant to demonstrate that the U.S. not only had complete control of the atom, but could also use it to increase general knowledge of atomic science for the greater good of humanity. These activities defined the scope of the ambitions surrounding Project Plowshares as explained by government officials and AEC scientists. They were a necessary part of making practicable the emerging ideal of nuclearism that would shape national and regional attitudes towards accepting nuclear technologies during the Cold War and beyond.

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[5] In this chapter, I use the term atomic and nuclear interchangeably. During the 1960's, the term "atomic" was used to refer to fissionable materials, but in 1972, the Atomic Energy Commission had changed into the Nuclear Regulatory Commission, and the term "nuclear" came into fashion as the description of fissionable reactions.

[6] Scott Kirsch, *Proving Grounds: Project Plowshare and the Unrealized Dream of Nuclear Earthmoving* (New Brunswick: University of Rutgers Press, 2005), 3.

But what is often missing in descriptions of Plowshares is that in order for the theory of nuclearism to work in reality, it had to first be enacted in physical spaces for the testing, experimentation, and containment of nuclear experiments. These places then became enmeshed specific places into a national nuclear agenda, making the promises of nuclear energy seem possible by materially grounding them in particular locales and regions. In turn, residents of these places begin to forge local identities in tangent with larger national nuclear goals. In other words, the AEC's pursuit of nuclearism justified the increased production of nuclear weapons as synonymous with the increase of productive potential for nuclear applications under Project Plowshares, but a major problem with the nuclearist ideals introduced in this project was that the government had to then identify, define, and produce these spaces and places as appropriate for atomic experimentation.

This chapter explores how a national program like Project Plowshares created local projects like the Gnome shot, effectively enmeshing Carlsbad in national nuclear projects. Through the activity around Gnome, Carlsbad as a locale is defined by its relationship to nuclear projects. Gnome was indicative of how science, patriotism, and economic incentives would be utilized to justify and rationalize future nuclear projects, both regionally and nationally. Carlsbad during the 1960's emerges as a testing ground for nuclearism, where national nuclear hopes were literally exploded underground to make room for nuclear energy as a benevolent and beneficial technology for American society, but also to demonstrate American scientific and military strength as well.

Creating the Nuclear Local

One of the major issues emerging in the 1950's was the effect on human health and safety from radioactive fallout, which complicated the message of peace through detonating nuclear weapons. Because of this concern, the places that the AEC needed for Project

Plowshares had to be remote, both geographically and politically. The effects of radioactive fallout which moved through wind, water, and earth were known to have some effect on human physiology at low doses, and by siting nuclear projects in geographically remote places, the AEC hoped to minimize the risk of fallout to the public. But Plowshares was also meant to show that the AEC had control over containing fallout from detonations, and in order to demonstrate this, they needed a public location that fit a set of criteria meant to limit the effects of fallout. The AEC started to focus on places that had a low population density and were distant from major urban population centers, which would minimize the spread of radiation and exposure.[7] It also looked for places that were environmentally marginal, in the sense that these locations did not have major waterways or produce agricultural items that would carry traces of radioactivity. Finally, they also looked for places that carried little political clout nationally, and whose population would be welcoming to the AEC goals of promoting nuclearism.

The AEC found its first site for Plowshares in the small town of Carlsbad, New Mexico, which was host to the first detonation open to select members of the public. On December 10, 1961, the detonation of a 3.1 kiloton nuclear bomb rocked the subterranean landscape of the far Southeastern corner of New Mexico. This first detonation in a planned series of test "shots" was dubbed "Gnome," and it took place in a geologic salt dome twelve miles outside of Carlsbad. Carlsbad is located geographically in the Northern Chihuahuan Desert of Southeastern New Mexico, 70 miles west of the Texas border. A sleepy town of 25,000 then[8] and today, the landscape around the town is typical low desert- hundreds of

[7] Kirsch, *Proving Grounds*, 21.

[8] U.S. Department of Commerce, Bureau of the Census, 1961, *Census of Population, 1960: Total Population Counts for the U.S., States, Outlying Areas, Counties, Cities, Standard Metropolitan Statistical Areas, Urban and Rural, Etc. Characteristics of the population. Number of inhabitants, Volume 1, Part 1*, p. 33-8,

miles of dusty, dry, flat terrain, dotted with sage and cholla cacti, and few towns to break up the rolling desert landscape. Since the end of World War II, the region's identity has always been linked to what lies beneath the surface, and the area is known principally for Carlsbad Caverns, a subterranean network of caves open to tourists and designated a national park in 1930. Prior to becoming a mecca for tourists trying to escape the desert heat, the caverns served as a resource for collecting bat guano for fertilizer. However, in 1961 and continuing into the present, the economic base of Carlsbad literally lies underneath the surface of the region: potash mining, natural gas extraction, and oil wells provide the bulk of economic activity in the region.

There was another feature under the ground of Carlsbad that the Gnome shot exploited. As early as 1957, geologic salt beds had been researched by federal scientists as a means of containing and controlling the effects of radiation, since any fractures in the salt would begin to seal naturally, theoretically containing the radioactive materials inside the salt beds.[9] As preparations for Gnome were carried out, it seemed that Carlsbad could potentially have another subterranean economic commodity: creating and storing nuclear steam in the salt beds located a few miles outside the city boundaries. This steam could then be released to turn turbines and create energy, which the AEC hoped would become a model for energy production nationally. The geologic qualities of the salt beds, and the geographical qualities or remoteness and aridity, remade Carlsbad into a critical site for convincing the national public that Project Plowshares was a viable means of creating peaceful applications for formerly devastating nuclear weapons.

(**http://books.google.com/books?id=SMSOrJwVjLIC&dq=what+was+the+population+of+eddy+county+in+1960&source=gbs_navlinks_s**)

[9] Chuck McCutcheon, *Nuclear Reactions: The Politics of Opening a Radioactive Waste Disposal Site* (Albuquerque: UNM Press, 2002), 10.

The theory of nuclearism also had a third requirement in order to uphold its democratic promise of peace through nuclear weapons. The consent of the public in the region was a critical, if tacit, aspect of Project Plowshares and nuclearism, as a means of counteracting the secretive aspects that enshrouded nuclear technologies. The citizens of Carlsbad expected their town to become the next scientific epicenter of the United States, akin to Los Alamos, with a strong commercial basis for public utilities and a reputation for being on the cutting-edge of scientific inquiry and practice. An abiding trust in federal science was part of the local character in Carlsbad, reflective of a larger public trust in science to minimize risk from and maximize potential of nuclear technologies. Residents of Carlsbad also saw their support of Gnome as means of demonstrating their patriotism and dedication to this national project, and viewed participation in Project Plowshares as a means of contributing to the fight against communism. But perhaps most of all, the residents of Carlsbad hoped that Gnome would create new economies to support the struggling region. These expectations, which were supported by correspondence from the federal government's representatives, shaped the acceptance and implementation of the Gnome experiment, and also contributed to the idea that nuclearism was not only peaceful in its intent, but also a democratically-compatible project accepted by supportive locals.

The political goals of Eisenhower's Atoms for Peace ideal, the AEC, and Project Plowshares ultimately came to rest in this remote corner of the U.S., and established two major themes regarding the appropriate use of nuclear technologies by the federal government: The rise of nuclearism as a practicable political philosophy, and the use of the periphery of American geography to demonstrate that nuclearism was possible. Places like Carlsbad have been historically necessary for the creation of the political ideologies of nuclearism, and are crucial for the physical manifestations and public acceptance for the

projects that nuclearism creates theoretically. Carlsbad set the standard for how nuclear experiments like Gnome would be introduced to the public in order to serve a variety of political goals, including the acceptance of nuclear technologies as inherent and necessary to a prosperous and secure future for America. However, in order for these experiments to be successful, local residents must also willingly accept these experiments and technologies in contrast to the authoritarian practices of communist countries. The Gnome shot ultimately led to the creation of a new nuclear space that demonstrated a new agenda of nuclearism, which in turn necessitated the willing compliance of new nuclear subjects, in this case, the residents of Carlsbad. The history of nuclearism and its establishment in a specific region of the U.S., as well as the implicit and explicit promises made to the residents of Carlsbad that shaped their hopes and expectations regarding their local environment, economy, and national status, continues to affect national nuclear discourses in the present.

From Trinity to Gnome

Atoms for Peace was conceived as a means to counter the destructive nature of the atom bomb, both in terms of developing peaceful applications, and psychologically as a way to prove to the world that the U.S. was not a combative nation in terms of possessing nuclear technologies, but rather at the forefront of using them with peaceful intentions.[10] Project Plowshares was the physical manifestation of Atoms for Peace, a national project that could change the international face of nuclear politics, with the U.S. continuing to be at the forefront of different nuclear applications.[11] While Atoms for Peace introduced the concept of nuclearism as a guiding philosophy for finding the appropriate use of nuclear weapons in

[10] Ira Chernus, *Apocalypse Management: Eisenhower and the Discourse of National Insecurity* (Stanford University Press, 2008), 70, 96-97.
[11] Scott Kirsch, *Proving Grounds: Project Plowshare and the Unrealized Dream of Nuclear Earthmoving* (New Brunswick: University of Rutgers Press, 2005), 3.

a democratic society, Project Plowshares would prove it to be physically and materially viable.

The AEC was created in 1946 by President Truman, and was charged with not only controlling the policies and practices of using nuclear weapons, but also with controlling the image that the public had regarding atomic technologies. The AEC therefore had to promote and oversee nuclear activities nationally, and convince the American public that AEC scientists had complete control over the atom and its destructive power. After the awe-inspiring lethal power of atomic weaponry was unleashed on Hiroshima and Nagasaki during WWII, the imperative for this new agency was clear: "[F]or the first time in history, science had produced something that required immediate intervention on the part of government."[12] Initially, in the immediate post-War period, the American public was elated that the U.S. had this technology first, but many were also struck by the realization that the U.S. would not hold a monopoly for long. The AEC felt the need to reassure a public haunted by "a primal fear of extinction"[13] as well, which required a way of repackaging the bomb tests as a means of shoring up American might.

By the 1950's, the Eisenhower administration realized that it faced the challenge of harnessing and controlling the deadly atom, and turning perceptions of this technology into seeing it as a beneficial tool for humanity in general, and Americans in particular.[14] As historian Paul Boyer has noted, "Shaken and disoriented by an awesome technological development of almost unfathomable implications, Americans grasped at straws, searched for hopeful signs, and tried to arrange scary new facts into familiar patterns."[15] The unique aspects of nuclear weapons led to a fear not only of imminent destruction in the fiery

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[12] Ferenc M. Szasz, *Larger Than Life: New Mexico in the Twentieth Century (*Albuquerque: UNM Press, 2006), 128.
[13] Paul Boyer, *By the Bomb's Early Light: American Thought and Culture are the Dawn of the Atomic Age* (New York: Pantheon Books, 1985), 15.

incineration of the mushroom cloud, but also a fear of radiation, which presented a new invisible, odorless, and tasteless terror. The public began to fear the ways that radiation entered their bodies as much as the detonation of atomic weapons themselves. Eisenhower realized that a new characterization for the ways that people thought about nuclear weapons was needed, and a hope for turning public opinion towards the use of nuclear technologies in everyday applications through public demonstrations of the usefulness of the bomb.

Beginning a Legacy of Nuclearism in New Mexico

As an untested project, the AEC still needed experimental sites in order to enact the civic-minded qualities of Plowshares. The qualities of remoteness, isolation, and low population density were main recommendations for the Carlsbad site, which followed a trend established by the military in the 1940's in its selection of the Los Alamos area for the Manhattan project. Originally, J. Robert Oppenheimer, the director of scientific operations for the atomic bomb project, had recommended Los Alamos, commenting that it combined his two great loves, physics and the desert.[16] Military leaders such as General Leslie Groves agreed that the New Mexican highlands were remote enough that it could safely and securely hold national nuclear secrets, as well as the effects from testing these new nuclear technologies.

At the end of the WWII, Los Alamos and its secret laboratory became famous when it was revealed as the place where the atomic bomb was made. However, the future of the formerly secret outpost lay in doubt, as the federal government struggled with how they would corral the effects of designing, creating and testing nuclear bombs. As historian Ferenc Szasz notes, there was "a distinction here between national plans for future atomic

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[14] Chernus, *Apocalypse Management,* 68.
[15] Boyer, *By the Bomb's Early Light*, 24-25.
[16] Kai Bird and Martin Sherwin. *American Prometheus: The Triumph and Tragedy of J. Robert Oppenheimer* (New York: Knopf, 2005).

research and the *place* where such research would likely take place."[17] In 1946, Los Alamos was chosen as the specific place where future nuclear research for national military purposes would be sited, thus remaking New Mexico's role in the national imaginary from one of remote outpost to one of scientific vanguard. The establishment of the Los Alamos National Laboratory (LANL), along with Sandia National Laboratory in Albuquerque, began a long relationship between New Mexico and nuclearism, and established New Mexico as an effective place for pursuing advances in nuclear knowledge. Justified by a need for national security, an influx of funds and secretive military projects went to LANL and other bases and labs open only to authorized military personnel and the scientists who carried out nuclear research. Eisenhower famously referred to these installations as the military-industrial complex, which simultaneously demonstrated the sophistication and control of nuclear technologies in the United States with increasingly more powerful and sophisticated nuclear weapons.

In addition to the secrecy that defined nuclear experiments during the Cold War, the problem of where to safely test nuclear weapons lingered as well. By 1954, some scientists felt that there were no places remote enough for the known dangers of nuclear fallout and radiation. Increasingly more powerful hydrogen bombs not only multiplied the power of the atom bomb, they also exponentially increased the intensity of fallout risks from radiation spreading with the wind. The 1954 Bravo test shot in the Pacific underscored the dangers of radioactive fallout when the detonation emitted more fallout than expected, and lethally irradiated a Japanese fishing boat that had been outside the fallout perimeter. After this incident, the AEC put the outside limits of safety from radioactive fallout at "570,000 square

[17] Szasz, *Larger Than* Life, 127-128

miles, or twice the area of Texas."[18] Because of these parameters, physical spaces to test nuclear technologies were shrinking from a scientific standpoint, even as the imperative from the federal government to keep testing new bomb designs was increasing. In the wake of these conflicting needs – to halt testing because of health concerns and to increase testing to further understand the parameters of new nuclear weapons- it became even more important for the AEC to identify places where risk from testing could be minimized, though places like Nevada would continue to bear the brunt of military testing.[19]

The AEC as faced with a dilemma. How could they safeguard the health of the public, when the military insisted that more testing was necessary? And how could they carry out Project Plowshares without exposing more Americans to fallout? What was once a straightforward objective, achieved by testing weapons in remote places like remote islands in the Pacific Ocean and the federally controlled desert of Nevada, was becoming more complicated in the 1960's by increasing knowledge of the ways that radioactive fallout was spreading across the globe due to these tests. The Gnome shot in Carlsbad seemed to provide an feasible answer to both questions, since it met the "[g]eneral criteria for the site [which] included location of a salt area not more than 800 feet below the earth's surface, a region of relatively low population density on land controlled by the U.S. Government and an area where silica-bearing contaminants were less than one per cent and sulphates less than 10 per cent."[20] These criteria made Carlsbad a seemingly logical choice for this model experiment, yet the relative isolation of Carlsbad in relation to the rest of the nation contributed to its appropriateness in the same way that Los Alamos' isolation made it logical

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[18] Richard G. Hewlett and Jack M. Holl, *Atoms for Peace and War 1953-1961: Eisenhower and the Atomic Energy Commission* (Berkeley, CA: University of California Press, 1989), 178.
[19] Szasz, *Larger that Life, 128*.
[20] Atomic Energy Commission, *Background Information on Plowshare Program*, (San Francisco: Operations Office, 1958), 3.

for Trinity. The same "low population density" that characterized Los Alamos did not mean that there were no people who would be affected, but rather that it was an easily overlooked population. In a scientific sense, Carlsbad was a logical place for the Gnome shot. New Mexico had both the military bases and national labs needed to create and move nuclear weapons easily to Southeastern New Mexico, but Carlsbad also had the general remoteness and lack of population to minimize fallout risks. The geologic, underground siting of the Gnome shot was seen as a way of further minimizing these risks, eliminating the mushroom cloud that had become synonymous with destruction and radiation.

In this context, the use of Carlsbad for Project Plowshares became an important site to show the American public that nuclear weapons were not the sole purview of the military and also to show that nuclear science could be beneficial to American society in general. During the Cold War, the theory of nuclearism depended on Plowshares to provide an outlet for both civilian and scientific purposes that counteracted the destructive image of the bomb. Historian Daniel Kevles notes that, "In the wake of this physicists' war, the Los Alamos generation insisted that if it was the responsibility of the civilian scientists to contribute his expertise to defense research, it was also the responsibility of the federal government to finance the basic research and training on which the nation's security ultimately depended."[21] Experiments such as Gnome were an attempt to socially temper the military juggernaut and instead fuel economic growth and increase scientific knowledge through transparent intentions. Gnome was the first shot to link together military prerogatives, federal scientists, and public demonstrations of the "peaceful atom." It embodied the nuclearist ideals of using nuclear weapons for peaceful purposes, but also

[21] Daniel Kevles, *The Physicists: The History of a Scientific Community in America* (New York: Knopf, 1995), 341.

served to underscore how geographically remote places like Carlsbad were essential for showing that bombs could be used with no risk to the public.

Newspaper articles across the nation touted the shot, declaring it the "most advanced phase of the Plowshares program, dedicated to discovering peaceful uses for atomic energy,"[22] and as a means to "enrich mankind from a nuclear 'boiler' blasted deep beneath the New Mexican desert by the first atomic explosion ever triggered for purely peaceful purposes.[23]" Local papers noted that, "345 accredited visitors, including newsmen, scientists, politicians, and representatives of 10 foreign countries" would be on hand to witness the blast.[24] These carefully chosen members of the public would attest to the success of the first Plowshares shot. Lengthy reports in small towns near Carlsbad detailed the preparations for Gnome, and one paper even included the Project Plowshares inspirational mandate in its entirety, as if to remind readers what the overall point of Gnome.[25]

Bringing the Periphery to the Center

The expectations of the local populace in terms of the effects of the shot were very different from the scientific rationales. Prior to WWII, much of the American West saw itself as subordinate to Eastern urban centers. For New Mexico, a state that had just achieved statehood in 1912, and remained at the margins of the nation politically and geographically, state politicians felt that for the state to improve its economic standing nationally, federal projects such as Gnome were necessary to elevate its status as a region and locale nationally. Historian Gerald Nash noted that Westerners often viewed themselves in a subordinate role nationally, with a "significant economic dependence on the industrial East, a minority position in the American political arena, and …the importation of

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[22]"Proposed Project Gnome Explosion Outlined for Atomic Experts," *El Paso Herald,* September 26, 1961.
[23] Associated Press, "AEC Hails 'Project Gnome,'" *Raleigh Register,* December 11, 1961.
[24] "Foreign Aides to Be at Test.," *The Albuquerque Tribune*, December 8, 1961.
[25]"Nuclear Blast: U.S. Atomic Energy Commission Project Gnome," *Hobbs News-Sun*, October 27, 1960.

almost every aspect of culture from the East."[26] The establishment LANL and Project Plowshares' Gnome shot were seen as a crucial part of changing these roles, by making New Mexico the center of a new scientific establishment. The creation of LANL as a model science city, funded by the federal government, was now shaping national policies instead of just following them. The creation and establishment of LANL served as inspiration for political leaders in Carlsbad, who felt that their town could accomplish the same goals.

This economic infusion was important to the region because Southeastern New Mexico had not been swept up in the post-WWII economic boom affecting larger urban centers in the West. Geographically, southeastern New Mexico had been bypassed by the newly constructed national interstate system,[27] leaving Carlsbad located at least two hundred miles from any national highway. For Carlsbad residents, the Gnome shot seemed a way of attaining some national recognition, similar to other once-remote places in New Mexico. At the time, a local newspaper hoped that, "As Alamogordo had become the symbol of the beginning of the A-bomb, so would Carlsbad symbolize the beginning of peaceful uses of nuclear explosives."[28] Carlsbad seemed on the brink of becoming a peaceful version of Los Alamos, and as the local newspaper, called the Current-Argus, noted, "It is to be hoped that the shot is successful enough to warrant continued studies and development in Southeastern New Mexico."[29] Hope for a change in political stature for the US, and for the political economy of southeastern New Mexico, is a continual thread of discussion in descriptions of projects such as Gnome.

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[26] Gerald Nash, *The American West Transformed: The Impact of the Second World War* (Lincoln: University of Nebraska Press, 1985), 3.
[27] Marie Montoya, "Landscapes of the Cold War West" in *The Cold War American West*, ed. Kevin Fernlund (Albuquerque: The University of New Mexico Press, 1998), 17.
[28] Szasz, *Larger Than Life*, 160.
[29] "Gnome Significance," *Carlsbad Current-Argus*, October 8, 1961.

One politician in particular, Senator Clinton P. Anderson, exerted his political influence when he was appointed the chairman of the Joint Committee on Atomic Energy, the oversight committee of the Atomic Energy Commission, from 1955-1959. Originally drawn to New Mexico in 1917 as a cure for his tuberculosis, Anderson became a state senator in 1945 and used his subsequent political influence to bring atomic projects to New Mexico in order to bolster the economy of the state.[30] Although Anderson considered Eisenhower's AFP speech "visionary," and he "certainly did not want Hiroshima and Nagasaki to be the principal monuments of our interest in the power of the atom,"[31] Anderson also believed that nuclear power needed to be instituted safely and responsibly, and he believed that the Gnome shot would provide a suitable model for future use of nuclear detonations.

In 1961, Anderson gave a speech in Albuquerque that summed up the hopes of southeastern NM for the Gnome project. In this speech, he noted that, "Since that primitive device, atomic energy has been the keystone of the research and development structure of the state."[32] He also noted that, "it is hopeful irony that here in New Mexico where man's most terrifying weapon came into being, men are at work on the development of peaceful uses of atomic energy." For Anderson, who objected to needless nuclear bomb tests for military purposes,[33] projects like Gnome were a way of using atomic weapons to further national goals and of using nuclear weapons productively and safely, without compromising human health, while also bringing much needed economic support to remote regions of New Mexico.

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[30] Szasz, *Larger Than Life,* 158-159.
[31] Clinton P. Anderson with Milton Viorst, *Outsider in the Senate: Senator Clinton Anderson's Memoirs* (New York: World Publishing Company, 1970), 163.
[32] "Gnome Significance," *Carlsbad Current-Argus*, October 8, 1961.
[33] Anderson, *Outsider in the Senate*, 202.

The openness of Gnome stood in direct contrast to the secrecy that defined Los Alamos and its activities, and made it an attractive economic gamble for Carlsbad, a region that was looking for a way to raise its profile beyond mining and the Caverns. For these myriad reasons, nuclear projects were relatively unproblematic for the populace of Carlsbad in 1961. Economic boon, a diversified economy, a changed national role, patriotic duty, and the lure of federal money and new economies made the project attractive to local politicians and boosters. The nuclearist ideal had come to roost in the deserts of southeastern New Mexico.

Trust in Science

In order to establish the ideals behind nuclearism as a viable policy for justifying the use of more nuclear weapons, the consent of local, national, and international publics had to be made. In 1961, Project Gnome set the standard for local expectations for the extent and capabilities of Project Plowshares. Gnome was expected to reshape how Americans at large looked at nuclear projects, and to remake international opinions as well, as "the first scientific experiment with nuclear explosives designed to provide information pertaining to the non-military uses of these explosives."[34] Its main scientific goal was simply summarized as a means "to study the effects of an underground nuclear explosion in salt,"[35] with the ultimate goals of collecting newly created isotopes, producing heat to create steam for energy production, and to aid mining excavations in the area.

It was also meant to mark another moment of progress and another step in the modern, where nature could be completely controlled to its atomic core, allowing it to be wielded in the public sphere for the good of humanity. Instead of science in the service of

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[34] D. Rawson, C. Boardman, and N. Jaffe-Chazan. *Project Gnome: The Environment Created by a Nuclear Explosion in Salt.* (Livermore, CA: Lawrence Radiation Laboratory, 1964), 8.
[35] D. Rawson, C. Boardman, and N. Jaffe-Chazan. *Project Gnome: The Environment Created by a Nuclear Explosion in Salt.* (Livermore, CA: Lawrence Radiation Laboratory, 1964), 10.

the military, it was science in the name of public good. The most authoritarian of technologies would, after Gnome, become a utilitarian technology for the benefit of all, and sleepy Carlsbad would be at the epicenter of that push. Gnome would also demonstrate that not only was the fissioned atom controllable, so was the environment in which it was detonated, as well as the public opinion that would surely become wholly positive upon witnessing it. For the Atomic Energy Commission, Gnome would demonstrate control over the environment, which would assist in shoring up public support for future nuclear projects. Thus was the AEC creating a material aspect to shore up and prove that nuclearism was not just a theory but an actual and supportable rationale for increasing nuclear technological production. It would also simultaneously justify and necessitate more atomic tests, and more funding for atomic research, through the material applications of nuclear bombs in carefully chosen places like Carlsbad.

The production of Carlsbad as an appropriate site for nuclear experimentation begins with scientific characterizations of its unique geological features, namely, the vast salt beds located 30 miles west of the city. The salt bed in which Gnome was detonated was expected to seal in the radiation from the blast, while the cavity the bomb created would hold super-heated steam that could be stored and then used to produce electricity. This scientific ideal- that the presumptive and inherent "nature" of the salt beds was imminently predictable- is a facet of a larger national goal to control the atom. Gnome becomes an important site for understanding how a regional political economy becomes enmeshed in a national nuclearist agenda. Without the salt beds, Carlsbad could not have been envisioned as an appropriate place for nuclear experimentation. Because of them, Carlsbad could be produced as an ideal nuclear site.

Looking at local discourses surrounding the detonation at the time, it becomes evident that acceptance was phrased as almost wholly universal by local journals, and in one article the *Current-Argus* quoted several citizens of Carlsbad, most of whom were enthusiastic about the blast. One booster, Herman Wertheim, noted that he "is 100 per cent for it. There has never been any objection here, outside the potash industry…"[36] Opposition to Gnome was publicly framed as marginal and localized, limited to the potash industry that fretted over the stability of their mines and were wary of trusting governmental scientists. The potash industry was the only non-supportive voices that the local journal reported, which were noted in a separate column. Members of the potash industry, however, displayed their concern in terms of how the detonation might affect the safety of their mines and workers. Jerry Tong, the resident manager of the Duval Sulphur & Potash mine, commented that, "We feel the AEC is not able to guarantee there will be no bad results from the shot. They have said they do not think there will be any bad results, but they cannot guarantee it…We are also afraid that there may be some contamination of gasses or water causing them to be radioactive. It is a known fact that gases [sic] and water both migrate to a considerable extent and we feel the AEC has no control over that."[37] The potash industry debate highlights the issue of trust in science and in the words of the federal government's science in particular. Yet these concerns were ultimately trumped by scientific arguments and the pressing need and hope for an economic boom brought on by Gnome.

Faith in science is a recurring theme as well in the reports surrounding Gnome, especially as more federal scientists were brought in to convince the public of Gnome's safety. Denny Moore, the president of the Carlsbad Chamber of Commerce, strongly stated his support of the AEC, commenting that, "As a rancher who has water well developments

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[36] "Businessmen Give Solid Support to Next Year's Project Gnome," *Carlsbad Current-Argus*, nd, na

within three miles of the proposed nuclear shot, I have no apprehensions concerning this project. I have complete confidence in the judgment, integrity and the ability of these men of the AEC and the American Academy of Science, all of whom are consulting on this project."[38] Locally, people were told that there would be very little disturbance, and the local newspaper described the population of Carlsbad as "quietly jubilant" that they had been selected as the site for Gnome. Many of the residents seemed to understand the international implications of the detonation, as well as the potential economic effects locally. The same article points to the official stance of government scientists, and the author concludes that, "No damage is anticipated. Eminent scientists have concluded that the explosion will be fully contained in the salt bed, that no radioactive material will escape, and that underground formations will not be damaged**."**[39] Trust in science was at a peak socially in the U.S. at large in this political moment, and Carlsbad business and political leaders echoed this mentality.

The theme of trust in science as a means of creating consent was also promoted by the national attention that Carlsbad began receiving in the months before the shot. A week before the shot, on December 3rd, 1961, the Atomic Energy Commission noted that it had received about 200 affirmative replies from people who wanted to tour the site before the shot. The group included media personnel, as well as "representatives of government, industry and science of the United States and several foreign countries."[40] By December 7th, three days before the Gnome shot, a headline from the Argus declared that "Hundreds of Prominent VIPS Due Here for Gnome Test," and placed the number at over 350

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[37] "Businessmen Give Solid Support to Next Year's Project Gnome," *Carlsbad Current-Argus*, nd, na.
[38] "Businessmen Give Solid Support to Next Year's Project Gnome," *Carlsbad Current-Argus*, nd, na.
[39] Jeter Bryan, "Carlsbad Quietly Jubilant," *Carlsbad Current-Argus*, n.d.
[40] "Gnome Site Tour Draws Hundreds," *Carlsbad Current-Argus*, December 3, 1961.

representatives.[41] Besides the gathering of elite and international personages, the types of scientists coming in also had a reassuring effect on the public. U.S. Public Health Service (USPHS) officials set up an office in Carlsbad, and enlisted the local populace in testing for the effects of radiation. The involvement of the USPHS demonstrates how much the stance towards public involvement had changed since the Trinity blast in 1945. Where Trinity was defined by secrecy to the extent that local residents were not even warned about the blast, the local newspaper ran a picture of a USPHS official standing with a local meter maid, demonstrating how to use a radiation badge to measure the amount of ambient radiation.[42] This type of public involvement in a radiation testing exercise creates a sense of insider knowledge, that the expertise of trained scientists can be adopted temporarily by the local populace as well. By engaging the public, the federal government made them complicit in the project as well, and simultaneously demonstrates a sense of openness that the government carefully cultivated in order to shows the separation between civilian nuclear projects and military ones.

In another instance of scientific expertise having influence on local opinion, a team of scientists was brought in to settle the unease amongst the potash industry. A film entitled "Industrial Applications of Nuclear Explosions" was shown to industry executives, and seismologists, geophysicists, and environmental engineers. It explained to the specially assembled group that "no harmful effects would result to nearby populated areas, potash mining operations, or potential mine sites, oil fields or agricultural interests."[43] The experts sent in by the federal government understood the economic concerns of local residents, and focused their attention on soothing those concerns through the application of scientific

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[41] "Hundreds of Prominent VIPS Due Here for Gnome Test," *Carlsbad Current-Argus*, December 7, 1961.
[42] "All Precautions Being Taken to Safeguard Public Health." "Public Health Unit in City For Gnome Blast Sampling," *Carlsbad Current-Argus*, December 9, 1961.

knowledge and authority. Yet what is missing from the reports of these scientists is an acknowledgement of not only the potential short-term effects of Gnome, but also the long-term. Partly this public lack of recognition of the dangers of the shot was due to a lack of certainty as the results of the shot, which was rationalized by the experimental nature of the project. Also, even though the dangers of acute radiation exposure were well-known to federal scientists by the 1960's, scientists believed that the inherently insulating properties of the salt beds would fully contain the radiation from the blast. Therefore, they felt it was unnecessary to cause concern among the public for what was considered a low-risk experiment.

Using science and its accompanying language to minimize the economic risks of Gnome was assuring, and the certainty of scientists that nothing untoward would occur also shored up support. If there was a perceived division between military projects and civilian, or industry led projects, Gnome seemed to gulf that divide between dangerous projects under the guise of national security, and peaceful projects that would be directed at shoring up the economy by providing cheap energy, and also prove American superiority in science and nuclear technologies. Yet strong indelible links between military projects and civilian nuclear projects remained. Among the eminent scientists involved in the Gnome project, the most famous was Edward Teller, dubbed "the father of the h-bomb." As one of the original Manhattan Project scientists, Teller held an undeniably powerful voice in the realm of national nuclear decisions. After the Manhattan Project, Teller worked at the University of California's Lawrence Livermore National Laboratory as a weapons scientist, but he was also deeply interested in Project Plowshares, not only for its practical uses, but also because he felt that if the USSR achieved this goal first, it put the United States at a disadvantage

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[43] "Expert Says Plan Gnome Won't Hurt Mine, Oil Area," *Carlsbad Current-Argus,* September 11, 1958.

internationally in terms of atomic ascendance. In an exclusive article to the *Carlsbad Current-Argus*, Teller explained that the Gnome shot would "merely serve as a model, but if it is successful, we might at some future date explode much bigger devices at great and safe depths."[44] Teller believed that Gnome was the beginning of a new stage of nuclear energy production, one that would produce plentiful and cheap energy, as opposed to that produced by current nuclear power plants, which were heavily subsidized by the federal government.

Teller's comments are also interesting because his focus was squarely on the importance of gleaning scientifically important information from Gnome, such as how a salt bed reacts to huge increases in heat. There is little in his article about the future of Carlsbad in this vision, although he did promise the residents of Carlsbad that, "The explosion will be completely contained and no radioactivity will appear on the surface." For the residents of Carlsbad, the assurances of safety from men such as Dr. Teller were crucial to gaining acceptance for the project. Although Teller specifically stated the Gnome was only a model shot, he also hinted that it may lead to something larger. But the lack of geographic specificity of his statements never explicitly states that Carlsbad would be that place, which was the major hope of the region.

Nuclearism engendered a sense of the quotidian as well. One resident described his feelings towards Gnome, stating "I've never been afraid of any damage from this shot. It's a good thing. It is one of those things that is more or less necessary. It is a coming part of our everyday lives." [45] It is unclear whether the speaker is thinking about detonations nationally, or whether he thinks that Carlsbad will be daily inundated with the nuclear project, but the naturalization of nuclear economies is evident in this statement. For local

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[44] "Teller Lists Importance of Gnome Findings." *Carlsbad Current-Argus*, March 1, 1960.

residents, nuclear projects were no longer considered exotic or tangential to everyday experience but something to be expected and endured, as well as central to the American experience, especially if it meant continued American superiority in developing and using these weapons.

Trust that these kinds of experiments would be safe, and the constant reassurance by scientists and engineers, was crucial to forming consent for the project in the local populace. In turn, this consent further shored up the reputation for the AEC as a trustworthy organization, in a departure from the shadowy origins of the Manhattan Project. Gnome was not just a model shot for gleaning scientific information; Carlsbad itself was also serving as a model for gaining public acceptance for national nuclear projects through openness and public involvement. Missing from federal discussions of Gnome were the specific impacts of the blast in Carlsbad itself, not just in terms of public health and safety, but in terms of future expectations of what Gnome would bring politically and economically.

Patriotism and National Belonging

The AEC was also assiduous about selling the bomb to Carlsbad by bringing local residents to other national nuclear sites. To this end, a group of local businessmen, politicians, and reporters from Eddy County were invited to the Nevada Test Site in 1958, to see nuclear tests firsthand, and relay their impressions back to residents of Carlsbad. Jeter Bryan, editor of the Carlsbad newspaper, recounted his experience on this trip in 1961, prior to the Gnome shot. He noted that: "We witnessed awe-inspiring blasts, as well as underground shots in the Nevada tuff. Those blasts set off some 1500 feet above the ground left one with a feeling of insignificance…a feeling that you were witnessing something that should be left for the gods. The underground blasts were not as spectacular,

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[45] "Carlsbad Quietly Jubilant." Jeff Bryan, *Carlsbad Current-Argus*. n.d.

but I could not help but reflect on the how powerful those forces were and what they might mean for the future of mankind."[46] Bryan's comments reflect how national interests were made local through the impressions of residents who bore witness to the power of nuclear technologies and who could then transmit those eye witness accounts to their own constituency. This aspect of spreading the positive aspects of a nuclear experience were instrumental in creating consent from local residents by taking them to other nuclearsites, in order to show the power and control that the government held over the atom. By demonstrating this power, and simultaneously sharing that experience with locals from Carlsbad, the federal government made those residents part of the Plowshares Program, which contributed to a national vision for a peaceful atomic future. It also cemented Southeastern New Mexico as a nuclear site through these nuclear subjects, with reverberations into the present and the future.

The immediate political effects of Gnome were not limited to the local or national nuclear scene- it would have global implications as well. These were reflected in reports from the Carlsbad Current-Argus, which put Gnome in a global perspective: "Carlsbad Caverns and the vast potash industry put Carlsbad on the map. Today, world-wide interest is focused on Carlsbad because of Project Gnome."[47] Gnome was important to the region, because it demonstrated a link between world, nation, and region. Gnome would be the first detonation after the lifting of the international test-ban treaty, which had been in place from 1953-1961. After the U.S.S.R. broke the treaty, America's response would show that not only did America still possess atomic technology in spades, but that it could be controlled by American scientists and engineers for peaceful purposes.

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[46] Jeter Bryan, "Carlsbad Quietly jubilant," *Carlsbad Current-Argus*, n.d..
[47] "Project Gnome." *Carlsbad Current-Argus*, December 10, 1961.

Gnome was therefore a piece of a national effort to demonstrate nuclear superiority in a technological sense, as well as a moral sense, and because of this, a sense of patriotism infused local feeling towards the Gnome shot. The *Current-Argus* reported that, "Aside from any future benefits that this community may derive from the project, Carlsbad residents were highly interested in the effect the detonation of a nuclear device for peaceful purposes around the world."[48] After President Kennedy confirmed that the shot would occur in December, 1961, Russian observers were invited by the president to witness the shot, who said that "the United States welcomes observers from interested United Nations Countries, as well as news media and [the] scientific community."[49] Although the Russians declined to participate, local residents of Carlsbad, such as Joe Gant, noted that, "I think President Kennedy acted wisely in asking the Russians to be observers. This will show the world that we do things openly, and for peaceful purposes, in contrast to what Russia has been doing in the past few days."[50] Another point of view reflects the idea that America would be sending a warning to Russia. Ed Skinner, who worked in the mineral industry, commented at the time that, "I'm glad to see them going ahead with it. It will give the Russians something to think about."[51] The international implications of this regional exercise were important to national leaders eager to put international and national fears about American control of the atom to rest. But for local residents, this sense of patriotism was part of rationalizing the detonation, by contributing to both a national sense of purpose, as well as a regional sense of belonging to a national goal.

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[48] Jeter Bryan, "Carlsbad Quietly Jubilant," *Carlsbad Current-Argus*, n.d.
[49] "Test Use of Atom in Peace," *Carlsbad Current-Argus*, October 25, 1961.
[50] Jeter Bryan, "Carlsbad Quietly Jubilant," *Carlsbad Current-Argus*, n.d.
[51] Jeter Bryan, "Carlsbad Quietly Jubilant," *Carlsbad Current-Argus*, n.d.

Nuclear Economies: Expanding the Subterranean World

However, perhaps the strongest rationale for Gnome, and one that dovetails with the scientific trust and sense of patriotic duty that suffused local discussions about Gnome, is the economic aspect. Carlsbad was seen as an ideal site for the first Plowshares shot for another reason. As a site of redemption, New Mexico was a strong candidate as well as an example of how the national nuclear project was ensnaring areas of the United States that, prior to WWII, had been considered poor remote outposts from the large urban centers and rural production points that characterized important places in the United States. LANL is an example of how the national nuclear project came to be seen as a localized economic necessity. Prior to Gnome, economic activity already picked up with the preparations of the Gnome shot. Local businesses were tapped to dig the mine shaft that the Gnome bomb would be lowered into, and also to ship equipment to the site itself. The mini-industry surrounding the emplacement of the bomb served to pique the interest of local businessmen who assumed the work would only increase if Carlsbad were to become the home of underground energy reserves from multiple detonations.

Changing the very basis of the local economy was very much the center of how local residents viewed the future possibilities of Gnome. For Carlsbad, which was at the periphery of the national imaginary both psychologically and geographically, Gnome seemed like a way of making Southeastern New Mexico more central to national goals and projects. For a region dependent on the boom-and-bust nature of oil and potash extraction, building a technoscientific national laboratory, like the ones at Sandia or Los Alamos, seemed like a departure from local economies, but one that would raise the profile of Carlsbad nationally and offer a secure line of federal funding for the future. For instance, local businessman Woody Inman commented that, "The people of Carlsbad- everybody- should extend a

welcome to those guys and let them know we want the project. We could encourage it. We don't want to run any more business out."[52] This statement demonstrates a longing of acceptance and belonging, as well as a need for economic diversity critical to the health of the region. Rather than remain a perennial outpost for the nation, the local hope was that Gnome would show that New Mexico was ready to commit to bringing in other nuclear economies. This feeling of acceptance extended across the state as well. State Senator T.E. Lusk commented that," There would be no reason not to go ahead with the project unless someone can demonstrate it will have an adverse effect on the existing economy." [53] Another article, titled "Atom Bomb May Bring Boon for Carlsbad," outlined the specific economic changes that a successful Gnome shot would bring.[54] The author outlines the two main reasons why Gnome would be good for Eddy County, in that "it could be responsible for the location of an electrical power plant" as well as "for producing and recovering valuable isotopes" that may be useful commercially. Economic rationales, bolstered by trust in the scientific acumen and accuracy of science, dictated how people responded to the Gnome shot.

However, the economically-hopeful tone of local newspapers is also indicative of a growing gap between the hopes of local residents, and the scientists' point of view. Where for one group, Gnome could potentially shape the political economy of the region, for the other group, it was merely a test site to glean knowledge about isotopic behavior. This divide is made obvious in the comments of Ernest Wynkoop, the project engineer of the Gnome Project in Carlsbad, who commented that, "Gnome experiments may open a whole

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[52] Mike Hill, "Atom Bomb May Be Boon For Carlsbad: Could Bring About Further Industrial Expansion in Eddy," *Carlsbad Current-Argus*, January 25, 1959.
[53] "Businessmen Give Sound Support to Next Year's Project Gnome," Carlsbad Current-Argus, 1960.
[54]Mike Hill, "Atom Bomb May Bring Boon for Carlsbad: Could Bring About Further Industrial Expansion in Eddy," *Carlsbad Current-Argus*, January 25, 1959.

new horizon of inexpensive energy sources for the generation of electricity. If lab tests and drawing board theories are confirmed, Gnome may make a very notable contribution to man's search for more and cheaper fuel sources."[55]

The article continues in a somewhat different vein, however, noting that "The AEC project director made it plain, however, that the present project does not embrace the generation of electricity," which seems to negate the idea that Carlsbad would quickly become the focus of an established nuclear site. But just a few lines later, Wynkoop does give hope to the idea that Carlsbad could become the new epicenter of nuclear experimentation because of its unique geographic features: "As heat dissipated from the underground chamber, Wynkoop said it might be even more practical to detonate a second and third and even more nuclear devices to create new chambers and stream. 'The Salado Basin, immense in size, would be an ideal source for underground steam generation via nuclear detonation,['] Wynkoop pointed out. 'Conceivably, a tremendous power-generation industry could develop around it, bringing with it industries dependent upon low-cost electric power for manufacturing."[56] Wynkoop simultaneously stresses the experimental aspect of Gnome, yet implies a strong future for regional economics if the shot is successful. Placing the future effects amongst the geographic specificity of the Salado Basin, which is part of the Permian Basin in Texas and New Mexico, adds salience to the idea that New Mexico is not only an ideal place to site future nuclear projects, but ideal also for commercially viable projects, not just military-related ones. The idea of Eddy County and Carlsbad being the seat of inexpensive, plentiful energy to power the American Dream in the 1960's, seemed logical and attractive to the local populace, who may have read into the words of AEC scientists, but who also felt assured that there were solid possibilities for

[55] "Gnome to Test Steam Generation," *Carlsbad Current-Argus*, July 27, 1961.

economic change and growth. The support of local businessmen and politicians was integral to the government's initial success in selling the project to the public in Carlsbad, and in return, that public expected a longer-term commitment from the government.

The Aftermath

Gnome was detonated half a mile underground on a cold clear day, on December 10th, 1961. However, after the shot went off, the expected community, commercial, and scientific reshaping of Carlsbad never occurred. The unexpected release of radioactive steam, as well as the tremors felt by people in the surrounding area from Malaga to Artesia, when people had been told they would feel nothing at all if the shot was successful, made the success of the shot seem immediately suspect. The main government response after the shot was to analyze the site, run scientific tests, and understand why the site behaved the way it did after the shot. In terms of the local populace's reaction, the reporting in the *Carlsbad Current-Argus* focused only on this scientific language; notably, much of the optimism surrounding the future plans for Carlsbad were very subdued. The first article after the shot published on December 11, 1961, had this description of the experiment from AEC officials: "The shot was termed 70 per cent successful at a briefing Sunday night despite the fact that it vented radioactive steam and temporarily forced the closing of State Highway 31. At last report, radioactive steam was still wafting from the shaft, but scientists said in a post-briefing Sunday night that this radioactivity was not considered high enough to be dangerous to humans, animals or crops. 'To the best of our knowledge, safety precautions have been adequate.'"[57]

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[56] "Gnome to Test Steam Generation," *Carlsbad Current-Argus*, July 27, 1961.
[57] Dick Hardwicke, "A-Blast Results Studied," *Carlsbad Current-Argus*, December 11, 1961.

The shifting and cautious language here presents a departure for the surety of the bold declarations from atomic scientists a year earlier, or perhaps the change is in the feelings of the local reporters. In either case, the sense of optimism surrounding the blast emerges in random yet logical places. Curbing the anxiety of local residents, two days after Gnome, *Current-Argus* readers are assured that the blast did no damage to the nearby tourist spot of Carlsbad Caverns, [58] and a follow-up article on radioactivity had the headline of "Little Danger here From Radioactivity." This article quoted project leader Ernest Wynkoop, who told readers that, "The amount of radiation recorded anywhere outside the shaft head was actually less than a person would take in a undergoing an x-ray examination."[59] But anxiety and concern are reflected in later reports, tempering these optimistic notes with the uncertainty of the unpredictable shot. A headline from December 20, 1961 declared that, "Gnome Blast Jars World Scientists: Flabbergasts Everyone," in which the *Current-Argus* reported that not only had people in the area felt the blast, but that US Coast and Geodetic Survey scientists had "calculated that the shot would transmit one-third less energy in the salt bed in which it was fired than one in rock formation, where such shots are usually tested. But the shock waves were picked up in Finland, Sweden and in Japan, where shock from an underground test of similar size in 1958 were not recorded."[60] Words like "jar" and "flabbergast," in addition to the shock of the blast immediately and afterwards, are demonstrative of chinks in the scientific armor that the scientists at Gnome had built around the project. The salt beds seemed to contain the impacts of nuclear detonations less than the rocky underground around the Nevada Test Site, which was an important discovery for science, but not so positive for the region. If the salt beds would

[58] Stephan Crow, "Caverns Calm Unbroken By Gnome," *Carlsbad Current-Argus*, December 12, 1961.
[59] Dick Hardwick, "Little Danger Here From Radioactivity," *Carlsbad Current-Argus*, December 17, 1961.
[60] "Gnome Blast Jars World Scientists: Flabbergasts Everyone," *Carlsbad Current-Argus*, December 20, 1961.

not contain the steam that a radioactive detonation produced, then the region would not be able to support the economic activity of commercial energy production. A key component for producing peaceful atomic blasts would not be realized in Southeastern NM, and federal agents began to look elsewhere for ways to produce this component of nuclearism.

Yet there was still local hope that the Gnome shot would bring more permanent economic change to the region. Another article from December 28th remarked that there were still rumors swirling over what the future of Gnome would mean for Carlsbad. Another short article simply entitled "Planning Stages" noted that while "There are a number of other things being considered, mostly post-shot drilling or mining for further underground studies…All these things are in the 'discussion stage,' and no definite plans have been completed."[61] Two weeks after the detonation, the local populace was still eager to see the positive fallout from Gnome, but the scientific populace seemed less interested. Talk of additional shots for further tests or production faded and even the scientists who remained at the site were interested only in taking scientific measurements, and seemed to see no future for a commercial Los Alamos-type laboratory in Carlsbad.

However, in March 1962, the AEC revealed that it was planning a second shot for the area, dubbed Operation Coach. James E. Reeves, a project manager for the Gnome project, commented that the economic gain for the region would be about the same or a little less, since Coach would use the same facilities as Gnome did. The AEC held a public meeting to give out information about the Coach shot, to which only 65 people attended. Reeves was "pleased by the small turnout," commenting that, "'If the crowd is large, we're happy because everyone is interested to know what we're doing. If the crowd is small we're

[61]"Planning Stages," *Carlsbad Current-Argus*, December 28, 1961.

happy because they're not worried about what we're doing."[62] This is an illustrative moment in public relations for the AEC, as it denotes that the people of Carlsbad are realizing that their dreams for the future are not going to be realized by the Coach shot, or any other nuclear project at this point. But more importantly, the ability of the AEC officials to spin either a large turnout or a small one, demonstrates their increasing sophistication about dealing with public concerns. It foreshadows how regional and local public meetings would become a standard feature of the atomic projects introduced to the public in order to explain the complexities of nuclear experiments, which would also spawn public comment hearings.

But the planned Coach shot never occurred. Instead, the AEC decided that they had gleaned enough information from the Gnome shot, and returned the land to the Bureau of Land Management. The Gnome site has been closed and monitored for radioactive leaks ever since. Over the last five decades, the site has been reverted to grazing land, and is marked only by a plaque on a stone pedestal. The site marker is obscured by the Chihuahuan desert landscape and roaming cattle. The sign, in its entirety, reads:

UNITED STATES ATOMIC ENERGY COMMISION
DR. GLENN T. SEABORG, CHAIRMAN
PROJECT GNOME
DECEMBER 10, 1961
THE FIRST NUCLEAR DETONATION IN THE PLOWSHARE PROGRAM TO DEVELOP PEACEFUL USES FOR NUCLEAR EXPLOSIVES WAS CONDUCTED BELOW THIS SPOT AT A DEPTH OF 1216 FEET IN A STRATUM OF ROCK SALT. THE EXPLOSIVE EQUIVALENT TO 3,100 TONS OF TNT WAS DETONATED AT THE END OF A HORIZONTAL PASSAGE HEADING FROM A VERTICAL SHAFT LOCATED 1,116 FEET SOUTHWEST OF THIS POINT. AMONG THE MANY OBJECTIVES WAS THE PRODUCTION AND RECOVERY OF USEFUL RADIOACTIVE ISOTOPES. THE STUDY OF HEAT RECOVERY, THE CONDUCT OF NEUTRON PHYSICS EXPERIMENTS, AND THE PROVISION OF SEISMIC SOURCE FOR GEOPHYSICAL STUDIES.
NO EXCAVATION AND/OR DRILLING IS PERMITTED TO PENETRATE SECTION 34, TOWNSHIP 23 SOUTH, RANGE 30 EAST, NEW MEXICO

[62] Frank Smith, "Project Coach Purposes Listed by AEC: Bigger and Deeper Than Gnome, Public Meeting Informed," *Carlsbad Current-Argus*, September 9, 1962.

PRINCIPAL MERIDIAN AT ANY DEPTH BETWEEN THE SURFACE AND 1,500 FEET.

The marker makes no mention of the actual site itself, its relationship to the town, or whether the project was a success. For all of its technical detail, the Gnome marker does not say anything at all about the actual history of nuclear optimism regarding the shot, or the specific place it was held. It is a testament to nuclearism, in that it is highly specific about the goals of the shot, yet is completely lacking in regional and historical context, and makes no mention of whether these objectives were successfully carried out. But in looking at its placement, a lone marker in the remote desert, on land licensed for cattle grazing by the BLM, one can assume that it was not, especially when taken in context with the warning of the last sentence.

Adding more intrigue to the marker and the idea of Gnome is that the marker is pierced with random bullet holes- a reminder of the violence that accompanies even peacefully intended projects such as Gnome. The marker's language, which is extremely technical and specific in terms of location and depth, offers no real insight into the political and cultural context of the shot. It gives warnings about not interfering with the spot, but no specific reasons why. The sign itself can be read as a mixed message about nuclear experiments, and the future of nuclearism. It stands in contrast with the obelisk at the Trinity site near Alamogordo. That site, open to the public only twice a year, draws tourists eager to see the "birthplace" of the atom bomb, where the first nuclear detonation took place. Although Gnome is a unique nuclear instance in itself, it is not a celebrated site. Rather, the forgotten marker, surrounded by cows, brush, and sandy paths, is a testament to the ways that nuclear failures are summarily forgotten, left out of the narrative that celebrates nuclear technologies as synonymous with progress. Gnome is now a forgotten piece of the Plowshares Program, which in itself is seen as a naïve and dated attempt to sway

public opinion towards nuclear energy. As one historian described Gnome, "It made as much sense as powering a steam locomotive by opening a door on the boiler and tossing in a lit stick of dynamite every now and then…"[63] This approach could describe Plowshares as well, as a set of wacky experiments designed to use nuclear technologies in inappropriate and unnecessary ways in order to make a point about the possibility of nuclear and the might of the U.S. atomic arsenal.

Instead of creating a human-made energy source, Gnome instead demonstrated the limitations of science to control and predict how local environmental conditions would react to nuclear bombs. Gnome was a parallel story to the testing in the Nevada Testing Site, but on a smaller, more local, and more public scale. But Gnome did more damage than just irradiate a salt bed under Carlsbad; it also "literally" shook people's trust in government messages and government science. But this break in the successful nuclear narrative carved out of the Gnome experiment was only momentary, and the assurances of atomic scientists like Teller and trust in government officials from the AEC soon quelled fears that something had gone seriously amiss at the Gnome site. In the aftermath of Gnome, Carlsbad was left with nothing but an extra salt cavern filled with radiation. Today, the Gnome site is still monitored for radioactivity, and minute amounts are detected by the Carlsbad Environmental Monitoring and Research Center.[64] The physical legacy of Gnome is in this latent radiation, but the psychological legacy is that it prepared and familiarized the residents of Carlsbad with nuclearism, and the process of implementing and enacting national nuclear projects on a local level. This familiarity would pave the way for another unique project just eleven years after the Gnome shot.

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[63] James Mahaffey, *Atomic Awakening: A New Look at the history and Future of Nuclear Power* (New York: Pegasus Books, 2009), 237.

[64] "Gnome, Gnome on the Range," *Focus on Carlsbad* (Winter 2011): 24.

The centrality of New Mexico in the history of national projects aimed at creating, controlling, and using nuclear technologies is undeniable, and it has played a crucial role in creating and maintaining the possibility of nuclearism. By looking at New Mexico's unique regional history preceding the introduction of atomic sciences, and then examining the ways that nuclear communities affected the role of New Mexico in the national imaginary, the political and social means by which nuclear technologies were made acceptable becomes more clear and understandable. Ferenc Szasz, an atomic historian, has pointed out that, while the atomic project stretches from coast to coast, "for reasons that are not always clear, the 'atomic firsts' in New Mexico seem to have taken precedence over the others."[65]

Szasz' list includes Los Alamos National Labs, the Trinity detonation, and Sandia National Labs as the most well-known "firsts" marking the first inroads of nuclear activity, not only in the state but nationally as well. Yet Gnome is an important, if forgotten, first that established the tenets of nuclearism, rooting it in a particular place. While the Gnome shot was ultimately unsuccessful, it set the precedent for nuclear activities in Carlsbad, sowing the seeds of the future Waste Isolation Pilot Plant (WIPP) that is now the only geologic radioactive waste disposal site in the U.S. By understanding the historical context of nuclearism and Carlsbad through Gnome, other "firsts" such as WIPP become more easily understandable, even as their impact on the viability of America's nuclear future increases exponentially in the present.

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[65] Szasz, *Larger than* Life, 122.

Figure 1: Plaque marking the Gnome site today. (Photo by author)

Chapter 2: WIPP and the Materiality of Nuclear Waste

The 1961 Gnome shot introduced a federal nuclear experiment to the region of Carlsbad. It left few lasting material effects except for lingering radiation in the salt cavern deep below the surface of the desert, but a lasting political and cultural legacy. Though the project was ultimately unsuccessful in its aims of producing radioactive steam caverns, it did establish that the local population was accepting, and even welcoming, to federal nuclear projects. It served to familiarize local residents with atomic technologies, and gave them a vocabulary to understand the idea of nuclearism, whereby nuclear projects were seen as synonymous with American power and a technologically advanced society. Nuclearism drove the production of nuclear energy projects such as Project Plowshares, and brought together ideas of patriotism, economic benefits, and the ability of scientists to create new sources of energy to power the American military and economic juggernaut emerging after WWII. While Gnome drew Carlsbad and its inhabitants into the web of national nuclear projects, a new era of nuclearism would enmesh Carlsbad fully by the end of the 20th century, as the only permanent nuclear waste repository in the U.S. was established in the area.

The waste products produced by nuclear reactions have lingered in the American landscape since the creation of the atomic bomb in 1945 and have only increased with the addition of 104 reactors producing nuclear energy nationwide. To date, there is no cohesive or comprehensive federal or state policy for dealing with these myriad radioactive byproducts, and there is only one permanent site for radioactive waste in the U.S., located 26 miles outside of Carlsbad, NM in the salt beds of the Permian basin. Dubbed the "Waste Isolation Pilot Plant," or WIPP, this facility was first proposed by the Atomic Energy Commission in 1972 but didn't accept its first waste shipment until March 26, 1999. It is

only legally allowed to hold transuranic waste produced by the military during the Cold War, and is slated to close in 2030.

While the WIPP project was mired in controversy during its licensing and construction period,[1] this chapter is most concerned with understanding how it has been received by community members in Carlsbad and other regions of New Mexico since its opening. As a pilot plant, the success of WIPP in its first fourteen years (1999-2013) now has significant ramifications for future nuclear projects concerning the back end of the nuclear fuel cycle. Several new programs developed by the Department of Energy (DOE) are focused on dealing with nuclear waste, and national attention is now focused on WIPP as a potential solution for other kinds of radioactive waste. It is therefore important to examine how WIPP has reshaped public attitudes towards nuclear waste, both locally and regionally, in order to understand why southeastern New Mexico is once again the focus of federal attention regarding nuclear waste storage or other kinds of waste, including spent nuclear fuel, decommissioned nuclear power plant parts, and radiological medical equipment, as well as other nuclear facilities such as experimental nuclear plants and reprocessing centers.

Looking at opinions voiced at public meetings as well as interviews with various stakeholders, from local residents to anti-nuclear citizen groups, as well as information given by different federal agencies invested in finding a permanent home for nuclear waste, it becomes evident that WIPP has transformed the how the materiality of nuclear waste is understood in order to gain local acceptance. The nuclearist ideals first introduced to Carlsbad with the Gnome shot in 1961 have re-emerged in slightly different forms in the context of WIPP today. While nuclear energy has been framed as part of a "modernist ideology of progress that equates economic growth and technological power with social

success,"[2] the waste produced by these technologies must be dealt with in a comprehensive manner to make nuclearism possible. WIPP is being posed as not only a solution to the problem of nuclear waste, but also as a technological feat in and of itself.

But WIPP is not only a technological feat; it also represents a different social approach to siting nuclear facilities. By building on nuclearist principles introduced in the 1960's, WIPP has emerged as an attractive community partner due to the perception that is aids the achievement of nationalist goals regarding energy production and environmental stewardship. It is also seen as an economic boon to the region, not only in job production, but also in helping stabilize the population of Carlsbad. This first section of this chapter establishes how nuclearist aims in relation to WIPP can be seen in relation to local residents, who express ideas of nationalism, patriotism and environmental stewardship in regards to hosting the WIPP project, as well as the ways that WIPP has positively affected the local community in both expected and unexpected ways.

A critical but often over-looked aspect of WIPP that led to its widespread acceptance amongst the community in Carlsbad is the way that it has redefined the materiality of nuclear waste by making it visible, containable, and controllable. Radioactivity is an especially pernicious substance because of it amorphous nature, with invisible, odorless, tasteless particles floating in the wind, running through water, and laying in the soil. Instead, WIPP is evidence of the ways that "state, military, science, and industrial apparatuses…must be

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[1] For an overview of this process, see Chuck McCutcheon, *Nuclear Reactions: The Politics of Opening a Radioactive Waste Disposal Site (*Albuquerque: UNM Press, 2002).

[2] John Byrne and Steven M. Hoffman, "The Ideology of Progress and the Globalization of Nuclear Power," in *Governing the Atom*, eds. John Byrne and Steven M. Hoffman (New Brunswick: Transaction Publishing, 1996), 13.

integrated in order to develop nuclear technology"[3] through physical technologies like containment casks and mines, but also through education and images to shape public perception of radioactive waste. WIPP has made nuclear waste a non-threatening presence in Carlsbad, especially through projects related to educating the public and by using imagery that makes the boundaries of radioactive contamination seem manageable through simple engineering and isolation techniques. Nuclear waste is given a materialism that makes it seem mundane, a materiality that presents no risk to the public as long as it is properly understood in technical and scientific terms. I argue that nuclearism, through nationalist and economic arguments and through nuclear materialism, provides an impetus for government agencies to reduce nuclear waste to a *technological artifact*.

As a technological artifact, nuclear waste becomes a material product that was created under specific political conditions, specifically a Cold War nuclearist agenda. Not only is waste seen as a material object, it is made into an artifact by being bound to a specific moment in time, and as part of an era and set of practices that is placed solely in the past. Scientists and engineers see nuclear waste as a technical problem whose risks can be addressed comprehensively and permanently using specific materials and practices. It is a passive object that can be wholly contained under the aegis of human control, as long as it is properly understood. This is especially true of the waste bound for WIPP, which can legally only consist of transuranic, military-produced waste. Transuranics are long-lived isotopes that must be stored in geologic disposal sites, and that were produced during the Cold War. For the Department of Energy (DOE), the federal agency responsible for safeguarding military-produced radioactive waste, the success of WIPP is an essential part of convincing

[3] John Byrne and Steven M. Hoffman, "The Ideology of Progress and the Globalization of Nuclear Power," in *Governing the Atom*, eds. John Byrne and Steven M. Hoffman (New Brunswick: Transaction Publishing, 1996), 13.

the American public that there is a solution for nuclear waste. The further production of nuclear waste would therefore not be an impediment to the production of nuclear energy; as such, the success of containing the threat from waste is paramount in order to justify producing more nuclear energy and by extension, more waste, in the future. It has been an imperative for the DOE to make WIPP acceptable to residents of Carlsbad, to demonstrate through the ideal of nuclearism that nuclear waste can be a desirable good for a community. For federal agencies charged with finding a permanent storage site for commercial nuclear waste, the stakes are high for WIPP's success. If the waste at WIPP, produced under specific circumstances, can be successfully held in WIPP, then agencies like the DOE need only alter or expand the criteria of what kinds of waste are appropriate for WIPP (or just a Waste Isolation Plant- a WIP). GTCC waste, for instance, has some similar attributes as transuranic waste, which is why WIPP is a proposed site for GTCC waste.

However, the idea of radioactive waste as a technological artifact of the Cold War is deeply contested by factions opposed to WIPP, who are suspicious of the potential to open WIPP to other kinds of radioactive waste. These groups, including environmentalists and anti-nuclear activists, base their positions on a more historical view that encompasses the last seven decades of nuclear culture in the U.S., a time frame that includes nuclear weapons produced by the military during the Cold War as well as uranium mining in the western U.S. In these conversations, radioactive waste cannot be reduced to a technological artifact, bound by a specific time period or source of production, and then simply solved by storing it underground. In the third and final section of this chapter, I examine the ways that nuclear waste, and by extension WIPP, is emblematic of a larger *cultural problem*, linked inextricably to the nuclearist ideals that led to its production. For opponents of WIPP, the waste intended for WIPP is part of a longer practice of using politically marginalized communities to bear

the brunt of the side effects of America's nuclear program. WIPP has led to continued protests against the project from scientists, anti-nuclear groups, and residents of the state because they feel it doesn't address how nuclear technologies and the production of waste from weapons and energy production have actually served to create "nuclear communities. These communities are intimately connected by the negative effects of radioactive contamination due to negligence and dishonesty on the part of federal and industry parties to downplay or ignore the risks of nuclear technologies.

From down-winders who lived in the vicinity of testing sites, to employees and contractors at federal facilities, to populations living along transport lines that WIPP uses, representatives from these nuclear communities feel that finding a place to store the detritus of nuclear projects in the U.S. also means that their environmental concerns and health issues will remain unresolved, even as WIPP seems to provide a "solution" to the material problem of waste. For them, nuclear waste can never be reduced to a technological artifact or divorced from the nuclear communities they have created in New Mexico and other parts of the country. Instead, WIPP allows the military industrial complex to escape interrogation and exposure to censure for continuing to foist Cold War materials onto marginalized communities. If the circumstances under which nuclear waste is produced are not held to more scrutiny, then the site could easily be opened to other kinds of waste as well.

This position in not a binary one to that of seeing nuclear waste as a technological artifact, but rather a means of forging a more comprehensive recognition of the potential communities that this oversimplification of nuclear waste could create. The materiality of the waste itself, which include its historical conditions of production and its effects on communities that have been contaminated, are necessary aspects of nuclear projects that need to be acknowledged and discussed, not hidden underground. Bruce Braun and Sarah J.

Whatmore have put forth the idea that "taking nonhumans-energies, artifacts, and technologies- into account in the analysis of how collectivities are assembled" is an important step in seeing the nonhuman "as active parties in the making of social collectivities and political associations."[4] The collectivities and associations that have emerged in relation to the negative effects of nuclear projects are not incidental to nuclear production, and cannot be bracketed out by scientific characterizations of half-lives and salt beds. Rather, human and environmental health concerns are central and inherent effects of using nuclear technologies and producing nuclear waste.

For opponents of WIPP, increasing nuclear waste sites in the vicinity of WIPP and in New Mexico creates an ever-expanding web of risks stemming from the transportation of nuclear waste from the Cold War sites that cannot be fully remediated in the first place. Risk theorists have argued that nuclear risks are unique in the pantheon of human existence because of the ways that radioactive elements change bodies and environments, and how it moves silently and stealthily through the air, water and soil. Using theories developed by Ulrich Beck and others, the risks inherent to WIPP are not local, and cannot be contained by geologic repositories when every individual on the planet has been affected by radioactive isotopes released during accidents and testing of nuclear technologies. For opponents, bringing more nuclear by-products and technologies into the state and thereby creating new nuclear communities is unconscionable without addressing the nuclear legacy already in existence in other parts of the state.

Remnants of the Cold War: A History of Waste

Nuclear waste had not been a main concern for AEC scientists throughout the first three decades of atomic projects, and in fact, was thought of as a hindrance to progress in nuclear

[4] Bruce Braun and Sarah J. Whatmore, "The Stuff of Politics: An Introduction," *Political Matter: Technoscience, Democracy and Public Life*, eds. Bruce Braun and Sarah J. Whatmore (Minneapolis: University of Minnesota Press,

weapons production. Carroll Wilson, the first manager of the AEC, noted that, "Nobody got brownie points for caring about nuclear waste."[5] There was no systematic plan for dealing with radioactive waste, a problem compounded by the fact that there was no professional specialty for that discipline. Concepts such as environmental engineering were more concerned with municipal waste systems than the physical remains of a national nuclear weapons building program. Reluctantly, after producing radioactive waste since the inception of the atomic weaponry programs in the 1940's, and after increasing controversy about exposure to low-level radiation , the Atomic Energy Commission (AEC) decided that it was necessary to finally address the issue of radioactive waste.[6]

The concept of a nuclear waste storage site that would isolate waste from the rest of the environment was first conceived in 1955, when AEC scientists looked at salt beds as a plausible method for storing waste. Waste was not a major concern then, since national nuclear projects were relatively small-scale at this time, and the race with the Soviet Union to stay at the cutting-edge of nuclear weapons production took precedence over the marginalized issue of waste. Radioactivity spread across the American West to the rest of the world in the form of radioactive dust, particles, and water, as nuclear weapons spread radiation haphazardly and unexpectedly. Due to a Cold War mentality that prioritized nuclearist principles over human and environmental health, most of these tests were performed secretly, and even when the public was notified, the risks from radiation exposure were not explained. The idea that the production of nuclear waste was a necessary byproduct of producing security for the nation was widely accepted, as nuclear waste was also thought of as a non-pressing problem by the Atomic Energy Commission (AEC). It

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2010), xiii-xiv.

[5] McCutcheon, *Nuclear Reactions,* 8.

turned out that finding a comprehensive method to deal with nuclear waste actually raised more questions that the AEC was unable to answer.

Disposal methods for radioactive waste in the early 1960's included dumping waste in deep oceanic trenches,[7] and onsite storage of wastes at nuclear facilities. In places such as LANL, this meant storage in unlined metal drums and cardboard boxes dumped into nearby canyons and ravines, or in unused buildings. In Rocky Flats, CO, where plutonium triggers for nuclear weapons were manufactured, storage consisted of cardboard boxes in unlined shallow trenches.[8] Dispersal into the environment, especially for gases and liquids, was also thought of as a perfectly effective way of diluting and negating the hazardous effects of radioactive substances.[9] There was no cohesive or federally mandated way of dealing with waste, and many scientists underestimated the danger of low-level radioactive waste during an era where political pressure to move ahead with experimentation and construction intensified. Understandings of the dangers of radiation were limited to victims observed after Hiroshima and Nagasaki in 1945, which only indicated acute levels of exposure to radiation. The known dangers of radiation seemed limited to sudden attacks of high doses, and the dangers of other types of radiation exposure were not well-understood, nor was there any pressure to study the effects of persistent low-level radiation or other types of exposures.

In 1956, the AEC approved the method of isolating waste in geologic salt beds, based on the long-term geologic stability of salt beds and the low moisture content that seemed to be

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[6] J. Samuel Walker, *Permissible Dose: A History of Radiation Protection in the Twentieth Century* (Berkeley: University of California Press, 2000), 20-21.

[7] Josh Darwin Hamblin, *Poison in the Well: Radioactive Waste in the Oceans at the Dawn of the Nuclear Age* (New Brunswick: Rutgers University Press, 2008), 193.

[8] Valerie Kuletz, *The Tainted Desert: Environmental and Social Ruin in the American West* (New York: Routledge, 1998), 82-83.

an inherent feature of these geologic features. The first approved site for studying how salt beds would react with nuclear waste was proposed for Lyons, Kansas in 1970. Lyons was a former mining town that had natural gas and oil deposits, as well as agricultural activity. But the residents of Lyon, initially receptive, became unhappy with the ways that AEC scientists treated the issue of storing nuclear waste in the area, even as the AEC attempted to reassure area residents that the nuclear waste storage site would provide jobs and more economic incentives. The economic benefits were not enough to convince local politicians and scientists, who discovered that the area was inherently unstable due to previous mining ventures.[10] Residents of Lyons were also suspicious of the AEC's final goals, that the temporary storage of waste for experimental purposes would actually become permanent. Seemingly simple questions, such as the longevity of the steel casks used to emplace waste and the length of time required to keep the casks isolated, preyed on the public's mind, and the AEC was evasive in addressing these issues.[11]

A nascent environmental movement also provided the impetus for the AEC to find a place to store nuclear wastes. Finding a place to have a pilot program became not only important for Carlsbad; it was also imperative for the federal government, as it allowed national leaders to say they were addressing one of the primary concerns of environmentalists. The buildup of nuclear waste around the country at research and commercial sites was a growing concern, twinned with the build-up of nuclear arsenals by the Soviet Union and the United States. In 1974, President Ford signed the Energy Reorganization Act, to recognize that the responsibilities of the AEC were becoming too varied and diverse for one agency to handle. The AEC was broken up into various agencies,

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[9] J. Samuel Walker, *The Road to Yucca Mountain: The Development of Radioactive Waste Policy in the United States* (Berkeley: University of California Press, 2009), 6.
[10] Chuck McCutcheon, *Nuclear Reactions,* 20-25.

including the Nuclear Regulatory Commission (NRC), who took over the supervision of commercial energy production, and the Department of Energy (DOE). Ultimately, the DOE gained sole oversight of the proposed pilot plant site, because it would hold only military-produced waste. The EPA would be the watchdog group to have oversight over the environmental regulations of WIPP.

Setting a trend that has continued to plague federal nuclear groups such as the AEC and the NRC,[12] nuclear waste became a political issue that raised uncomfortable questions about local trust in the federal government and the effects of nuclear waste on local environments-issues that could not be solved simply by utilizing technical engineering practices. The AEC no longer considered the salt beds of Lyons as a potential site for the permanent storage of nuclear waste. Ultimately, Lyons became a site mediated by local politicians and residents wary of the risks of radiation, federal imperatives that necessitated a storage site, and the scientists from the AEC who were in charge of defining those risks unequivocally. The promise of economic growth from hosting the site was not enough to quell the fears that local residents held, and Kansas state politicians became involved in protesting the site as well, forming an insurmountable obstacle for the AEC. While the AEC had learned several lessons from Project Plowshares in dealing with the public, it was untrained with dealing with the public in either a political or scientific way regarding the storage of nuclear waste. By 1972, the idea of sequestering nuclear waste in the salt beds of Lyons, Kansas, had dissipated under the pressure of local protests.

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[11] Chuck McCutcheon, *Nuclear Reactions,* 11.

[12] The AEC was divided in 1976 and the division that controlled the construction of nuclear power plants was subsumed by the Department of Energy, while licensing and oversight became part of a new branch of the federal government called the Nuclear Regulatory Commission (NRC), which still holds these responsibilities today.

From the Plains to the Desert: Nuclearism and WIPP

While controversy was erupting in Kansas, New Mexico state senator Joe Gant had read about the idea for a deep geologic nuclear waste site for Lyons and the ensuing controversy in a 1971 Albuquerque Journal article. He was aware of the fact that Carlsbad also had underground salt deposits nearby, along with Carlsbad's other unique underground assets. Another unique factor of Carlsbad's history made him believe that it would be an ideal place for a nuclear waste repository. Local politicians recognized that because the regional population already had experience with the AEC, this could be a way of attracting the attention of the federal government towards Carlsbad. Local politicians felt that because the Gnome experiment ten years prior had been "neither highly disruptive nor detrimental to the community's fortunes,"[13] nuclear projects did not bear any ill-will from the general populace. Senator Gant, who was also a local potash chemist, decided to write to the AEC, to alert them to Carlsbad's potential suitability as a site for the AEC's waste project.

After contacting the Atomic Energy Commission (AEC), Gant spoke with local officials in Carlsbad, but also enlisted the support of state governor Bruce King. After consulting among Department of Energy (DOE) officials and state politicians for nine months, the DOE set up a news conference to announce the plan to their public in 1972 to site a nuclear waste pilot plant in the salt beds near Carlsbad. Intriguingly, safety was not the focus of the conference. Rather, the DOE stressed that the facility would bring in more jobs, give the city a permanent economic foundation, and provide a secure economic future for residents of Carlsbad and an incentive for educated families to stay in the region. During this period, residents of Carlsbad felt that the word of the federal government could be trusted, that there was no reason that waste could not be safely stored underground. Even as the rest of

the country resisted the construction of new nuclear power plants, bombs, and waste repositories, for Carlsbad, the situation was reversed. The experience of Gnome actually lent credence to government claims that this would be a project undertaken under the best faith, since no radioactive issues had resulted from the Gnome detonation.[14] The local newspaper, the *Carlsbad Current-Argus*, echoed these sentiments, and local support seemed assured.

Nationalism and Nuclearism

Besides geologic suitability and a receptive political base, other factors also played into the idea of using Carlsbad as a site for WIPP. As discussed in the previous chapter, the ideal of nuclearism had already been introduced to the region of Carlsbad. In the early 1970's, with the country deeply entrenched in the Cold War, nuclearism became an even more important rationale for increasing the production and testing of nuclear weapons and technology. Nuclearism, the ideal that nuclear technologies could ensure prosperity and security for the nation, justified the production of more weapons and nuclear facilities. This predictably led to the production of more radioactive waste, with still no permanent solution thirty years after the advent of national nuclear programs. As more time passed and political pressure from environmental groups grew, the importance of finding a geologic repository for waste increased, and WIPP became a partial solution for specific kinds of waste. The goals of the Gnome shot and WIPP are similar in that they both utilized the salt beds of Carlsbad to push forward the production of national nuclear projects, even as their specific goals were vastly different. While Gnome was designed with the hopes of producing steam for electricity production, WIPP was designed with the ideal of permanently storing nuclear waste and containing any radioactive threat.

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[13] McCutcheon, *Nuclear Reactions,* 25.

For residents of Carlsbad, WIPP was seen as an extension of the Gnome project, with similarities in terms of how the project was viewed locally. WIPP would guarantee federal money for the area and introduce new revenue streams as well as a more dependable resource to replace the boom and bust cycles of potash mining and oil drilling. On a federal level, Gnome was seen by the AEC as a way of making nuclear projects more palatable and attractive to the American public by demonstrating how nuclear technologies could be fashioned into socially and economically beneficial tools for American society, instead of just tools for destruction. WIPP followed in this same vein, as it makes the permanent storage of nuclear waste a possibility, thus allowing the promise of nuclear energy to progress unfettered by the legacy of waste products.

Before WIPP was licensed, residents of Carlsbad felt that the goal of WIPP was part of a patriotic duty that the town could carry out for the country. In 1979, one businessman noted that "New Mexico may have another resource needed by the nation" in addition to uranium that was then being used for nuclear power generation.[15] In this case, he was referring to the naturally occurring salt beds that were being proposed as a repository site for nuclear waste. This vision of WIPP, as a facility that could help not only the region but the nation, was an extension of the same dreams that fostered the acceptance of the Gnome shot in 1961. Twenty years later, on the eve of WIPP's first certification by the EPA in 1998, similar ideas were still in play. Another "life-long resident" stated that," We as a community know what it means to serve our nation. Here again, Carlsbad has stepped up to

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[14] McCutcheon, *Nuclear Reactions,* 35.

[15] John H. Dehndal, "Testimony presented to the subcommittee on oversight and investigation of the house committee on interior and insular affairs." Albuquerque, NM, August 10, 1979.

bat to help the nation. WIPP is a national solution to a national problem."[16] Vicky Black, the business manager for Sandia National Laboratories for the WIPP project, noted that dealing with nuclear waste is a federal obligation, and "as a dominant world power, our leaders made the decision to stockpile nuclear weapons as a deterrent to nuclear war. There is a byproduct to this decision that must be dealt with. WIPP is part of that solution."[17] Not only patriotism, but also a sense of environmental stewardship for the rest of the nation, infused a sense of responsibility in Carlsbad regarding WIPP. Residents recognized that the WIPP mission was part of addressing a national solution for waste, and Carlsbad residents were happy to see themselves as able to step up and provide that solution.

Today, for leaders in the business and political community of Carlsbad, it is hard to understand any resistance to WIPP. They see the benefit of storing nuclear waste in one consolidated location, in order to reduce the contamination of other areas, and also tout the safe track record of WIPP after fourteen years in operation. Comments like Black's were echoed during public meetings held recently from 2008 to 2012 that raised the idea of introducing even more nuclear projects to the region, based on WIPP's success thus far, including advanced fuel reactors that would use recycled waste and for finding a site for spent nuclear fuel from power plants. Local politicians, who double as business owners in the town, spoke glowingly of the WIPP project. Current mayor Dale Janway expressed his support for WIPP, as well as other nuclear projects, by making it not only a state-wide concern, but a national one as well. He noted that, "The need to clean up the nation, and

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[16] Environmental Protection Agency. *Public Comment on Certification of Waste Isolation Pilot Plant*," Carlsbad, NM, January 6, 1998, (Statement by Jeff Neal), http://www.epa.gov/rpdweb00/docs/wipp/epajan6.pdf. Accessed June 5, 2010.

[17] Environmental Protection Agency. *Public Comment on Certification of Waste Isolation Pilot Plant*," Carlsbad, NM, January 6, 1998, (Statement by Vicky Black), http://www.epa.gov/rpdweb00/docs/wipp/epajan6.pdf. Accessed June 5, 2010.

the need to develop clean, renewable, and abundant sources of energy is understood by many in the state of New Mexico."[18]

In noting its progressive nature, former mayor Bob Forrest commented that "People see the good jobs, they see how safe it is, they see how we can do things. We can put a man on the moon, we can take care of high-level waste."[19] Forrest's comment puts WIPP in line with other technologically progressive moments in American history, such as the moon landing. WIPP is therefore situated as a scientifically engineered solution to the political controversies over radioactive waste, not as another problem to be solved. Former New Mexico State Representative John Heaton was equally effusive in his support. He described WIPP as "a national treasure" and he supported the introduction of more opportunities to close the nuclear fuel cycle to be sited in Carlsbad. Harkening back to the goals of the Atoms for Peace program that drove the Gnome project, Heaton noted that, "[I]t is always somewhat confusing and hypocritical from the U.S. perspective, in that it is only our foreign partners that play a role while we sit idly by because we have no real reprocessing capability in the country and no viable high-level waste repository."[20] Heaton's point is an endorsement of the nuclearist aims of projects like Gnome and WIPP, where the reputation of America as the most technologically advanced country in the world is at stake. Firmly ensconced in nuclearist ideals, the rhetoric of preserving and advancing the idea of progress linked with solving nuclear waste issues continues as a rationale for WIPP, and other projects that would lead to more waste and nuclear facilities in the region.

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[18] Blue Ribbon Commission, *Full Commission Open Meeting,* Albuquerque, NM, January 28, 2011 (Statement of Dale Janway).
[19] Department of Energy, *Global Nuclear Energy Partnership Public Hearing and Invitation to Comment,* Carlsbad NM, November 18, 2008 (Statement of Bob Forrest).
[20] Department of Energy, *Global Nuclear Energy Partnership Public Hearing and Invitation to Comment,* Carlsbad NM, November 18, 2008 (Statement of John Heaton).

Social Economics: Fighting Boom and Bust in Carlsbad

Following the pattern of nuclearism established by the Gnome shot, another compelling reason by local politicians for offering up Carlsbad as a potential site was the economic benefit of being associated with a federally funded nuclear project. Southeastern New Mexico in general, and Carlsbad in particular, have consistently sought alternative industries to the boom and bust extraction industries that defined local economies. For local residents, such as local historian and archivist Donna Birchell, looking at the history of industry in Carlsbad demonstrates a singular focus on extractive industries dependent on market forces outside of Carlsbad. She pointed out that WIPP "helped our economy, because potash mining was down and there were lots of strikes. It's a little frightening, if you have nothing else to fall back on than tourism, and that's not much during the year." The stability that WIPP seems to offer is a huge draw for the community, especially because it reintroduced themes that were familiar from Gnome. The promise of becoming a new American "science city," such as Los Alamos, was a powerful lure with the Gnome shot, and the idea of increasing federal funding for nuclear projects made WIPP, as well as other nuclear projects, attractive to a region tethered to boom-and-bust economic cycles.

Another economic avenue that has increased WIPP's acceptance in the region lies in the ways that WIPP took advantage of local economies and skills to create mines in the salt for nuclear waste storage. WIPP has used the potash mining community to dig the mines at WIPP, making the salt beds a quotidian exercise that falls fully in line with local economic activities based on extractive and subterranean industries. At public meetings in Carlsbad and Albuquerque, the economic activity of the region was also held up as a main reason for using the salt beds. Mining for potash and drilling for natural gas and oil are also part of the history of the region, and proponents of WIPP and other geologic repositories in the region

posited that because of the region's experience with subterranean geologies, it was an ideal place for nuclear waste storage because of this local expertise regarding mining. Local economies are therefore part of a continuum by local residents that see Carlsbad as integral to a national project, but also uniquely suited because of those economies to support the particular needs of this national project.

This stance is evident in comments made by employees of the local potash industry at recent public meetings held by the Blue Ribbon Commission for America's Nuclear Future. In a meeting held in Albuquerque on January 28, 2011, potash miners emerged as a positive local group for WIPP. Once reluctant to support WIPP in the 1960's, they have emerged as a wholly supportive group of WIPP as a project that not only uses local expertise, but also has learned how to mine safely and carefully. Steve McCutcheon, who works for a potash mining company in Carlsbad representing "five generations of Carlsbad residents," expressed his faith in WIPP by noting that "WIPP inherited Carlsbad's safety culture, which came from the potash industry." He also linked WIPP and the potash industry together, describing success for WIPP as "fostered since 1931 by underground miners" and that "all this was cross-pollinated when WIPP opened up because of the individuals that they hired to mine and work in the underground at WIPP came from the potash industry."[21] Another potash employee, Rudy Dominguez, noted that, "[A]t our mine in Southeastern New Mexico, the cooperation, benchmarking activities, and the sharing of information that takes place with WIPP, and other mines in the area, are just some of the reasons why our safety record today is one of the best in the business."[22] With an emphasis on safety and knowledge of what goes on underground, these supporters of WIPP see local

[21] Blue Ribbon Commission, *Full Commission Open Meeting,* Albuquerque, NM, January 28, 2011 (Statement of Steve McCutcheon).

expertise as a way of asserting a claim on the desert future, as a means of supporting a nationally progressive project to increase nuclear power by providing a solution for waste. The area around Carlsbad, once known only for its extractive resources, is now transformed into an area that is productive of a nuclear future, thanks to local knowledge of the underground. For local supporters, this specific expertise and knowledge of the landscape lends credence to the idea that WIPP is a wholly contained, local project bounded by the salt beds, and with Carlsbad as the main town responsible for WIPP's success and whose expertise is inherent to the success of the project.

However, the obvious pull of jobs and work should not overshadow a more complex viewpoint held by some members of the community regarding economic benefits. Long-time residents have also commented on the boom-and-bust nature of extractive industries on the area, leading to a more transient population. For them, WIPP offers not only economic benefits, but a new population demographic that promises not only construction jobs, but also more permanent, stable employment, leading to a more invested community with less chronic poverty. Tom Duffin, a WIPP security expert, and his wife, Barb Duffin, a middle school counselor, note that one of the social benefits of WIPP is that it has "brought a lot of educated people to town, and their spouses look for jobs too- lots of teachers and at the hospital who's spouses work for WIPP." They also noted that WIPP has changed local expectations of education. Tom commented that, "People worked at WIPP, their children went to college, went into engineering and other fields, and are interning at WIPP, getting summer jobs, getting exposure to science. That just wasn't here before WIPP."[23] The idea of a changing community, one that is not dependent on the transitory nature of the

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[22] Blue Ribbon Commission, *Full Commission Open Meeting,* Albuquerque, NM, January 28, 2011 (Statement of Rudy Dominguez).

[23] Tom Duffin and Barb Duffin. Interview with author. Personal Interview. Carlsbad, NM, April 8, 2010.

extraction industries, or on retirees un-invested in local schools, is immensely attractive, and a relatively unrecognized aspect of WIPP's emergence. But it is an important step for envisioning a successful future for Carlsbad.

In return, WIPP is perceived as a facility that defines the community of Carlsbad in positive ways. Federal funding has created new roads, new construction of offices and departments for other federal organizations, and supported infrastructure needs. In 1979, WIPP was estimated to cost $373 million and provide 2000 jobs during construction and 400 permanent jobs.[24] By 2012, WIPP has actually cost $6 billion, creates 1300 permanent jobs, and has a yearly budget of $215 million.[25] It is an expensive facility, but one that has led to the economic revival of Carlsbad and a hope for the DOE that they may have found a solution for military-produced waste. Ironically, because of the eternal nature of the substances in WIPP, local residents feel that it is a safe bet to continue bringing funds into the region.

WIPP could therefore be seen as a natural progression of an incomplete nuclear project that had begun with Gnome, and as another opportunity to ensure federal funding for a long-term project that would demonstrate Carlsbad's potential to be an economic center for scientific research and technological innovation, like Los Alamos or Sandia National Labs. Pride of place, patriotism, and economic incentives all play a role in WIPP's acceptance in the community, but the intangibles of creating a stable and educated community is a feature of WIPP that locals believe sets it apart from other industries like resource extraction or agriculture, and a different demographic shift that makes Carlsbad unique in the region.

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[24] Wil Lepowski, "New Mexicans Debate Nuclear Waste Disposal," *Chemical &Engineering News*, January 1979, 21.

[25] Chris Helman, "Nuke Us! The Town That Wants America's Worst Nuclear Waste," *Forbes Magazine*, January 25, 2012, http://www.forbes.com/sites/christopherhelman/2012/01/25/nuke-us-meet-the-town-that-wants-americas-worst-nuclear-waste/. Accessed November 12, 2012.

WIPP's continued acceptance by the community of Carlsbad, as well as offering to host new federal nuclear projects in the future, are therefore rooted in the ways that nationalism and economics are perceived on a local level.

Waste as a Technological Artifact

Beyond the nationalistic and economic draws of WIPP, another major reason that WIPP has been accepted by the community can be explained through the ways that the DOE shaped radioactive waste into a technological artifact. Material objects including the waste itself as well as the casks, trucks, roads, education projects, and the salt medium, can all be considered "technologies of government." Nikolas Rose refers to these as "technologies imbued with aspirations for the shaping of conduct in the hope of producing certain desired effects and averting certain undesired events."[26] For the DOE and its private contractors, these physical objects give materiality to the radioactive waste brought to WIPP. This materiality is meant to quell the fears of the public, by demonstrating complete control through redundant technologies. Education also plays a role in negating the risk of radiation from WIPP by making experts of the local population. Technologies of governance condition the local population to assume that the risks have been calculated in favor or predictability and safety by the federal government.

The application of technologies of government underscore the goals of DOE regarding WIPP, which is not just to ensure WIPP's safety, but to convince the public that it is safe enough to be controlled through the judicious application of technology and engineering. For the DOE, the "undesired events" are not just the containment of radioactive substances, but also any protestations against WIPP that draw into question the inherent "double

[26] Nikolas Rose, *Powers of Freedom: Reframing Political Thought* (Cambridge: Cambridge University Press, 2006), 52.

paradox of un/calculability and un/decidability"[27] of the ways that radiation moves unexpectedly through the environment. It is not just a project to contain waste, but also to contain fear, even as the long terms risks remain incalculable because of imperfect knowledge about nature and radiation. WIPP is a decision that is unable to address the "inevitability of other unintended consequences we do not and cannot yet know,"[28] and because of this inability, the DOE has emphasized how the salt beds of WIPP offer complete control over radiation by containing it for the foreseeable future..

From the Intangible to the Material

The acceptance of WIPP locally is enhanced by the ways that DOE and EPA scientists have characterized nuclear waste in WIPP. The DOE has stated that, "The WIPP mission includes the safe disposal of two types of defense-related TRU waste, contact-handled (CH) and remote-handled (RH). Both consist of tools, rags, protective clothing, sludges, soil and other materials contaminated with radioactive elements that have atomic numbers greater than uranium."[29] This definition is meant to clarify both the mission of WIPP and the type of waste that WIPP holds. Instead of amorphous, odorless, colorless radioactive isotopes floating around on alpha waves, waste is now given the solid form of rags and tools (as well the slightly amorphous label of sludge), things that are easily visualized by the public. Giving further material shape to the waste, a sample canister stands in the parking lot at the WIPP offices in Carlsbad proper, filled with sample items, such as clothes, tools, and even furniture. It is lit from the inside, and offers a cross-section view of the items jumbled inside, so that the casual visitor can see the seemingly innocuous items that fill WIPP.

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[27] Alan Scott, "Risk Society or Angst Society? Two Views of Risk, Consciousness, and Community" in *The Risk Soecity and Beyond" Critical Issues for Social Theory,* edited by Barbara Adam, et al (London: Sage Publications, 2000), 13.

[28] Alan Scott, "Risk Society," 13.

In order to convince the public that waste is only a technological artifact, the DOE used several methods to reduce the risks associated with radioactive waste in the minds of local residents. Learning from their experience with the residents of Lyons, DOE officials, WIPP scientists, and local politicians have assiduously paid attention to local public sentiment, and have attempted to make WIPP and nuclear waste as accessible as possible. One of the major campaigns that WIPP has run it to fully educate the public, and offer ways to make radioactive waste less intimidating and to give it a physicality that is relatable. The DOE and its corporate partner, Westinghouse, employed numerous methods. For instance, one can visit the WIPP regional office in Carlsbad and take a "virtual tour" of the site through a series of storyboards that illustrate what the site looks like and how it operates. At the conclusion of the tour, a short video is shown that takes the viewer down "into" the salt caverns, where enormous vaults have been carved out of the salt. In the middle of the table, the visitor (who has just seen the caverns on screen) is offered an actual sample of the salt in the WIPP site, in a plastic Ziploc bag. Written reassuringly on the bag are simple and direct facts: "Permian Age Rock Salt. 250 million year old from the 2,150 ft. underground disposal level, Waste Isolation Pilot Plant (WIPP) East of Carlsbad New Mexico." This simple description of the site and the salt medium reassures the visitor that these ancient salt beds have been around for a while, and implies that they will be around for many more.

The virtual tour and salt samples are a method of making the materiality of the caverns physically real to anyone curious enough to visit the office. It's as close as the average tourist can get to going inside the WIPP site at this time, although the DOE and Westinghouse used to also offer "community tour" days for interested members of the

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[29] Department of Energy, *DOE Issues Statement Concerning Debate Over Waste Disposal in Salt* (Washington, DC: GPO, 2009).

community ("All you need is transportation and a sturdy pair of shoes!"). The idea behind the salt sample is that if people can't be admitted to WIPP, then parts of WIPP can be brought to the public so they can see the material itself. The salt is now a physical medium instead of a theoretical or unimaginable product. The salt can be carved like rock, but it will seal itself around any object introduced into the medium. By giving the public an idea of what the medium is, WIPP is physically articulated as natural barrier to the threat of radiation.

Micheal Gerrard has noted that "compensation has never been used successfully in siting a [hazardous waste/radioactive waste] disposal facility…The reason is clear: the opposition to these facilities stems mainly from concern over their impact on health."[30] Gerrard's points apply to the situation of WIPP. Going beyond nationalism and economics, the DOE has found other ways to reassure local residents as the integrity of WIPP. Despite the idea that radioactive waste is massively unpopular around the rest of the country, the residents of Carlsbad feel that they have been educated and informed about this particular type of waste, and that they understand the risks accompanying it. This is partially due to programs like the "Lie Down and Be Counted!" campaign. Operated out of the Carlsbad Environmental Monitoring and Research Center (CEMRC), which is run out of the Engineering Department of New Mexico State University and partnered with Los Alamos National Laboratories (LANL), Sandia National Laboratories (SNL) and Washington TRU Solutions, this public service allows anyone from a 100-mile radius of WIPP to come into the CEMRC offices, and lie down on a medical table in order to have one's "internally deposited

[30] Michael B.Gerrard, *Whose Backyard, Whose Risk?: Fear and Fairness in Toxic and Nuclear Waste Siting* (Boston: MIT Press, 1996), 126.

radionucleides" tested.[31] The program began in 1993, and volunteers are tested every two years. Dr. Conca, the director of the CEMRC, notes that it is a unique public service that demonstrates the transparency of radiation concerns around WIPP. "People monitor workers, right? And we do too, but no one does the public, but we've been doing this since 1993."[32] He also noted regretfully that the main problem that they've had with the program is getting people to come back regularly: "People come in once, they find out their not hot, and they get bored."[33] The CERMC hosts the only whole-body counter in the world, according to Dr. Conca, but it has not detected any readings above background level. He feels that the "Lie Down and Be Counted!" program serves to demonstrate not only the transparency of WIPP's radiation counting, but also to educate the public about background radiation levels, as well as to quell fear about running "hot" (being irradiated). Radiation, instead of being something that is feared, is remade through education into something mundane, identifiable through technology, and not present beyond background levels. These types of campaigns have had the effect of rendering the radioactive risks from WIPP harmless.

These efforts at education have led to the overwhelming support of WIPP in Carlsbad, where the population feels that they have adequately educated, and they trust the track record established thus far with WIPP. In 1998, city councilman Chuck Wiggins offered a familiar refrain in support of WIPP. "Those of us who have taken the time over the past few years to educate ourselves about WIPP believe that it's safe and the only viable alternative to the continued stockpiling of transuranic waste around the country. Our best scientific minds

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[31] Carlsbad Environmental Monitoring and Research Center, *About Us,* http://www.cemrc.org/. (Accessed July 12, 2012.

[32] Dr. Jim Conca. Interview with author. Personal Interview. Carlsbad, NM, April 14, 2010.

[33] Dr. Jim Conca. Interview with author. Personal Interview. Carlsbad, NM, April 14, 2010.

have said so."[34] This attitude had not changed in the successive ten years, when, in 2009 at another BRC public meeting, Chamber of Commerce member Roxanne Lara stated simply that, "We know the risks. We understand the risks. We are very pleased that WIPP is in Carlsbad."[35] Risks are managed through understanding and educating the public that risks to the environment and public health are minimal, contained in the materiality of the waste itself, in familiar objects, in the salt of the Permian Basin, and through technologies that monitor human health and exposure. The end result is that nuclear waste is made unthreatening and understandable.

Isolating Imagery: Binding Nuclear Waste in Place

One final method exemplifies this approach to creating consent on a local level by making WIPP less threatening. The main idea behind WIPP is simple: geologic isolation is the key to minimizing risks from nuclear waste. For the DOE, WIPP will have ensured that these risks are bound geologically, in the salt of WIPP, but also conceptually, through imagery that shows the isolation and boundedness of nuclear waste. This ideal can be seen in the ways that WIPP is depicted on DOE websites:

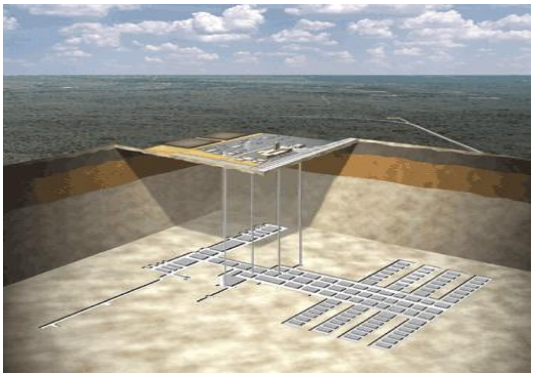

Figure 2: Computer model of WIPP site underground. (DOE)

[34] Environmental Protection Agency. *Public Comment on Certification of Waste Isolation Pilot Plant*, January 6, 1998, Carlsbad, NM, (Statement by Chuck Wiggins), http://www.epa.gov/rpdweb00/docs/wipp/epajan6.pdf. Accessed June 5, 2010.

[35] Blue Ribbon Commission, *Full Commission Open Meeting,,* November 18, 2011, Washington, DC (Statement by Roxanne Lara).

This is an artist's rendition of the WIPP site, located 2000 feet below ground. It is depicted as a neat and exact series of tunnels and elevators taking waste canisters 2000 feet underground. WIPP is made to seem entirely manageable with a completely controlled and engineered environment. The entire 2000 feet between the surface and the waste site, including geologic formations and aquifers, are absent, and the entire site is laid bare, transparent and completely visible. There is no topography, the desert is green and evenly covered with vegetation; there are no people, no intrusions, and nothing to interrupt the neatly laid out rows of rooms that will contain drums of nuclear waste. Fluffy clouds amidst a blue sky give the impression of timelessness, and the site is presented as bucolic, completely controlled area, with no outside nature or human populations to impede the project of sealing nuclear waste into the salt beds.

Figure 3: Waste containers in WIPP (DOE)

Meanwhile, inside WIPP, the drums are stacked three high with a ventilating unit on top to keep the hot waste from overheating and melting the salt before the chamber is sealed. The chamber itself is neatly cut out from the salt cavern, and the racks are neatly ordered, displaying contact handled waste that can be touched by humans. These ordered spaces

demonstrate how controlled the environment of WIPP is. In this image and the one above, nuclear waste is reduced to a technical problem, one that can be solved using a natural medium, ingenious engineering, and sound science. These images also underscore the quotidian nature of the caverns and the waste, similar to chemical waste drums, and with familiar scales to humans, even as the vast desert. These Cold War artifacts are bound by relatively simple and straightforward technologies, in time and space by mines and casks, and by the isolation of the desert itself.

Minimizing risks from radiation by isolating waste has to occur not only on a physical level, in the medium of the salt beds, but on a psychological level as well, in the minds of the local public. By extension, if WIPP can be deemed a success, the DOE can argue that it has found a solution for radioactive waste, and America will no longer have to worry about risks of contamination from radiation leaks at Cold War facilities around the U.S. The forty year history of WIPP in Carlsbad has made the facility part of the background of the community, and made not only waste mundane, but the facility itself part of the town. It is a mundane project, and the risks are known by an educated public. For community members of Carlsbad, radiation is nothing to fear, but rather something to embrace as part of a national effort to support national nuclear projects, to create stable local economies, and as a concrete and knowable entity. The point of WIPP is to demonstrate that these technological artifacts of the Cold War are being dealt with in a reassuring and understandable manner.

Resistance from Nuclear Communities

For residents and political leaders of Carlsbad, the WIPP project currently enjoys widespread acceptance, since it is viewed as a well-managed and low-risk project. But it also still faces opposition from those who feel that nuclear waste cannot be so easily bound. This attitude was evident at the 2009 WIPP Recertification Meeting held on June 30th, 2009 in

Albuquerque. The meeting began peacefully enough, as many public meetings regarding nuclear matters in New Mexico do. A panel of DOE and EPA representatives spoke about the success of WIPP's first 10 years, and were confident and optimistic about the next five. A series of dry powerpoints outlining the scientific assessments of the hydrogeology of WIPP, the waste containers, and performance of the site were addressed, as audience member shot increasingly contentious questions at the presenters.

These contentious comments came to a head before the meeting took a break, as a group of women chimed in to critique the WIPP project: "As grandmothers, we are concerned…And some of us are quite angry that some of this stuff actually exists and we want it not to exist, but what does exist we want to make sure it's safe, and we want stop all production of the all nuclear materials." At this point, the Raging Grannies had moved to a place at the front of the room. The five elderly women, one strumming along on her acoustic guitar, broke into song: "We are a group of grannies/ Urging you off of your fannies/ We're raising our voice/ We want a choice/ No More Nukes!"
They then began a chorus of "Walking in a Winter Wonderland," but with slightly altered lyrics. "Sirens scream, hair is bristling/ Children moan, pavement glistening/ We've finally paid/ for the hell that we've made/ Living in a nuclear wasteland. Cancer cells in mutation/ Growing wild from radiation/ No level is safe- a fact we must face/ Living in a nuclear wasteland."[36] The Raging Grannies, who are part of a national anti-nuclear and social justice group, were ignored by the meeting organizers, who take no note of the song or the performance. Yet the presence the Raging Grannies and their performance indicate a level

[36] WIPP Recertification Meeting 2009. Marriott Pyramid North Hotel, 6/30/09. The remaining stanzas are "In the rubble we can build a shelter/ And pretend that we live underground/ Dreaming of the days when we were healthier/ When earth had life and beauty all around. Later on, we'll expire/ As we're filled with the fire/ Still singing our song, "We all got it wrong"/ Dying in a nuclear wasteland." (Title: Living in a Nuclear Wasteland, Lyrics from BAAM Songbook, revised by Marcy Matasick).

of mistrust that is still attached to nuclear projects in the U.S., not only in relation to WIPP, but in attempts to resuscitate the nuclear industry by introducing new nuclear facilities and more waste dumps to New Mexico.

Part of the attitude expressed so eloquently by the Raging Grannies is due to the legacy of nuclear projects from the 1970's to the present. The period of time from the Gnome shot (1961) to WIPP's opening (1998) spans an era where nuclear projects fell out of favor with the American public. WIPP is of a different generation than the more trusting early Cold War era of Gnome. It is a post- nuclear catastrophe facility, and as such, continues to raise specters of risk, accountability, environmental justice, and public access to knowledge. Resistance to nuclear technologies, from bombs to power plants, increased during the 1970's when a possible radiation leak and meltdown at Three Mile Island, in Pennsylvania in 1979,[37] and the complete core meltdown of the Chernobyl nuclear plant in the Ukraine in 1986,[38] turned nuclear fears into a reality. One of the most egregious situations is the Hanford Nuclear reservation in Washington, where plutonium was produced throughout the Cold War. Radioactive elements were released into the air and water from the Hanford facility without the knowledge of local residents.[39] The tanks at Hanford, holding some 55 million gallons of waste, have leaked into surrounding soil, and over 100 million gallons of waste stored on site in ditches when the tanks were filled soon after WWII. Hanford presents several an instructive incidents which mock the connections between science and a definitive knowledge of nature, as "[a]ll the failed assumptions about retaining soils, sealed tanks, and

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[37] J. Samuel Walker, *Three Mile Island: A Nuclear Crisis in Historical Perspective* (Berkeley: University of California Press, 2004), 1-28, 205-208.

[38] Andrew Blowers and David Pepper, "The Nuclear State- From Consensus to Conflict," in *Nuclear Power in Crisis: Politics and Planning for the Nuclear State*, eds. Andrew Blowers and David Pepper (New York: Nichols Publishing Company, 1987), 17-22.

unsaturated zone barriers had contributed to the untested conclusion that Hanford's hazardous wastes could not reach groundwater in less than 10,000 years…[yet] tritium showed up in groundwater beneath Hanford…as early as the 1940's."[40] Federal scientists at Hanford grossly underestimated not only the volume of waste that was produced by plutonium production, but also how radiation would slip the boundaries of human-made constructs and move through the environment and into the human body.

The health effects of Hanford are still being analyzed, and thus far, political accountability is absent, creating a further level of mistrust in federal sciences to ever be held accountable for these emissions, and subsequent health and environmental exposures to radiation. After these incidents, health and environmental risks from nuclear technologies were no longer theoretical or incidental to the practice of nuclearism itself. Instead, the risks were real, material, and had serious consequences that have affected the future of nuclear technologies in the U.S. It is because of the materiality of the hazards of nuclear accidents that questions over nuclear waste rose to prominence by anti-nuclear activists. These incidents adversely affected the ways that nuclear projects were seen, and the pursuit of nuclearist ideals fell out of favor, as nuclear projects were subsequently viewed as too militaristic, economically too expensive, and the DOE and Nuclear Regulatory Commission (NRC) as too corrupt and vested in the privatization of nuclear energy and weapons to be trusted by the public. Public discourse on WIPP and its purpose, construction, and future are drawn into these debates as evidence for different views on the nuclear future of America.

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[39] Edward Liebow, "Hanford, Tribal Risks, and Public Health in an Era of Forced Federalism," in *Half-Lives and Half Truths: Confronting the Radioactive Legacies of the Cold War*, ed. Barbara Rose Johnston (Santa Fe: School for Advanced Research Press, 2007), 147.

[40]Howard G. Wilshire, Jane E. Nielson, and Richard W. Hazlett, *The American West at Risk: Science, Myths, and Politics of Land Abuse and Recovery* (London: Oxford University Press, 2008), 194.

The Cold War came to an end in 1988, with the collapse of the Soviet Union seeming to grant victory to America; the nuclear arsenals increasingly were seen as human folly, the madness of another generation. Nuclear projects were seen nationally with suspicion, and tellingly, the NRC did not license a new reactor from 1969- 2011. Public sentiment had turned against nuclear power, and concrete solutions from the federal government regarding the build-up of nuclear waste produced during the Cold War seemed distant. But the emergence of new federal nuclear programs in the latter half of the 2000's, built on the same nuclearist principles evident in the Atoms For Peace program, are raising the specter of a new era of nuclear technologies in the U.S. While these projects are built on nuclearist principles, with promised funding for local economies, the end result has been contaminated lands and compromised public health in return for many communities across New Mexico and across the country. Anti-nuclear groups see WIPP as central to these problems, and they argue that WIPP is being used to bracket the production of nuclear waste as problem solved by engineering and isolation, one that can be put underground and then forgotten about.

WIPP initially raised suspicions locally and statewide because of a longer historical development in American culture that typified the vast expanses of the American West as barren, unproductive, and therefore sacrificial regions of the U.S. From the Trinity explosion in the Jornada del Muerto in central New Mexico, to the Nevada test site, home of hundreds of nuclear bomb tests, to the nuclear production sites of Rocky Flats and Hanford, the American West has been host to several components of the practices that typified the nuclear projects during the Cold War, which encompassed diverse sections of the population and the geography of the nation in producing nuclear weapons. Uranium mining in the Four Corners area and the Navajo Nation remains evident in the uranium mill tailings pilings

scattered around the desert and born on the winds, and even seemingly isolated events like the Church Rock Mine Spill in 1979 on the Navajo remains the worst radiological release in American history, one that has yet to be acknowledged for its severity, or in the extent of its contamination.

WIPP protestors from various groups such as Concerned Citizens for nuclear Safety (CCNS), The Southwest Information and Research Center (SRIC), and Citizens Against Radioactive Dumping (CARD,) see WIPP as part of these previous projects and failures to contain radioactive contamination. Along with Hanford, Rocky Flats, and the Navajo Nation, WIPP emerges in the arguments against nuclear technologies as another way to envelope the region into what Joseph Masco calls "radioactive nation building," where "[t]he unprecedented national resources devoted to the bomb, its infrastructural role in everyday life, and the cross-section of American society working within the nuclear complex…"[41] which had severe negative results for many Cold War facilities and their neighboring towns. As Joseph Masco describes it: "Nation-building projects that pursue the public good through means that are simultaneously corrosive of the social contract are, in a sense, always 'radioactive,' because they contaminate the public sphere, invading bodies and disrupting cosmologies in way that promise to mutate over time."[42] The social and environmental price of the Cold War nuclear complex has made American's distrustful of "the state's ability to define security in a meaningful way" and therefore threatens any "collective, future-oriented national cultures it engenders."[43] The environmental and psychological cost of winning the Cold War was much higher than anyone had expected or predicted. Those opposing WIPP have seen and protested this pattern of degradation and disenfranchisement,

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[41] Joseph Masco, *The Nuclear Borderlands: The Manhattan Project in Post-Cold War New Mexico* (Chicago: University of Chicago Press, 2006), 25.
[42] Masco, *Nuclear Borderlands,* 25.

especially of impoverished or minority communities, who they see as unfairly targeted as sites for nuclearist projects.

During public meeting for the GNEP program in 2007 in Roswell and Los Alamos for nuclear facilities that would be potentially sited in southeastern New Mexico, commenters spoke about the far-reaching effects of nuclear reprocessing and contamination from radiation on far-flung communities and in New Mexico. Looking at the legacy of the nuclear project in America in a historical manner, they raised questions about the safety record of the DOE, and whether the potential formation of new nuclear communities was justified by the expedient entombment of nuclear waste. They were especially cognizant of how seemingly localized nuclear projects spread across geographies, time, and populations. For instance, Penelope McMullen described her experience working in New York with a Dr. Rosalie Bertell trying to understand the effects of low-level radiation on local populaces, especially nuclear power plant workers. After they published their initial results, funding was pulled for their research, leaving her with little trust in government funded science. She commented that, "Today's nuclear proponents claim that the industry is safe now, but given the continued incidence of security lapses, accidents and cover-ups and the still growing numbers of cancers among workers and in neighborhoods of nuclear plants, we do not trust that this is safe enough."[44] McMullen's story links together communities of nuclear laborers through exposure, but also raises questions about the effects of low-level radiation, a concept that is still unclear on many levels. If radiation does leech out of WIPP, new nuclear communities will emerge; a risk that antinuclear groups have seen played out amongst other federal and commercial nuclear facilities.

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[43] Masco, *Nuclear Borderlands,* 26.

[44] Department of Energy, *Global Nuclear Energy Partnership Programmatic Environmental Impact Statement. Public Hearing and Invitation to Comment*. Los Alamos, NM: November 20, 2008, (Statement by Penelope McMullen).

Historical patterns with nuclear waste facilities have left a damaging legacy on other communities, and Susan Gordon, of the Alliance for Nuclear Accountability which is headquartered in Santa Fe, used the example of the first commercial reprocessing facility in West Valley, New York, where 600,000 gallons of high level waste is currently being stored. West Valley started to reprocess nuclear waste in 1966, but after unacceptable levels of radiation emissions and worker safety issues, the site was closed in 1972. West Valley is currently the only attempt at a commercial reprocessing facility in the history of the U.S., and as such, has a problematic legacy. Gordon linked this legacy to other sites as well, including Hanford, Savannah River, and Idaho National Laboratory, where "millions of gallons of liquid waste sit in aging tanks, all of which have leaked, threatening water resources."[45] For Gordon, the risks inherent to reprocessing make it a project akin to WIPP, where the threat is known, it is material, but it has not and cannot be contained by simply moving radioactive substances around the country and putting nuclear waste in the ground.

Transporting Risk

Moving focus away from the discrete salt beds to the nuclear communities in New Mexico shows how risks from WIPP are characterized scientifically, and are based on the assumption that the only risks with nuclear waste are technical ones, solvable with the right application and approach to engineering and science. Risks are contained politically and geographically through the practice of science, in the sense that scientific expertise is the only accepted form of delineating nuclear risks. One of the main characterizations of risks today is that they are defined by science and engineering practices, which not only define specific risks, but the actions that are taken to contain those risks.[46] These fields are

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[45] Department of Energy, *Global Nuclear Energy Partnership Public Hearing and Invitation to Comment*, Los Alamos, NM, November 20, 2008 (Statement of Susan Gordon).

[46] Ulrich Beck, *Risk Society: Towards a New Modernity* (London: Sage Publications, 1988), 23.

insulated and divorced from larger cultural movements that created the impetus to produce nuclear materials in the past, and how we see them in the present. Instead, nuclear waste is reduced to a technological artifact, a product produced in the past for a specific reason that now simply has to be disposed of.

Ulrich Beck has noted that risks from radiation are unique because they "induce systematic and often irreversible harm, generally remain invisible, are based on causal interpretations, and thus initially only exist in terms of the (scientific or anti-scientific) knowledge about them."[47] According to Beck, these features of radiation, stemming from normalized practices such as bomb tests and experiments as well as accidents such as Chernobyl, have enmeshed the globe in a "world risk society," where each individual and community bears the burden of being exposed to radiation in some form. The emergence of a world risk society has created new communities that break across traditional lines of race, class, and gender. These groups resist nuclear technologies not only because of past environmental injustices done in the name of national security, but also because of the potential risks to future generations. They argue that the residents of Carlsbad cannot be the only citizens with a choice about taking on the risks from WIPP simply because they are the closest in proximity to the WIPP site. The threat from WIPP is simply too far-reaching in scope to be contained in Carlsbad; by their very nature, radioactive risks draw a larger web of environmental and geographic sites into the potential reach of disaster.

Instead, anti-WIPP groups are seeing the risks of WIPP through the lens of a risk society. For anti-WIPP groups, the safety record of WIPP transport trucks is beside the point. Instead, the risks of radioactive contamination are inherent and unknown, and by moving waste on federal highways, the risks of contaminating more people and greater

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[47] Ulrich Beck, *Risk Society,* 23.

swaths of land increase. Hancock has argued that, "We know that some of the trucks and trains coming to WIPP will have accidents- trucks and trains regularly have accidents. What we don't know is how many accidents, how serious they will be, and how many people- tens, thousands, millions- will be exposed to radiation from leaks."[48] For these groups, the alternative to WIPP is to keep waste exactly where it is, especially commercial waste that is stored on site at nuclear power plants in storage pool. He notes that his organization, the Southwest Research and Information Center (SRIC), which is based in Albuquerque, "has always been concerned about transportation, which is not unique to WIPP. That's why we generally favor keeping it a close as possible to where it was created, as opposed to moving it around. It is very likely at some point that there will be a serious accident with nuclear waste."[49] Joni Arends, director of Concerned Citizens for Nuclear Safety (CCNS) in Santa Fe, noted that the original WIPP route "from Los Alamos National Laboratory through downtown Santa Fe on St. Francis Drive past seven elementary schools and the hospital to I-25," thus creating exposure for extremely vulnerable groups.

This lack of recognizance by the federal government concerning the fact that accidents will happen, is troubling to these anti-nuclear groups. They see this as a continuation of the lack of care on the part of the federal government for its citizens, even as these projects are in the name of national security. Ursula Heise has noted that "Controversies in these areas are often deeply embedded in conflicts over cultural values and the question of who has the right to make decisions over how technologies are implemented."[50] For anti-WIPP groups, the main issue is the production of nuclear

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[48] Don Hancock, "Testimony before the subcommittee on oversight and investigation house committee on interior and insular affairs." Albuquerque, NM, August 10, 1979.
[49] Don Hancock. Interview with author. Personal Interview. Albuquerque, July 28, 2009.
[50] Ursula Heise, *Sense of Place and Sense of Planet: The Environmental Imagination of the Global* (Oxford: Oxford University Press, 2008), 132.

materials, and how that production has threatened the very populations they were meant to protect. There is no way to produce nuclear materials responsibly, and no way to responsibly implement them on the American public. Every solution that the DOE or NRC offers actually raises more questions and problems that can be solved in temporarily, but not in the time spans that the half-lives of radioactive isotopes require. Therefore, many anti-nuclear groups now urge for the government to consider "hardened on-site storage" (HOSS), as a temporary solution for nuclear waste. Rather than risk transportation or concentrating all the nuclear waste in America in one region, it seems less risky to leave it at sites that are already experienced with nuclear waste or at power plants that have already held the waste for fifty years, rather than rush into a solution that is irreversible.

Nuclear waste emerges in these arguments as irrevocably connected to the history of these products, and to the populations that it has affected. It is a deeply embedded cultural problem that has not easy solution, and the existence of nuclear waste, whether above ground or below, shows the fallacy of nuclearism. Nuclear weapons and energy cannot guarantee security and prosperity; they can only offer a shallow facsimile of temporary fixes to what anti-nuclear groups perceive of as a much more persistent and politically and culturally rooted problems that stem from a pattern of using nuclear technologies and producing nuclear waste in unsafe and irresponsible ways that detrimentally affect the health and environment of vulnerable communities. Its legacy never ends, even after complicated, costly, and long-lasting remediation projects. With the WIPP project, these groups argue that all communities are at risk, as the chances for catastrophic accidents increase with the number of shipments to WIPP, as well as a lack of transparency for the process, and accountability for stakeholders.

Conclusion

The history of nuclear waste management in the U.S. as marked initially by inattention and eventually by controversy. Proponents and opponents craft arguments for different strategies for discussing the proper ways of handling and disposing of waste, and in doing so, create competing discourses regarding the nature of waste. Scientific discourses, which describe waste in terms of a technological artifact or a cultural problem, reveal the ways that nuclear waste continues to be controversial, provoking passionate arguments and reactions from both sides. By reducing waste into a technological artifact, proponents of WIPP are able to consider it as a technical problem that can have a definitive solution, which is the major task set before the DOE. The residents of Carlsbad trust the DOE's decision, based on a complex matrix of a sense of patriotic duty, environmental responsibility, and economic incentive- all of which are grounded in hope that the presence of WIPP will provide a stable platform for social and community stability and prosperity.

For community leaders in Carlsbad, the position they are taking towards storing high-level waste is clear. Roxanne Lara, a local business owner and member of the Carlsbad Chamber of Commerce, has said, "The local government supports it, as does the community, and local businesses. I'm excited to say that, because I'm out there on a day to day basis, and I hear these comments from people. The reason that the community is so supportive is because of the impressive track record that WIPP has had in our community."[51] The community leaders in Carlsbad not only accept nuclear waste, but also desire more, because they believe and have seen how WIPP has cemented the national importance of the town, created new economies and social strata, and is based on the best science the DOE has to offer. The development of "Yes in my backyard," or YIMBY, best

describes Carlsbad's political community's attitude to storing commercial waste.[52] It is a technological artifact, not only of the Cold War but of the American economic juggernaut, which requires nuclear power to run. The DOE and Carlsbad residents believe they can handle the radioactive remains forever.

By complicating nuclear waste into a cultural problem, opponents of WIPP are focused on articulating the potential risks of storing waste in WIPP. These risks, which extend from the first creation of radioactive waste from military applications in the 1940's to hundreds of thousands of years into the future, are unacceptable, as they draw the entire nation and its future inhabitants into a web of potential radiation exposure. The argument that "this is the best solution right now" for storing waste rings hollow, because of the long half-lives of some radioactive isotopes. All solutions, in essence, are short-term solutions, that will always place the burden of safeguarding waste on future generations. The integrity of the casks storing the waste is questionable, as are the transport routes that potentially expose citizens to radioactivity without their knowledge. Another issue central to anti-WIPP arguments is that storing waste in WIPP does not address the ways and conditions under which nuclear waste is produced. As byproducts of the military-industrial complex, the waste stored at WIPP carries a legacy of health issues, environmental degradation, and unacceptable risks to the American public.

The stakes are high with these competing discourses. WIPP, after all, is a pilot plant, which has fulfilled its mission successfully for fourteen years. It has become a model facility for the DOE, one that is touted as a meaningful and responsible way to deal with a lingering problem that has haunted the military nuclear program, and remains the only successful

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[51] Department of Energy, *Draft Environmental Impact Statement on Greater Than Class C Waste Public* Hearing, Carlsbad, NM, April 26, 2011 (Statement by Roxanne Lara).
[52] Christopher Helman, "Nuke Us!" *Forbes Magazine*, February 13, 2012.

geologic nuclear waste repository in the country. In 2011, WIPP once again became the center of national focus, as well as controversy, as the beleaguered Yucca Mountain repository in Nevada was cancelled before it ever took a shipment of the high-level, commercially-produced waste that it was supposed to hold. With the closure of Yucca Mountain, Carlsbad mayor Bob Forrest immediately volunteered Carlsbad as the new repository location.

It is looking increasingly likely that Carlsbad will also become the host for other types of nuclear waste in the future, a view that is supported in some views by the "sound science" backing WIPP that has thus far been successful. But looking to open or introduce new waste programs in the region raises questions about whether science can offer any certainty over the various natures at play in WIPP, and whether nature is stable and predictable enough to support nuclear waste storage at WIPP. The following chapter looks more closely at the two concepts of science and nature, and attempts to interrogate how the two are linked to make science the arbiter by which nuclear projects are justified by national imperatives of progress, and make the salt beds of WIPP a natural solution to waste produced by nuclear energy programs. By examining how narratives over science and nature collide in public meetings regarding several different national nuclear projects that have emerged over the past five years, it becomes evident that the question of the nuclear future is very much tied to the present, even as the present implicates the far future when nuclear waste is involved.

Chapter 3: Contesting the Nature of Science and the Science of Nature

In April 2012, attendees of the Carlsbad National Nuclear Fuel Cycle Summit were given the opportunity to go "down hole" into the Waste Isolation Pilot Plant (WIPP), the only geologic repository in the world for nuclear waste. When we arrived at WIPP after a 30-minute bus ride, we walked through a parking lot filled with sample waste containers, including huge canisters that can pack up to 10 smaller canisters of contact-handled radioactive waste. Inside the facility, after receiving our badges, we headed into the contact-handled waste room, observing how the facility receives waste in drums transported across the country. As we watched, one larger canister was unloaded, its contents transferred to a staging area, and then packed onto trains that take the waste underground into the belly of WIPP.

We then entered the staging area for visitors above the central area of WIPP. We were outfitted with hard hats, protective eyewear, headlamps, emergency oxygen canisters, and a small gold coin with a number engraved on it. These coins are the only means of tracking visitors, and serve to make sure that all visitors are accounted for upon return- a low-tech means of keeping a head count. The mine itself is located 1800 feet below the surface of the earth, almost half a mile deep, and is accessible by a large elevator, with open metal latticework. We watched through the bars as the geologic strata changed from a rocky layer for the first 800 feet, and then to smoother salt for the next 1000 feet. The trip became noticeably quieter when we entered the geologic salt layer, as the creaking of the elevator was dulled by the smoky gray salt, sparkling in the dim glow of our headlamps- the only light in the elevator shaft. The WIPP site is encased in the middle of the salt layer, which extends

a total of 2000 feet. The elevator landed with a soft thud, and we step out into the salt mines of WIPP.

The mine itself was dimly lit by occasional fluorescent overhead which seem to emerge organically from the ceiling of the mine itself. WIPP is excavated in a ladder type formation, consisting of two long hallways which form the major transit avenues of the mine, with rungs connecting those hallways. As the rooms at the farthest parts of the hallways are filled, the rungs connecting them are also filled with drums of nuclear waste. The rooms are not excavated until they are needed because the salt in WIPP creeps so quickly, encasing the waste and collapsing the room. WIPP Communications Director Susan Scott calls this process "just in time" mining, and the creeping action of the salt has surpassed expectations in terms of the speed with which it encases the waste.

As we traveled in golf carts to the areas where waste is being currently stored, it is apparent that the walls of WIPP have to bear an immense load from the weight of the salt. The ceiling, which is about 20 feet high, seemed to sag where steel supports meet in the center, and we drove around miners who were putting in new supports. Single rooms branched out to our left, containing equipment, sensors, and carts, and we finally reached the end of the hallway, cordoned off by yellow rope and a sign warning of potential radioactive hazards. At the end of this dark corridor, eerily lit only by the feeble lights from our headlamps, were several canisters of radioactive waste filling the back of the chamber. When enough canisters have been stored, the room will be closed off, sealed against the intrusion of humans and water. The hope of the Department of Energy (DOE) is that it will remain that way for at least 10,000 years- the amount of time that the Environmental Protection Agency (EPA) has mandated that waste in a geologic repository must remain stable.

We re-boarded the golf carts, and then trundled back to the elevator. On the way, we stopped at a particularly colorful pile of rock salt, pieces carved out of the walls of the caverns. While the walls of WIPP are a colorless gray, rough and crumbling to the touch, this selection has been chosen to showcase the myriad colors and minerals found in WIPP. I and the other visitors combed through the rocks, commenting on the colors and smoothness of the salt. Mike Antiporda, another WIPP public relations liaison, confided that if you want to keep the salt together, spraying it with hairspray is a good trick. Otherwise, it will dissolve in the elements if you leave it outside since salt is permeable in water. We collected our samples, colored pink and red by the iron in some parts of the salt cellars, and noted that in some of the clear, translucent samples we could see inclusions, bubbles of water left over from the Permian sea that used to cover New Mexico 250 million years ago. Other pieces were perfectly cylindrical- remnants of bore hole drilling used to test the solidness of the formation. We met again in front of the elevator, where we have a group photo taken, in front a sign that has just materialized here at the end of our journey. Though we were about to leave, the sign stated, "Welcome to the WIPP underground! You have just entered an environment committed to safety." After the requisite photo opportunity, we headed back up the elevator, to the bright sunshine outside and the New Mexican desert.

This journey into WIPP highlights some of the scientific and engineering feats of using salt mines to store radioactive waste, and how some kinds of nuclear waste are reduced to technological objects, their harmful properties mediated by the salt caverns. The WIPP model is an attempt to control and negate the materiality of nuclear waste as a dangerous substance that is threatening to human and environmental health. WIPP focuses attention on the ways that scientific disciplines have been asked to deliver concrete knowledge about

the various natures of the site itself, as well as the radioactive materials that the salt beds are expected to contain in perpetuity. The creation of WIPP is indicative of the DOE's faith in the medium of salt and the assumed predictability of these ancient Permian salt beds, that they will never be breached by any natural occurrence. Not from the brine pools that lie under the site, or the freshwater aquifer that lies near it. Not from earthquakes or a changing climate. And not from the inquisitiveness or economic need of future generations of humans, or other beings.

WIPP has been accepting waste shipments from DOE sites since 1999, and because of its fourteen year success rate, is now the focus of expanding desires from the DOE and NRC to store more and varied kinds of waste, in the form of commercially produced radioactive materials or Greater-Than-Class-C waste. The remaining salt beds surrounding WIPP have been the focus of conversations to create an interim storage site for commercially-produced radioactive waste, decommissioned reactor parts, and as well as a permanent site for spent nuclear fuel.[1] These conversations put more pressure on the science underlying the safety and longevity of storing radioactive wastes at WIPP, and they highlight the importance of examining these scientifically produced ideas of nature that seem to point to the innate natural aspects of the salt beds as a solution to storing nuclear waste.

This chapter looks at the ways that scientific disciplines such as hydrology, geology, seismology, and nuclear physics are being used to produce knowable, predictable, and ultimately controllable natures that are now tasked with isolating waste from the environment and humanity for the next 10,000 years. As WIPP, DOE, and EPA scientists presented their findings to the public in a series of public meetings regarding different

[1] World Nuclear News, "Report Pushes for American Interim Storage" April 8, 2012, http://www.world-nuclear-news.org/WR_Report_pushes_for_interim_store_1408121.html. Accessed April 9, 2012.

federal nuclear programs over the last five years (2007-2012), it became clear that these presentations and the public reactions to them encapsulate many different arguments over what constitutes nature and the actual practice and process of scientific inquiry. Contested discourses emerged over how much modern science can really *know* about nature, and how much local expertise can contribute to or refute ideas about the predictability of nature. These concerns ranged from defining the parameters of natural features such as salt, water, and radiation, to ways that knowledge and expertise are defined and articulated. Arguments over nature and science emerged most pointedly during public meetings concerning the recertification of WIPP in 2009, and Greater-Than-Class-C (GTCC) waste disposal in WIPP, as well as the establishment of reprocessing facilities in Southeastern New Mexico during Global Nuclear Energy Partnership (GNEP) meetings, and the creation of permanent or interim high-level commercial waste storage near Carlsbad during Blue Ribbon Commission (BRC) meetings.

The first narrative that emerges out of these meetings concerns the ways that science is used to make factual claims about nature, couched in claims of "sound science." The creation of insider, or federally supported, scientific knowledge is contrasted with the creation of outsider, or non-federally supported and independently sourced, scientific knowledge. Claims to "sound science" have been used by both anti-nuclear activists and pro-nuclear government definitions, with neither side trusting the other to define this. It remains a highly contested term in practice, and claims of "sound science" have been used at varying times by various actors in nuclear waste debates to discredit sites proposed for nuclear waste, or alternately, to uphold the supposed natural suitability of certain sites. In order to discuss how nuclear waste sites are culturally constructed out of natural formations, it is necessary to examine how the concept of "sound science" has been constructed in the

context of WIPP. At the core of debates over "sound science" are contestations over what science can actually know about nature, as well as how scientists articulate inherent uncertainties about different aspects of nature. The manner in which scientists and federal agencies transmit scientific knowledge troubles the practice of scientific knowledge production itself, yet the future of nuclear waste storage (and by extension nuclear energy production) hinges on inherently unstable and evolving understandings of nature.

At the crux of this discussion is the issue of certainty, especially regarding which definitions of nature will be used to characterize sites that hold nuclear waste, and whose expertise counts in these discussions. The underlying issues of dealing with nuclear waste are based on whether nature is predictable, knowable, and controllable. By looking at the language used in public meetings for nuclear projects in New Mexico, it becomes apparent that WIPP scientists are looking to uphold an ideal that WIPP is scientifically sound- a natural solution to a human-created problem. But complicating these arguments over certainty and predictability of nature are the different kinds of nonhuman elements at play in siting nuclear waste sites: The nature of water and earth, the nature of salt, and the nature of radiation and rates of decay. Natural solutions to dealing with nuclear waste, in the form of entombment, are complicated by these conflicting narratives over what constitutes the inviolable and definite state of these natures.

Contestations over the limits of knowledge, and how scientific inquiry brackets out certain questions, continue to shape arguments about WIPP. For those arguing against WIPP, it is critical that any proposed solution for nuclear waste also acknowledges the limits of what we can know, and what we don't know yet, about the physical properties of nature. The concepts that form the basis for using the salt beds of WIPP to contain radioactive waste are predicated on notions of the predictability and permanence of nature, of knowing

the nature of salt and radiation when they come into contact with each other over long periods of time. Yet how human actions will affect this landscape in the present, by putting radioactive waste in the salt beds, and in the future, as the waste interacts with the salt beds of thousands of years, are inherently *unknowable* and therefore *unpredictable* aspects of this nuclear project. The WIPP project itself is an experiment, one that will take thousands of years to unfold. These aspects of inherent uncertainty emerge in arguments about science and WIPP, as commenters are actually asking scientists to acknowledge this aspect of science. For federal scientists resist exploring the realm of uncertainty regarding nuclear waste, a central part of their task is to reassure the public that there is no refutation that has emerged to trouble the scientific characterizations of WIPP as inherently stable. These conversations are as much about the nature of science as they are about the science of nature.

A second, interconnected, narrative that emerged from these public meetings demonstrates how different and disparate aspects of nature are constructed in the context of WIPP. The establishment of WIPP pulls from a longer historical narrative about the "desert imaginary," where the nature of deserts in general, and New Mexico in particular, has been constructed in a nuclear context. But the future of who controls the desert imaginary is what is at risk in the move to potentially site more nuclear waste and other nuclear projects in southeastern New Mexico. A narrative that sees "deserts as dumps"[2] has defined Western desert landscapes, and it continues to shape land-use patterns in the present. Arguments over aridness and salt demonstrate the struggle over who will control the idea of the desert

[2] This term is taken from the imaginatively titled anthology, *Deserts as Dumps? The Disposal of Hazardous Materials in Arid Ecosystems*, edited by Charles C. Reith and Bruce M. Thomson (Albuquerque: UNM Press, 1992). The editors themselves note that "The book asserts, perhaps contrary to the implications of its title, that the proper disposal of hazardous waste is considerably more regulated, engineered, and monitored than the mere dumping of unneeded materials…" (5).

imaginary itself. This is especially true in terms of the extremes that have defined the desert as both a place to hide the offal of modernity while also simultaneously constructing deserts as places of high-tech exploration and experimentation that feed into a narrative of progressiveness for science. These conflicting ideas of whether the desert and the geologic salt formations are the correct method dealing with nuclear waste are also indicative of how desert landscapes are defined by their stark beauty or conversely, by their usefulness to the larger body politic for storing the waste produced by nuclear technologies.

Local knowledge of the landscape and the history of nuclear projects plays a large part in countering the impersonal and dry science behind WIPP. Some presenters and attendees of public meetings argued that their local knowledge of the nature of the area around Carlsbad takes into account aspects of nature that federal science overlooks. Others from different parts of the state looked farther afield at the potential disasters that WIPP, as well as other planned facilities for that region of the state, could have on seemingly disparate communities in New Mexico. They were especially concerned with the ways that nuclear communities had already formed, intimately connected through the contamination of radioactive waste, and they wished to prevent new ones from occurring. This concept connects back to seeing nuclear technologies as cultural problems, irrevocably connected to the ways they were produced, but it also expands on those historical arguments by looking at how desert landscapes are seen as sacrificial wastelands, populated by expendable communities. This section looks at arguments made over the nature of the land around Carlsbad and New Mexico as a means of countering the historical pattern of using desert as dumps, as they specifically pertain to ecological and environmental understandings of the region. By looking at how supporters and opponents of WIPP express ideas about the nature of the desert, it is easier to understand how historical narratives impact the acceptance or rejection

of WIPP. For the former, WIPP can be seen as both an extension of attempts throughout American history to make the desert productive, but for the latter group, opposing WIPP is part of an environmental justice movement concerned with preventing the desert from becoming an increasingly irradiated wasteland with unpredictable and unprecedented ecological effects.

The final section of this chapter turns to another aspect of nature, where arguments over science and nature are ultimately trumped by the nature of time. The passage of time and its effects on the landscape, waste, and decay, remain an ultimately unknowable aspect of WIPP. All of the scientific and engineering- based information around WIPP is geared towards a seemingly simple goal: sequester human-produced radioactive waste away from the populace. But one way that WIPP remains problematic as a permanent storage site for nuclear waste is due to the difficulty of marking the area in any meaningful way based on the limited life spans of the human species. The somewhat arbitrary time limit of 10,000 years is the designated amount of time that WIPP markers must be effective, according to the Environmental Protection Agency (EPA). This amount of time is longer than any known human culture has existed, and yet only a fraction of the time that some of the radionuclides in WIPP will be radioactive. This final section of this chapter looks at how cultural assumptions about symbols and warnings shape design imperatives, and how to take into account how future populations may use land and understand the local landscape.

Ultimately, trying to mark the WIPP site for the next 10,000 years demonstrates the cultural problems of utilizing nuclear technologies in the present. It raises the question of how to communicate warnings of danger to populations in the future, when no society has existed for the duration of the EPA's mandate of 10,000 years. How we communicate the dangers of nuclear waste to future generations says much about how society perceives it in

the present, and it shows the inherent difficulty for a federal body to extrapolate on a period of time that will include the dissolution of the United States. The potential signage for WIPP indicates that as much as the federal government, industry officials, and local residents want to place their trust in WIPP as a site for holding waste into perpetuity, articulating its danger over long time periods trumps the idea that WIPP can hold waste safely for even 10,000 years. Ultimately, the DOE's attempts to find ways to mark the WIPP site actually demonstrate how little control or predictive power humans have over various natures in the future, whether they are radioactive, geologic, or human.

A Comparative History of Science and Nuclear Waste: Yucca Mountain and WIPP

The history of radioactive waste in America has been overshadowed by debates over nuclear weapons and the promise of energy production. While waste has been produced since the first atomic experiments during WWII, the question of what to do with radioactive wastes was not considered until relatively recently. Scientists and federal agencies in the post-War era believed that it was a problem that could be dealt with later, when newer technologies would emerge from for processing, reusing, or storing wastes. In fact, in 1948, during the early era of atomic research and weapons designs, the Atomic Energy Commission actually employed only two sanitation engineers to deal with waste, underlining a lack of serious attention to radioactive waste streams.[3] Nuclear waste was simply not a pressing issue at a time when developing more efficient and destructive weapons, as well as more productive nuclear technologies for energy, were of paramount political importance.

Until the passage of the Nuclear Waste Policy Act (NWPA) in 1982, there was no official governmental process to locate a commercial spent nuclear fuel (SNF) storage site for the waste accruing at nuclear power plants in the U.S. Though spent nuclear fuel and

other radioactive wastes such as decommissioned power plant parts and GTCC waste are currently kept on-site at individual nuclear power plants and federal facilities, all of this waste remains the responsibility of the federal government. However, the actual process of siting a nuclear waste site demonstrates how politically messy and socially fractious the issue of nuclear waste storage is for the U.S. government and private nuclear facilities. A closer look at the ultimate decision to site nuclear waste provides an overview of the problems that programs like the Global Nuclear Energy Partnership (GNEP) and the Blue Ribbon Commission (BRC) are trying to avoid in locating a new site for high-level commercial waste.[4] The issue of scientific knowledge is the crux over controversies of nuclear waste sites; specifically, can scientific evidence provide support for storing radioactive waste that will be dangerous to humans and the environment for millennia at a specific site?

The NWPA led to a final decision by the U.S. government to store commercial spent nuclear fuel and other waste inside of Yucca Mountain, located on the Nevada Test Site where atomic bombs and nuclear weapons were tested after WWII. The Yucca Mountain site is part the rocky desert landscape north of Las Vegas, and this arid region was chosen for similar reasons as WIPP. With no obvious pathways to surrounding landscapes, or obvious waterways to leech the waste into aquifers, the very nature of Yucca Mountain was thought by federal scientists to be enough to contain the threat of radiation.

Yucca was also a politically expedient choice. Though the NWPA mandated two sites, one in the East and one in the West, Nevada quickly became the sole choice for myriad

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[3] J. Samuel Walker, *The Road to Yucca Mountain: The Development of Radioactive Waste Policy in the United States* (UC Press: Berkeley, 2009), 13.

[4] The WIPP project involves a constellation of federal agencies, the most notable of which is the Department of Energy (DOE). The Environmental Protection Agency (EPA) is in charge of seeing that the DOE adheres to the NEPA and NWPA regulations set out in the federal registry and that they adhere to the environmental regulations laid out in 40 CFR 191 and 40 CFR 194 regarding radiation. The Nuclear Regulatory Commission (NRC) is in charge of overseeing that the casks used to transport and store radioactive waste at WIPP adhere to federal guidelines as well.

reasons. Because over 80% of the state's land is owned by the federal government, Nevada seemed to be ideal for political reasons as well as environmental reasons, and was quickly selected as the only site that federal money would support. However, the speed with which the site was chosen actually undermined the scientific effort to determine if the rocky cellars of the mountain were actually suitable for storing nuclear waste in perpetuity. Yucca Mountain was also considered a compromised site because of the science underlying the site selection. Fault lines were discovered within two miles of the site, and water leeching from the surface also seemed to affect the experimental casks detrimentally in much faster times than scientists had predicted.[5] With the election of Barack Obama to the American presidency, with the support of anti-Yucca Nevada Senator Harry Reid, the federal position on Yucca was officially reversed. Yucca is currently closed to the possibility of holding nuclear waste, after $7 billion dollars of research and experimental funding has already been spent. In 2010, the DOE filed a motion to withdraw the license permit for Yucca, effectually ceasing any construction on the site[6].

Both Yucca and WIPP are similar in that they are both part of a federal mentality that presumes that geologic entombment and isolation are the most expedient and feasible means to deal with nuclear waste. Assumptions inherent and central to both Carlsbad and Yucca Mountain include the aridity and unproductiveness of both sites, linking the two projects to desert nature narratives. And while one has been eliminated as an option and the other has been deemed a success after twelve years of successful operations, they are also linked

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[5] John D'Agata, *About a Mountain* (New York: W.W. Norton & Co., 2010), 54-56.

[6] DOE, *U.S. Department of Energy Files Motion to Withdraw Yucca Mountain License Application*, (Washington, DC: GPO, 2010). http://energy.gov/articles/department-energy-files-motion-withdraw-yucca-mountain-license-application. Accessed May 10, 2012. Yet the Yucca saga is not over, as the DOE is officially and legally only allowed by congressional mandate to look at Yucca as the sole site for nuclear waste disposal in the country. Until this law is repealed, the DOE cannot officially look at any other site. The DOE is hoping this law will be repealed so that they can focus their attention elsewhere for the storage of nuclear waste, which the NRC is also actively seeking.

together through the concept of "sound science." In discussing Yucca Mountain and its failure to produce a site that could accept commercially produced nuclear waste, Obama's main contention was that Yucca Mountain could not be supported by "sound science." WIPP, on the other hand, is seen as a success because the science behind the salt beds encasing radioactive waste has supported federal characterizations of the region. It is therefore revealing to look at how science has been both marshaled and contested in the context of WIPP in order to understand the power of scientific narratives.

The Science of Salt

As evinced by the numerous federally-organized meetings that have occurred in New Mexico since 2007, much federal attention is currently being focused on the Permian salt beds outside of Carlsbad as a potential means of permanently dealing with the back-end of the nuclear fuel cycle. Salt beds such as the one underlying WIPP have been explored as sites for radioactive waste by the National Academy of Sciences since the 1950's, because the presence of geologically stable salt beds indicates a lack of water and a geologically stable field free of fault lines. In 1957, scientists noted that, "From a geological standpoint, salt is plastic and flows under pressure" [7] which will allow the salt to fill in any opening created in the mined out area. This "creeping" action of the salt beds, under undisturbed conditions, was expected to eventually create an impermeable seal around the enormous casks of nuclear waste, keeping the canisters dry and separated from outside elements.[8] Federal scientists believe that the salt will eventually crush, entomb and stabilize the radioactive waste in perpetuity. The very nature of the salt beds- their seemingly inherent and material

[7] National Academy of Sciences- National Research Council, "The Disposal of Radioactive Waste on Land: Report of the Committee on Waste disposal of the Division of Earth Sciences" (Washington D.C.: NAS/NRC, 1957), 75.

biophysical properties- are therefore being framed as a natural solution to the intractable problem of nuclear waste disposal in America.

Gathering information about nature, such as the nature of the salt in WIPP, can be seen as a means of producing factual ideas about nature, which in turn provides the foundation for "sound science." Bruno Latour has said that, "[T]he power that allows mute objects to speak through the intermediary of loyal and disciplined scientific spokespersons, offers a significant guarantee: it is not men who make Nature; Nature has always existed and has always already been there; we are only discovering its secrets."[9] The salt beds of Carlsbad, once a hot bed of controversy over its twenty year journey from proposed site to its first waste shipment, is being framed by scientists in the contemporary moment as a natural solution to a lingering nuclear waste issue, and one that needs minimal engineering by humans. Following Latour, the useless salt of the desert is now being revealed as an almost perfect medium for dealing with the political and environmental uncertainties raised by the existence of nuclear waste. While WIPP has not garnered the type of national recognition, either negative or positive, as Yucca Mountain, it is now being discussed in federal circles as the only successful long-term engineered nuclear waste site in the country, and the known properties of its salt seem to offer a "significant guarantee" that waste can be dealt with in an expedient and scientifically-supported manner.

The idea of "sound science" implies that, as a society, we must make decisions based on the best knowledge we have, which is based on empirical and objective information gathered through rigorous testing and fact gathering. Sound science is seen as apolitical, untainted by

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[8] National Academy of Sciences- National Research Council, "The Disposal of Radioactive Waste on Land: Report of the Committee on Waste disposal of the Division of Earth Sciences" (Washington D.C.: NAS/NRC, 1957), p. 135.

[9] Bruno Latour (translated by Catherine Potter), *We Have Never Been Modern* (New York: Harvester/Wheatsheaf, 1993), 30.

political interests, and as merely revealing the natural insolating and insulation properties of salt in the desert. It was heard as a constant refrain during public meetings regarding WIPP, used by both proponents and opponents of increasing nuclear activity in the area, and it remains a contentious issue central to the acceptance and opposition of storing more nuclear waste in the region. New Mexico Governor Susana Martinez repeated it several times in her remarks to the BRC in Carlsbad, noting that, "[A]t the end of the day, the science must be the decision-maker. At the end of the day, it must be the science that will lead us to the best decision that will be in the best interest of the community and of our nation."[10] Martinez' faith in science as the only non-political arbiter of truth and facts, is indicative of the ways that historians and sociologists of science, such as Sandra Harding, describe a modern process of trying to create "one and only one possible true account of nature."[11] It is through science that society creates this comprehensive, knowable, predictable, and ultimately controllable version of nature, which can be made usable and productive. Scientists become merely interpreters, as "science" becomes divorced discursively through its production, floating by itself as an untouchable category of description and justification for projects like WIPP. The salt beds of WIPP, once indicative of an arid and economically useless ecosystem, are made through the WIPP project into a useful space, one that has become necessary to a federal commitment to finding a home for nuclear waste. Comments like Martinez' show the power and authority given to scientific disciplines in deciding the future of nuclear waste repositories. In the absence of disastrous consequences thus far, the science behind WIPP is seen as sound and supportive of the endeavor.

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[10] Blue Ribbon Commission, *Full Commission Open Meeting,* Carlsbad, NM, January 27, 2011 (Statement by Governor Susana Martinez).

[11] Sandra Harding, *Is Science Multicultural? Postcolonialisms, Feminisms, and Epistemologies* (Bloomington: Indiana University Press, 1998), 165.

Many other New Mexican politicians stress the idea that science is fueling their support of WIPP, from the local to the national level. Former Senator Pete Domenici has spear-headed the establishment of a nuclear corridor in Southeastern New Mexico, and has been a tireless champion of WIPP over the past thirty years. During the Albuquerque BRC meeting, he reiterated his belief in WIPP, noting that for him, WIPP's success stems from the established scientific facts, and that, "[F[or those…interested in the facts, they ought to avail themselves of the facts. If they're interested in myth, they can come here today and talk about all kinds of things that aren't true about WIPP, and somebody will hear them. Nonetheless, I am hopeful that at least the Commissioners have seen the truth, have seen the facts."[12] Here, science is presented as laying bare the immutable properties of the salt in WIPP, as a fact of nature, as opposed to the myths of WIPP opponents, who are presumably not basing their opposition on the facts. Domenici's position is indicative of trying to get beyond the idea that decisions about nuclear waste are solely based on "politics," the notion that political biases undermine the interpretation of sound science (which is ironic considering their roles as professional politicians). Sound science in this context is presented as apolitical, based on facts alone, divorced from political self-interest.

Domenici's interpretation of factual information, and Martinez' dependence on such to make political and economic claims about New Mexico's relationship to nuclear as wholly positive, are indicative of a historical separation between science and culture, which has a long history in Western culture dating to a paradigm developed during the Enlightenment paradigm.[13] As evinced by their respective stances, science has come to be seen as a field of objectivity, where there is no room for personal interpretation, and whereas cultural aspects

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[12] Blue Ribbon Commission, *Full Commission Open Meeting,* Albuquerque, January 27, 2011 (Statement by Senator Pete Domenici).

are seen as inherently subjective, biased and untenable, as well as derogatory to the practice of science. Once posed in opposition to the vagaries of religious explanations of nature, sound science is now posited in opposition to politics, where politics stands in as biased or motivated by economics or local interests. Intriguingly, bridging the gap between reason and religion, the Reverend David Rogers, a local pastor in Carlsbad, also urged the BRC to "listen to the science" and that in Carlsbad, "we have studied the science and we believe in the science, and are confident in the science."[14] However, science is inherently a cultural practice, imbued with the cultural and social values of the society in which it is produced.

As many who study the cultural aspects of science and technology have pointed out, the value of having objectivity is a value in and of itself that is endemic to Western scientific practice.[15] Donna Haraway has pointed to the seemingly mundane and profound aspects of viewing nuclear waste production specifically in this modern, objective light, where:

> "Two things stand out simultaneously in the presence of the transuranic elements: First, they are ordinary, natural offspring of the experimental way of life, whose place in the periodic table was ready for them. They fit right in. Second, they are earthshaking artificial production of technoscience whose status as aliens on earth, and indeed in the entire solar system, has changed who we are fundamentally and permanently."[16]

While Haraway is describing the atomic particles themselves, nuclear waste also fits this description, both another kind of waste product of an advanced technoscientific society, but also as a novel product that has no solution within that society. As material products of modernity, nuclear waste therefore encompasses disparate poles, of something at once natural yet human-made, and as something controllable yet controlling of human societies.

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[13] See Thomas L. Hankins discussion of reason and science in *Science and the Enlightenment* (Cambridge: Cambridge University Press, 1985), 1-17.

[14] Blue Ribbon Commission, *Full Commission Open Meeting,* Carlsbad, NM, January 27, 2011 (Statement by Reverend David Wilson Rogers).

[15] See Donna Haraway, "Situated Knowledges" in *Simians, Cyborgs and Women: The Reinvention of Nature* (New York: Routledge, 1991). The field of Science and Technology Studies (STS) has been instrumental for raising these issues. See Bruno Latour, Donna Haraway, Sandra Harding, and Michel Foucault.

[16] Donna Haraway, *Modest_Witness@Second_Millenium.FemaleMan®_Meets_Oncomouse™:Feminism and Technoscience* (New York: Routledge, 1997), 55.

WIPP, and any other attempt to create nuclear waste repositories, can therefore be seen as a complex extension of trying to maintain control over these new products on the periodic table as they become waste products. The salt beds of the Permian Basin can contain the mundane properties of radioactive waste as just another kind of waste that can be logically and expediently dealt with once the right kind of medium is found. But the salt beds are also fit as a novel solution for radioactive waste that allows for the continued and unfettered production of nuclear products.

Haraway's point is illustrated in a fascinating exchange between Dr. Per Peterson, a physicist at the University of Berkeley and a member of the BRC, Dr. Don Hancock of the Southwest Research and Information Center (SRIC) in Albquerque, and Dr. James Conca, former director of the Carlsbad Environmental Monitoring and Research Center (CEMRC), at the Carlsbad BRC meeting. Peterson pointed out one of the strangest aspects of dealing with the idea of hazards from radioactive substances stems from the fact that waste is classified "mainly based on the source of origin, military versus civilian, chemical versus radioactive, and so on. We don't classify waste in general based on hazard." Hancock agreed that this was problematic, and offered the example of uranium mill tailings in the Church Rock area of New Mexico, where they "are classified in a way as if they're not hazardous, [but] where they're still killing people." Peterson and Hancock are recognizing that even characterizing nuclear waste into different categories is a complex and difficult process, especially because these definitions can have material and hazardous consequences for the environment and populations dependent on those environments. The radioactive substances themselves escape easy categorization, and present a problem of being mundane enough to continue the production of nuclear waste, but not mundane enough to be disposed of easily, because of their long-lived half-lives.

But if the categorization of waste is confusing because it doesn't take into account the hazard to humans, then the salt beds of WIPP seems to provide a solution to that confusion. Conca went back to the properties of salt as a natural means of resolving this problem. He argued that, "you try to take advantage of something Mother Nature's already engineered for you so you don't have to reinvent the wheel, and if you pick a geologic formation that is robust enough…hazard makes no difference to the performance of the repository." Peterson agreed, noting that with the salt medium, not only is it more cost effective because no extra engineered barrier is needed, but it also "open[s] the possibility of placing into geologic disposal materials today that we routinely put into shallow land disposal."[17] WIPP, or a new site like WIPP in the salt beds, is created anew here as not only a natural barrier, but also one that is attractive because of its relative cost-effectiveness. It is an elegant solution to a decades-old problem that will linger far into the future. "Mother Nature" is revealed here as having already engineered the best solution for a pernicious scientific problem.

This exchange is illuminative of the hope that the medium of salt will solve the myriad problems related to radioactive waste, including its naturally occurring radioactive decay. The actually calculable hazard or half-life of the waste will no longer matter, the type of radiation- alpha, beta or gamma- will no longer matter, and even the reasons behind the waste's production will no longer matter. If the proper geologic medium is found, then all of these problems will become solvable. Supporters of WIPP often note that it is "the most studied sixteen square miles in the world,"[18] and the lead scientist at WIPP, Dr. Roger Nelson, boiled the scientific questions of WIPP down to three simple points: 'What can

[17] Blue Ribbon Commission, *Full Commission Open Meeting,* Carlsbad, NM, January 27, 2011 (Statement by Don Hancock, Per Peterson, and James Conca).

happen to the disposal system, [or] what are the events that can happen to it…what are the chances of it happening, and then what are the consequences once it does happen if it happens. If you can answer those three quantitatively, you can predict the behavior into the future."[19] By reducing the problem of radioactive waste into three simple questions, the problem becomes more manageable, solvable, and containable. And the salt beds of WIPP become a more obvious solution, especially because they are already there, just waiting to be carved out and used.

But what is omitted in this solution of simply burying all waste is how nuclear waste is produced and for what reasons. It also occludes who has been affected by the production and use of nuclear technologies, as well as contaminated environments. Simple questions and elegant solutions provided by nature itself and backed by sound science cannot ultimately answer the questions raised by the introduction of nuclear waste to the world, nor can they answer future questions about what to do with future products. Even with three basic questions, there are more issues that still need to be recognized, acknowledged, and addressed. When those three questions are expanded on and complicated, the idea of using salt as a permanent solution also becomes less certain. Ultimately, the idea of "sound science" is predicated on assumptions of nature, and on evidence of less than fifteen years of witnessing the interactions of radioactive waste and salt. By bracketing prickly political discussions about why so much waste is produced, and instead focusing on disposal alone, the questions of why, where, and how waste is produced go unexamined, allowing for a continued lack of accountability on the part of nuclear waste production and producers.

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[18] Blue Ribbon Commission, *Full Commission Open Meeting,* Carlsbad, NM, January 27, 2011 (Statement by John Heaton).

[19] Blue Ribbon Commission, *Full Commission Open Meeting,* Carlsbad, NM, January 27, 2011 (Statement by Roger Nelson).

Contesting the "Scientific Trap" of Certainty

BRC commissioners and WIPP scientists are optimistic that salt is a medium that can answer lingering problems with nuclear waste storage of all kinds, from high level commercial waste to uranium mill tailings. On the other hand, citizen groups and public commentators argue that the parameters by which scientific constructs are discussed are too narrow and limiting. The definitions of sound science regarding characterizations of nature are separated into fields of expert knowledge, and delimited to official topics of conversation. The WIPP site presents a powerful example of what the National Academy of Science has termed a "scientific trap," where the managers and creators of WIPP are "encouraging the public to expect absolute certainty about the safety of the repository for 10,000 years and encouraging DOE program managers to pretend that they can provide it."[20] But in the case of WIPP, there is simply no guarantee, scientifically or otherwise, that WIPP can work as intended. Instead, the idea of a successful program based on sound science relies on establishing clearly delineated parameters of nature and then creating models of how that nature will behave in reaction to the creation of radioactive mines. Conversations about sound science become increasingly contentious regarding the assurance of certainty when it comes to nature: on the one hand, WIPP scientists want to assure the public that the nature of the salt beds is predictable to some degree of certainty, but on the other hand, the public also wants scientists to acknowledge that their degree of knowledge about nature is inherently uncertain to some degree as well.

A contentious WIPP Recertification Meeting in 2009 illustrated the paradoxical nature of science and certainty. Intended as a public information meeting to inform

[20] National Research Council, "Rethinking High-Level Radioactive Waste Disposal: A Position Statement of the Board on Radioactive Waste Management" (Washington D.C.: National Academy Press, 1990), 1.

stakeholders in general about WIPP's recertification process, it was also meant to be a roundtable meeting, where the public could ask questions, and actually receive answers. It soon resembled a tennis match, with federal scientists engaged in increasingly heated exchanges with members of the public and citizen groups. Questions over parameters and definitions quickly took over the meeting, as one audience member interrupted DOE Compliance Certification Manager Russ Patterson with a question about powdered plutonium and whether it was being shipped to WIPP. Patterson replied that he didn't know, but if it met the criteria for transuranic waste it could be. Another panelist suggested that Patterson characterize remote handled (RH) waste for the audience, to which Patterson laughingly replied, "That's beyond me." Bev Crawford, who is in charge of transuranic waste inventory at WIPP, took the reins and said it that whether a substance is defined as RH depends on the dose. The audience member replied, "I asked for a characterization, not a dose." This exchange continued as the audience member was told to check the WIPP website for the remote handled waste acceptance criteria, to which the questioner snapped, "I know the waste acceptance criteria, I just want to know if it's [powdered plutonium] been shipped there." After a pause, Crawford asserted that powdered plutonium must be in WIPP, since it would have been the residue on glove boxes used in Rocky Flats, which have been shipped to WIPP. A final voice from the audience chimed in: "A lot of you don't even know what's gone down to WIPP" because of historic government mislabeling of waste drums.[21] This exchange, in the first twenty minutes of the meeting, set a tone that was echoes in a longer history of challenging the science behind WIPP since the proposal of the site. What was reflected in this confused exchange was a lack of trust in government

[21] Department of Energy. *WIPP Recertification Meeting Public Comments,* Albuquerque, June 30, 2009 (Exchange between Russ Patterson, unidentified audience member, Bev Crawford, Catharine Montano).

science, ranging from categorizing waste, to labeling waste, to identifying waste streams, identifying hazards from different kinds of radiation, and finally, even defining the kinds of waste in WIPP and whether it was there or not. But a larger issue is the questioning of the expertise of WIPP officials, as simple questions turn into convoluted answers that require a host of answers. Uncertainty lies not only in the categorization of waste, but who actually has the answers to questions posed by the community.

Attendees of the Recertification Meeting also raised questions regarding the facts underlying scientific characterizations of the nature of the WIPP site. While EPA and DOE representatives there pointed out that this meeting was "not an opportunity to revisit initial decisions of opening [the site] or to make significant design or program changes," the audience members challenged the idea of predictable natures, interrupting speakers for clarifications about the characterization of waste, for specifications of particular terms, and how change is accounted for at the site. The idea of a "performance assessment" and computer models used to make predictions of site behavior came under particular focus, as audience members asked "How can you make an assessment of the performance without any statistical population or history?" and "How do we know that the land isn't going to shift? How do we know that it's safe?" In response, DOE scientists responded that "The performance assessment…is a computer modeling system using the best information we have on what we think the system is going to look like. And then that's evaluated." Hhydrologist Rick Beauheim explained more thoroughly that, "Basically, we're talking about very well-known and demonstrated physical laws. We understand ground water movement. We understand processes like corrosion. We understand rock creep. So yeah, we haven't had 10,000 years of direct experience at WIPP with these processes, but these processes are very well-known. *It's just simple extrapolation.* How are they going to behave over the next

10,000 years? Well, how have they ever behaved? There's no change there."[22] Beauheim's position reflects an idea of certainty regarding the salt beds because of their continued existence over 250 million years. Their very existence seems to guarantee their future presence. But Beauheim's response doesn't acknowledge the change that is obvious: the storage of radiation- and heat-emitting nuclear waste. The addition of waste creates a new era of history for the site, one that permanently changes the parameters of the salt beds. And yet, the salt beds and their creeping action continue to be a source of assurance for WIPP scientists, who pass on this ideal to a curious public. Ultimately, the question of "how do we know?" is unanswerable in the present. It's only after the passage of time that models are proved reliable and accurate. Uncertainty exists, even if it isn't acknowledged in this particular context.

Uncertainty does emerge in these conversations more clearly when scientists are not communicating to the public, but rather when they communicate with each other in public. The limits of scientific information were raised by Dr. Allison McFarlane during the Carlsbad BRC meeting. McFarlane, who at the time was a member of the BRC, was named by President Obama as the chairwoman of the NRC in 2012. Her questions therefore point to an interesting fissure in the idea of scientific certainty and what questions remain unanswered by current models and ideas of how salt behaves under different conditions, even questions that had been raised during the NAS Salt Vault experiments in the 1950's in Kansas. She commented that, "As a geologist, I'm well aware that the 1970's and the 1980's might as well have been the 1920's in terms of recent science and scientific advancement," bringing in the concept of the history of science, and how scientific knowledge about the

[22] Department of Energy. *WIPP Recertification Meeting Public Comments,* Albuquerque, June 30, 2009 (Exchange between Dave Moody, Bob Bailey, unidentified audience member, and Rick Beauheim). Italics added.

material qualities of nature have changed over time. Her questions revolved around "the migration of fluid inclusions in the brine due to heat, [and] the effects of actinide concentration in brines, microorganisms and gas generation," noting that "there are quite a few questions like this that haven't been resolved and so just from the technical side I'd like to know whether there has been any work or [are] there plans to do any work like this." After a brief exchange with WIPP chief scientist Roger Nelson, who pointed her to a document that McFarlane said did not answer her questions, Nelson acknowledged that "there's many questions about how that actual process works and the timing associated with it as the formation heats up and the brine moves back and forth…there's a lot work left to do."[23] Questions of brine and brine migration from boreholes drilled by mining and natural resource extraction have plagued the WIPP project since its inception because it is a human-introduced element. But issues regarding brine have been bracketed out of questions regarding the behavior of salt in ideal conditions when no liquid has been introduced. When McFarlane, and other commenters, raise questions about non-ideal situations, especially ones involving human activities, the issue of stable natures becomes much less certain and assured. While WIPP scientists presented a very confident face to the public, for scientists on the BRC, these remaining uncertainties about basic issues such as heat and brine have yet to be answered. Scientific uncertainty emerges as the only certainty in the project.

Perhaps the most illuminating exchange regarding the limits of sound science occurred between BRC committee member Vicky Bailey and James Bearzi of the New Mexico Environmental Department. After hearing testimony from a panel of scientists reiterating the strength of the science behind WIPP as well as anti-WIPP representatives

[23] Blue Ribbon Commission, *Full Commission Open Meeting,* Carlsbad, NM, January 27, 2011 (Exchange between Allison MacFarlane and Roger Nelson).

questioning that science, Bailey commented that, "the public must clearly perceive that site-selection and characterization is science-based and not a political process…But then I hear this issue of science and people use that either I want the science to prove that this isn't a proper area…So you know, we can use it either way." Conca immediately noted that "Science is a necessary but insufficient criteria for anything…these decisions are not based on science. You have to have an underlying fundamental understanding of the science but the decisions are always going to be sociological, always and essentially there are going to be costs." Bearzi replied that, "It isn't always about science, but what it is about is risk and risk perception, and a simple model of risk is consequence times probability." Bearzi went on to make the point that, with enough transparency and information, "we reach a point where people have enough information that says yes, this is something that we can live with as a society which is really for the greater good. And you kind of subordinate those individual aversions to even the most infinitesimal risk to the larger risk of community."[24] This exchange encapsulates some of the paradoxes concerning certainty and science, as Commissioner Bailey's questions point to the fact that science can be used to both support and undermine plans to store more waste in the WIPP vicinity. For some, the science behind WIPP shows that the site is fundamentally sound, based on the existing parameters of scientific inquiry. For others, the science is uncertain at best, and the parameters for information are too narrow to bear the weight of the next few years, much less 10,000. Conca's and Bearzi's comments, both made by scientists, demonstrate the paucity of relying solely on science to make decisions about nuclear waste. Their acknowledgement of the fact that science cannot determine anything marked an intriguing break in the arguments about

[24] Blue Ribbon Commission, *Full Commission Open Meeting,* Carlsbad, NM, January 27, 2011 (Statement by Vicky Bailey and James Bearzi).

sound science, which Commissioner Bailey noted in her question as well. Science, in this case, cannot be the determinant of whether nuclear technologies are appropriate to use. Instead, social, cultural, economic and environmental concerns must also be weighed.

Though WIPP maintains that it is completely transparent with and wholly part of the community of Carlsbad, anti-WIPP groups see a far more tangled history of withholding information, and decisions based on political expediency, which further undermines the role of science in the process of siting nuclear waste facilities. For Hancock, "The question is to predict what the changes will be" to the salt beds at WIPP.[25] Hancock feels that Carlsbad has been targeted because of its amenable political landscape, and seemingly appropriate geology, but he is suspicious that the DOE has not looked at other sites. This concern extends from the issues that the NRC faced with Yucca Mountain- after spending billions of federal dollars, there was a sense that the site had to be opened to justify the financial expenditure. Hancock argued that in order to truly do a scientific test, scientists at WIPP needed to "forgo WIPP as a waste disposal site and instead use it as a demonstration project, using benign heaters, to test how bedded salt will react to various types of mining techniques and temperatures."[26] With a hypothesis in mind, testing the site would allow for further knowledge, rather than filling it with waste and monitoring it for 30 years without being able to readily retrieve the casks that hold waste. Joni Arends, of Concerned Citizens for Nuclear Safety (CCNS) based in Santa Fe, has also argued that community groups are hampered by a lack of funds to provide independent scientific experts, and that "NGO's had hired a number of technical experts" to argue about water and mining activity at the WIPP site, but

[25] Neal Singer, "The Hot Topic of WIPP," *Quantum* 7, no. 1 (1990), 5.
[26] Don Hancock, "Testimony before the subcommittee on oversight and investigation house committee on interior and insular affairs." Albuquerque, August 10, 1979.

that it was difficult to find and fund those scientists.[27] This continuing problem of creating an opposing scientific expertise to challenge the complacency of the DOE is one that WIPP opponents find frustrating, since it places so much decision making power in federal hands. This is especially troubling because federal science tends to focus on the most basic questions, ignoring the ways that nuclear waste production has harmed communities and has been politically unaccountable to those communities. Science done outside of federal aegis approaches questions of radiation and ecology form a different perspective, where the risks and effects of radiation are writ upon human bodies and environmental landscapes and then traced back to their sources. The human and environmental tolls are seen first, and then addressed. In the case of WIPP and nuclear waste, this process has yet to take place, because there are yet to be afflicted bodies or environments. But activist groups argue that this is because of the narrow focus of federal science, not because of "sound science."

Ecological Understandings of Nature: Geology and Hydrology

Opposition to storing more nuclear waste is New Mexico is not easily reduced to "individual aversion." Commenters at public meetings expanded on the context of ecological sciences, recognizing how risk from radioactivity is never individualized, and always communal. At the BRC meeting in Carlsbad, Dr. Peter Galison, a historian of science at Harvard University who was an invited panelist, stated the paradox of the mission of the BRC most simply, when he described "nuclear waste as always both local and more than local." Locating one place to store waste does not localize waste, but rather expands communities' exposure to potential radioactive hazards. These communities erupt along waste routes and downwind from emissions, for instance, or when nuclear materials are shipped and new facilities are built. During his eloquent overview of the history of nuclear

[27] Joni Arends. Interview with author. Personal interview. Santa Fe, September 13, 2010.

projects in the U.S., Galison further described the issues that the BRC would have to contend with in trying to find a permanent solution for storing nuclear waste: "In the post-Cold War world, nuclear waste more than any other issue before the public today engages every scale of our society, from small cities through the debates over the future of energy on the planet. And that scale shifting, far more than any particular issue of nuclear physics or salt dynamic is what makes it so complex."[28] The scales implicated in radioactivity are especially complicated due to the length of time that some substances remain radioactive, but also because they are odorless, tasteless and invisible, making their passage through the landscape especially threatening.

Galison's remarks reveal a different way of looking at the conversation between opponents of WIPP and supporters. Opponents of expanding WIPP who reacted negatively to local site characterizations as stable and predictable were often labeled as" NIMBYists", or "not in my backyard." Dismissed as rejecting a scientifically sound solution to nuclear waste, opponents of increasing nuclear waste and storage in southeastern New Mexico can also be seen as approaching this argument with alternate ideas about nature and resisting the parameters for science set by federal scientists. This approach can be seen in comments during public meetings which reflected a more nuanced and comprehensive understanding of ecology and the interrelatedness of environmental impacts, ultimately, challenging not only the idea of scientific fact, but the parameters of what constitutes scientific discussion. Former Nuclear Waste Project Director for CCNS, Margaret Carde, pointed out some of the ways that the public has a direct connection to local ecologies: "The history of WIPP owes much to the input of citizens. Citizens tend to have a good idea about what happens in their

[28] Blue Ribbon Commission, *Full Commission Open Meeting,* Carlsbad, NM, January 27, 2011 (Statement by Dr. Peter Galison).

own background…Sometimes science can't cover what happens in a person's neighborhood." She also acknowledged the importance of local knowledge, though the boundaries of the local are also a site of contestation: "If it's true that citizens in their own backyards know more about their safety than other people do, then it would follow that the citizens of Carlsbad know more about WIPP than anybody else. [But] we knew that WIPP was not just about Carlsbad."[29] Carde's point about the importance of citizen science is an important one because it demonstrates a way to expand the parameters of science away from the salt beds themselves, to larger local ecologies and to the lived experiences of people in nuclear communities. It also expands the notion of the local by looking at different ecological boundaries, or lack thereof.

Another point of contention with how the nature of the salt beds is scientifically characterized pertains to the ways that the salt beds are described as discrete and geologically stable site. Anti-nuclear groups such as Citizens Against Radioactive Dumping (CARD), CCNS and SRIC have consistently raised the point that the WIPP site has been too narrowly categorized, and that the salt beds are less stable than federal scientists have stated. Janet Greenwald, of CARD, noted at the Carlsbad GTCC meeting that the safety record of WIPP is admirable, but the hydrology of the site remains suspect. She quoted the DOE site characterization of WIPP as an "island in a sea of karst," where the rock formations around the WIPP site are actually very porous. The DOE argues that the exact locations of karst formations are very well known and have no bearing on WIPP, but the question about its potential effect on WIPP is still a point of contention with opponents of WIPP.

[29] Blue Ribbon Commission, *Full Commission Open Meeting,* Carlsbad, NM, January 27, 2011 (Statement by Margaret Carde).

Another aspect of concern for opponents of WIPP is the issue of water contamination. Reflecting a larger understanding of hydrology and geomorphology, speakers who resisted the narrative of predictable and stable natures brought in the risks of having imperfect assumptions about the natures of WIPP. For instance, Dr. Joan Allen connected the risks of WIPP with the contamination of drinking water in Albuquerque from leaking jet fuel wells at Kirtland Air Force Base. She listed current issues facing New Mexico, such the "permanent contamination of our drinking water supply…plumes of toxic waste flowing towards our drinking water from Los Alamos…contamination of Indian lands and water, and the health of native people in Western New Mexico from uranium mining."[30] While Allen's comments provide an overview of water issues that have resulted in New Mexico because of both nuclear and military activity, another speaker, Joe Wexler, spoke about issues more specific Carlsbad and WIPP. Claiming his expertise as a civil engineer in New Mexico who has been working on flood control issues since 1964, Wexler noted that "a flood occurred in the summer of 1954…of 1 million cubic feet per second. That's a flow the size of the Mississippi River, and it occurred at the Pecos Basin somewhat south of Carlsbad…My calculations show that 1 million cfs form the Pecos Basin will raise the river 3 feet, that's 10 meters, and will expand the water flow to within three miles of the western edge of the WIPP site."[31] Wexler's use of local knowledge of Chihuahuan desert ecosystems, with their unusual water patterns of general aridness punctuated by extreme weather events, adds another layer of local ecologies to WIPP hydrological studies, which focus mainly on the site itself, and not on the karst-ridden borders, or surface hydrology issues.

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[30] Blue Ribbon Commission, *Full Commission Open Meeting,* Albuquerque, January 28, 2011 (Statement by Dr. Joan Allen).

[31] Blue Ribbon Commission, *Full Commission Open Meeting,* Albuquerque, January 28, 2011 (Statement by Joe Wexler).

These refutations of the DOE's characterization of risk and nature are grounded in the dangers of not immediate risks, but rather in "cumulative risks" which Ursula Heise describes as "deriv[ing] from the planet-wide summation of local changes that end up affecting large portions or even the totality of a global environmental phenomenon or resource." These cumulative risks "tend to be perceptible at the local scale in a way that systemic ones are not, or only with a far longer delay,"[32] and as they accumulate, more communities are drawn into becoming at-risk populations to radioactive contaminants. Looking at the danger from cumulative radioactive exposure, where radiation may seep from carefully designed containers into the desert due to unexpected natural events, illuminates the ways that characterizations used to describe communities unwilling to host nuclear sites are far too narrow in scope. It is a reduction of a larger and more comprehensive understandings of the ecological science of the Chihuahuan desert, where watersheds are interconnected far beyond local borders, and where the effects of radiation cannot be contained by natural boundaries. In the case of WIPP, the idea of local ecologies are not limited to the salt beds of WIPP, but rather the scale of potential danger, from transportation to waterways, and the potential effects on the thousands of humans along those routes of radioactive transportation.

The Desert Imaginary: The Role of Nature in the Contradictory West

Arguments over expertise and local ecologies are part of a larger and longer discourse that situates the appropriate use of desert landscapes in relation to the idea of productivity. But desert discourses also exemplify the contradictory natures at play here, and how the American West in the national imaginary is a place that is constantly in flux. The

[32] Ursula Heise, *Sense of Place and Sense of Planet: The Environmental Imagination of the Global* (Oxford: Oxford University Press, 2008), 153.

role of the desert in American culture has historically played a large part in how nuclear projects are enacted, and this characterization continues to shape nuclear projects like WIPP in the present, as well as reactions to WIPP. Environmental historian Catrin Gersdorf has noted that, "The transformation of nature into civilization, land into landscape, landscape into text, and text into a social and political tool for producing and reproducing a nation's cultural identity is a process foundational for our understanding of America."[33] The desert therefore functions as a "trope, a cipher signifying deficiency, lack, absence"[34] which needs to be surmounted before the region can become truly "American." In the context of nuclearism, the desert is made productive as a place of experimentation with nuclear technologies, including weapons, uranium enrichment, and reprocessing. In the context of WIPP, the desert is productive of nothing. It must produce no trace of the radioactive waste produced by modernity in the nuclear age.

WIPP therefore emerges as a kind of *heterotopia*, as Gersdorf describes the America desert using Edward Soja's phrase. She describes this kind of space as "situated *outside the center* of social and political order at a given historical moment *yet not totally disconnected from that center."* [35] The ways that the desert, and ultimately the salt beds of WIPP themselves, are construed politically, environmentally, and scientifically are all intertwined, and have a direct impact on how certain places are deemed appropriate, or even ideal, for storing waste. Expanding on the idea of a heterotopia, this specific desert landscape is geographically and physically remote from the center of political order, and therefore seen as a place that can be sacrificed. Yet at the same time, WIPP is completely central to a federal nuclear project that sees nuclear energy as necessary to the stability and productivity of the United States. The

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[33] Catrin Gersdorf, *The Poetics and Politics of the Desert: Landscape and the Construction of America* (New York: Editions Rodopi, 2009), 13. Italics within.
[34] Gersdorf, *Poetics and Politics,* 16.

centrality of the salt beds, and therefore Carlsbad and the WIPP site, is clear in both the GNEP and BRC programs, which have stated clearly that without a plan for the backend of the nuclear fuel cycle, it is hard to see a way to continue the expansion of nuclear energy. It is therefore important to look more closely at how the desert functions as a place for the potential realization of national nuclear dream, and where the unwanted, radioactive debris of nuclear experimentation for weapons and energy production are hidden. Its heterotopic value lies in the ways that it can hold nuclear waste in not only a geographically, but also an environmentally marginal area of the U.S. The salt beds are both necessary, but also forgettable, in that the waste is supposed to lie undisturbed for the foreseeable future.

The Western American desert therefore serves as both a trope for progress and for desolation in relation to nuclear projects. The establishment of some nuclear-oriented national nuclear sites in the post-WWII era, such as Los Alamos National Laboratories (LANL) and the Nevada Test Site (NTS) demonstrated that the West would be a place where nuclearism would leave an indelible mark. The desert plays an important role in facilitating American dominance in nuclear issues, and the rationale behind selecting desert sites is rooted in the nature of deserts, in their aridness and isolation. Historian Maria Montoya has noted that, "The desert is dry, hot, and, unless you look closely, apparently barren of life. This seeming emptiness and vast unoccupied space has provided an opportunity for humans to experiment, to free themselves from the confines and demands of the normal cycles of family and society that existed in the farms and cities of Europe and the eastern United States." Perhaps most significantly, the Western American desert is a place where military nuclear experimentation takes "refuge from the presence of humanity to

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[35] Gersdorf, *Poetics and Politics,* 237.

test their new and destructive creations…The desert's openness seems to beg for transformation."[36]

Popular perceptions of the West as empty, arid, and unproductive, but also as a place ripe for transformation, are partially produced by the science that was introduced there in the 1940's. These were not the only ideas at play in shaping how the West is perceived locally and nationally. Even as WWII-era federal science seemed to be a defining era for how the West would be seen in the national imaginary, local science "continued to pursue new discoveries based on the region's status as a natural laboratory."[37] WIPP is a new chapter of that natural history of experimentaton as the only "pilot plant" for the storage of nuclear waste, a natural means of solving a currently intractable social and technological problem. Ironically, this discourse ignores not only the delicate ecology of the region, but also the populations of town such as Carlsbad, Hobbs, and Roswell, as well as other affected communities in the state in Los Alamos, Española, and Albuquerque. Linked together through the effects of nuclear technologies in the desert, nuclear communities have emerged that show how the spread of contamination lingers in the ecosystem and the bodies that populate the "empty" desert. Nuclear communities stand as testament to the lack of containment of radioactivity and to the problems underlying the logic of using deserts as dumping grounds for nuclear waste.

Resisting Deserts as Dumps

This discourse of the empty West misrepresents a land that is actually teeming with life, both human and non-human. In the context of WIPP, the desert imaginary has had a

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[36] Maria Montoya, "Landscapes of the Cold War West" in *The Cold War American West, 1945-1989*, ed. Kevin J. Fernlund (Albuquerque: University of New Mexico Press, 1998), 13.

[37] George E. Webb, *Science in the American Southwest: A Topical History* (Tucson: University of Arizona Press, 2002), 121.

long-reaching effect how the site is viewed by different stakeholders. The site has been constantly and consistently described in federal documents as ideal for nuclear waste storage because of a sense of double isolation. First the waste is isolated by the material properties of the salt itself, the existence and stability of which is an oft-mentioned reason for using it to store radioactive waste. But secondly, WIPP is isolated from urban centers and agriculturally productive land, located as it is in a sparsely populated region of the nation, and far from any natural resources such as water. For opponents of WIPP, this ideal of an empty waste and an idealized nature is a political tool to justify some of the most long-term and toxic experiments in human history. One of the largest federal interests that shape how nature is perceived in the West in general, but New Mexico in particular, is a focus on nuclear projects. While the vast majority of nuclear energy is produced east of the Mississippi River, the majority of future plans for storing nuclear waste lie in the West.

Local knowledge presents a conflicted corollary to the universalist claims of scientific endeavors regarding the "knowability" of nature. One the one hand, supporters of WIPP point to their local expertise with resource extraction and mining as a means of asserting a claim to the future narrative of the region as a nuclear corridor. Because of the region's history with oil and gas drilling and potash mining, these supporters of expanding WIPP point to the fact that because of the salt and their local experience, the region is uniquely suited to hosting more and varied kinds of nuclear waste. On the other hand, opponents of WIPP point to the ways that siting more nuclear waste in southeastern New Mexico unfairly target this desert ecology, threatening to turn it into an environmental wasteland. They look at the longer historical pattern that Gersdorf illustrated, and see a continuation of local sacrifice with increasingly extensive pollution and contamination. By connecting the idea of siting more nuclear waste in WIPP or creating reprocessing centers in the region to other

failed experiments of trying to contain nuclear waste, they set up a discourse where nuclear is no longer a progressive energy, but rather one that cannot sustain itself without rendering parts of America as radioactive sites.

For opponents of WIPP, the idea of local expertise with subterranean projects like mining and WIPP is trumped by the larger communal effects of using desert lands as dumping grounds. The desert is not empty and dry, but actually populated by people who deeply care about their place of being. Resisting scientific narratives that define desert by their aridity, ardent opponents of storing nuclear waste in New Mexico or reprocessing facilities argue that it is precisely because of the nature of deserts that make them inappropriate places to store waste, since "deserts tend to have unstable landscapes with extreme weather, hence the risk of erosion and dispersal of waste is greater; and that the reduced quantity of water in deserts makes that water more valuable, hence the loss to society is greater if it becomes contaminated."[38] This idea of desert ecosystems as being delicately balanced is a counter-narrative that disrupts the idea of deserts as ecologically void, and that what resources are there cannot simply be defined and measured through simple economic ledgers of production of water, agriculture and minerals. By challenging historical ideas of deserts as vast wastelands, opponents of nuclear technologies are seeking to claim alternative narratives for the desert based on ecological ideas that present a more complicated reality of the region.

Reacting to the idea of "deserts as dumps," opponents of the GNEP program's ideas of reprocessing and storing high level nuclear waste in Southeastern New Mexico objected

[38] C.C. Reith, "Introduction: Waste Management and the Arid-Land Disposal Concept" in *Deserts as Dumps? The Disposal of Hazardous Materials in Arid Ecosystems*, eds. Charles C. Reith and Bruce M. Thompson (Albuquerque: University of New Mexico Press, 1992), 5.

to making the area "the next toilet of America."[39] During this set of four meetings in Hobbs, Carlsbad, Roswell, and Los Alamos in 2008, Roswell was by far the most contentious site against the GNEP Environmental Impact Statement (EIS), and the potential of setting a reprocessing facility in the area. Another public commenter, Tom Jennings, decried the idea of making Roswell a "dumping ground," and stated his belief that "if there is a spill and rain, then the water goes to the Pecos," contaminating one of the few aboveground water sources in the region. Commenters in this case were looking not isolating waste in southeastern New Mexico, but rather at the ways that it potentially contaminates by concentrating waste streams in Carlsbad and neighboring towns.

As other community members spoke up at the GNEP meetings, it was clear that not only were understandings of different ecological effects being illustrated, but also more expansive communities united under a nuclear umbrella. Returning to Peter Galison's comments about nuclear issues being "always both local and more than local," communities have formed themselves around the experience, trauma, and ultimately, the rejection of nuclear technologies within those communities. In the previous chapter, nuclear communities emerged around transportation, but in this instance, ecology also links together and makes obvious how radiological contamination carves out nuclear wastelands that are hidden from sight but writ large on human bodies as contamination moves through the environment and into internal human ecologies. Linking together communities and ecologies, opponents of more nuclear waste are indicative of new understandings of the environmental threat of contamination of rare resources, as well as the communities of citizens who are defined by their unwitting and unwilling participation in continuing a legacy

[39] Department of Energy, *Global Nuclear Energy Partnership Public Hearing and Invitation to Comment*, Roswell, NM, November 19, 2008 (Statement of Rachel Kales).

of using the desert as a dumping site. Their positions contradict scientific models or ideals that nuclear waste can be safely or easily contained by looking at the historical ways that these projects have failed. As Charles Powell, the president of the Albuquerque Chapter of Veterans for Peace, exclaimed that "We are tired of being used as a national sacrifice zone."[40] Resisting the idea of becoming a national sacrifice zone, a term used by those seeking environmental justice in nuclear wastelands, links these different places together through time and space. It is an idea raised by these speakers to show commonalities among seemingly disparate communities in the U.S. in general and New Mexico in particular.

Ultimately, these kinds of comments show that the expansion of nuclear waste repositories and facilities will affect not only the community of Carlsbad, but also communities that populate the waste routes, waterways, and wind patterns of radioactive fallout. Akin to what Rob Nixon has termed "slow violence," opponents of nuclear waste are challenging the "violence that occurs gradually and out of sight, a violence of delayed destruction that is dispersed across time and space, an attritional violence that is typically not viewed as violence at all."[41] Nixon's characterization of "slow violence" shows another aspect unique to radioactive materials that science has yet to deal with, one that is evident in illnesses and environmental contamination in nuclear communities in New Mexico and beyond. The threat of turning vast swaths of the American deserts into ecological wastelands makes it difficult to accept any uncertainty pertaining to nuclear waste dumps. This point becomes even clearer when one looks at the ways that decisions about nuclear waste affect not only communities across ecologies and geographies, but also across time. Joni Arends made a passionate plea for this future community, "a silent group that has

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[40] Blue Ribbon Commission, *Full Commission Open Meeting,* Albuquerque, January 28, 2011 (Statement by George Powell).

neither voice, nor representation, and that is future generations who will have to live with the decisions we make today."[42] Arends is pointing out here that any decision made by the DOE and the EPA today will be the project of future generations to handle as well, for longer than human records exist.

The Nuclear Future

The final section of this chapter explores how the act of marking a site like WIPP for the next 10,000 years further complicates arguments over permanently storing nuclear waste in the salt beds of the desert. According to a mandate by the EPA, WIPP must be marked for 10,000 years after its closure to prevent inadvertent human intrusion. The DOE subsequently put together a "futures panel" to discuss how the site could be marked effectively. Pulling together four teams of semiologists, geomorphologists, linguists, physicists, writers, and representatives from other disciplines, who came up with criteria for the most likely scenarios of intrusion, and how to potentially mark the site to ward off intrusion by humans. The documents produced by these projects show the difficulty in predicting not only the future nature of the site, but also the future nature of humans.[43] Marking WIPP is seen as necessary in order to warn future generations about the danger of the site, but it also gives credence to the concerns raised by Gordon, Powell, and Arends, since any attempts to mark the site make it very clear where a desert landscape has become a "zone of sacrifice." Marking WIPP brackets out land that Valerie Kuletz has said will

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[41] Rob Nixon, *Slow Violence and the Environmentalism of the Poor* (Cambridge: Harvard University Press, 2011), p 19-20.

[42] Blue Ribbon Commission, *Full Commission Open Meeting,* Carlsbad, NM, January 27, 2011 (Statement by Joni Arends).

[43] The two documents are 1)Stephen Hora, Detlof von Winterfeldt and Kathleen Trauth*, Expert Judgment on Inadvertent Human Intrusion into the Waste Isolation Pilot Plant* (Albuquerque: Sandia National Laboratories, 1991) and 2) Kathleen Trauth, Stephen Hora and Robert Guzowski, *Expert Judgment on Markers to Deter Inadvertent Human Intrusion into the Waste Isolation Pilot Plant* (Albuquerque: Sandia National Laboratories, 1993).

"emerge as the price for, and inevitable result of, a particular set of power requirements" [44] that made nuclear energy a necessity in the 20th, and perhaps 21st century, but will condemn land for the next thousand centuries. WIPP supporters in the contemporary moment have framed WIPP as a solution for nuclear waste, which makes a national nuclear project to increase nuclear energy production a possibility. But it also challenges that narrative by making the nuclear wasteland a clearly demarcated ecological zone.

Another problem presented by marking WIPP is that its "wicked problem" has yet to occur. The marker system is predicated on a disaster that is *assumed* to happen, at some unspecified point in the future, to the site. It shows the inherent unpredictably of trying to understand how humans will interpret warnings at the site as time progresses, and what kinds of societies will emerge in the next 10,000 years. The designers had to consider not only the limitations of human understandings of science, technology and the environment, but also the limits of the existence of modern American society. They have been asked to imagine what the world looks like when there is no longer any United States, no Americans, and perhaps reduced technological advancement and certain cultural memory loss. Nuclear projects have always been dependent on political and national stability; something taken for granted in the present, but impossible in the future. Beyond marking the ecological wasteland, the project of creating a marker system for WIPP is therefore a project predicated on the dissolution of human societies, and in particular, American societies, making it a national project that will certainly outlast the nation itself.

Marking WIPP is an exercise in marking the future, but without being able to assume anything will be recognizable the way it is in the present, including any of the markers of

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[44] Valerie Kuletz, *The Tainted Desert: Environmental and Social Ruin in the American West* (New York: Routledge, 1997), 7.

modern society. The idea of marking WIPP raises important questions: Who is the intended audience for these markers? And what kinds of societal understandings will they have about the dangers of radiation? Part of what is drawn into sharp focus here are the extreme yet vague dangers of radiation. The fact that, at low yet persistent levels, radiation cannot be felt, seen, smelled or tasted makes it a unique toxic liability for environmental and human health. The markers project has to not only describe the invisible substance, but also communicate its particular and unique dangers. The following images demonstrate some of the ways that the WIPP marker teams attempted to answer these questions, using pictographs and earthworks. These attempts to demonstrate warning and danger about a particular site, over a particular time period, regarding a particular substance, tell present-day viewers about the assumptions we have today about nature, radiation, and the limits of science and technology to deal with those issues in the long-term. For these individuals, the main question the markers project raises is: How can nuclear energy be considered green or sustainable, if the future it makes is so difficult to mark and explain, and if the danger inherent to its production lingers for so long?

Take, for example, this pictograph:

Figure 4: Suggested pictograph to mark WIPP (DOE).

It is perhaps the most direct and clearest message for contemporary, English-speaking populations. Yet these symbols are also highly contingent on a very specific set of cultural understandings. The assumption that the radiation symbol will transmit a message of warning to a present day audience is clear, as is the idea of the date itself, A.D. 12,000.

Yet these are not symbols or ideas that are bound to age well. The radiation symbol only has meaning in this context when combined with the understanding of the word "radioactive," and the "A.D." denotation is only applicable in a society that has a Christian-oriented "*domine*." Intriguingly, it cannot be assumed that even these two signifiers are commonly understood in modern American culture. This assumption is carried over into the pictures themselves, with one that seems to reference Edvard Munch's iconic painting "The Scream," while the other is simply a human head that implies a general sense of disgust. Both of these images are obviously based on the long term assumption that the viewers of this plaque will be human, but even in the immediate contemporary moment, it is doubtful that a painter from turn-of-the-20th century Europe can encapsulate the danger and uncertainty of what the WIPP site holds. It is debatable that a modern viewer would understand each concept, but would understand the general gist of the sign. For an audience 10,000 years in the future, this sign could be seen as a curiosity, beckoning the viewer.

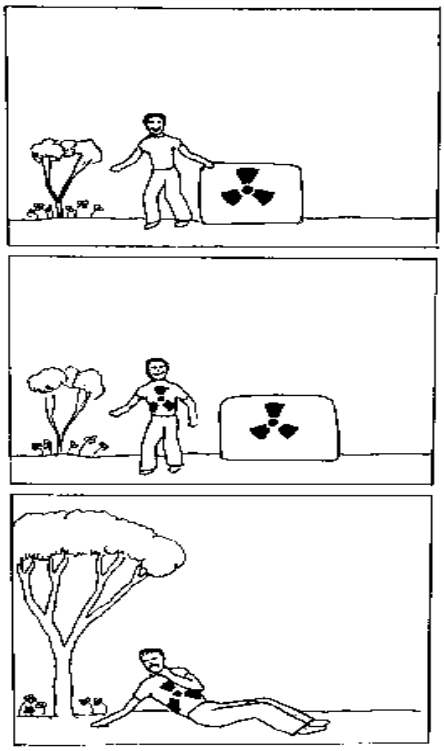

Figure 5: WIPP pictograph (DOE).

This second pictograph[45] also contains numerous assumptions about the site's potential future, and the message it sends to the potential viewer is loaded with symbols whose meanings may not be clear to a viewer in the present, much less hundreds or thousands of years in the future. The symbol for radiation, for example, is very culturally-contingent, and it cannot be assumed that all people living in the present recognize it as dangerous. There is also a nature component to this pictograph that is problematic. The WIPP site is located in the Chihuahuan Desert, which is a low-lying desert landscape. There are no leafy trees providing shade for budding flowers, yet this pictograph assumes knowledge of certain vegetation, including growth rates, as if to say, "If you touch the substance when the tree is

[45] "Pictograph Definition of Symbols- Radiation Trefoil" (art by Jon Lomberg), in Kathleen Trauth, Stephen Hora, Robert Guzkowski, *Expert Judgment on Markers to Deter Inadvertent Human Intrusion into the Waste Isolation Pilot Plant* (Albuquerque: Sandia National Laboratories, 1993), G-20.

this big, you will get sick when it is this much bigger." The landscape in the picture represents a generic site, which lessens the impact of the message if it were found in the desert. The pictograph raises more questions than it answers, and that is before a significant passage of time. While these pictographs are only small markers, meant to bear a specific message of sickness related to radiation poisoning, they are still very limited in scope and meaning.

On a larger scale, some designs are more immediately dramatic. The following markers are just two of many designs proposed for the site, but they all bear the same ideological underpinnings- massive earthworks that are supposed to seem foreboding, marking the ground underneath as off-limits. Some of the proposed ideas contain huge metal spikes, erupting form the ground in a confusing and terrifying array, as if the very earth has rejected the radioactive waste interred and is expelling it into the air. The message, at least in the present, is clear: Do Not Enter.

And yet these markers will be jutting out of the relatively flat Chihuahuan desert. Perhaps the most obvious analogues are the Great Pyramids of Egypt, imposing structures designed and constructed with few apertures to gain access. However, archaeologists, grave robbers, and tourists have diligently spent the last four thousand years trying to invade the pyramids, to find that which was never supposed to be disturbed by outsiders. Can the WIPP site avoid the same fate? The desert landscape here is flat, with lots of vegetation, including sagebrush, cholla cactus, and mesquite. Yet because of the arid nature of the weather, very few organisms, plant or animal, grow more than two or three feet tall (not including humans, of course). The huge spike fields[46] dwarf human proportions, jutting out

[46] Spike Field (Concept by Michael Brill and art by Safdar Abidi). In Kathleen Trauth, Stephen Hora, Robert Guzkowski, *Expert Judgment on Markers to Deter Inadvertent Human Intrusion into the Waste Isolation Pilot Plant* (Albuquerque: Sandia National Laboratories, 1993) F-64.

hundreds of feet into the sky. In the flat desert landscape, they simultaneously declare to the oblivious traveler to approach, explore, but to ultimately be driven away by the imposing nature of the structure.

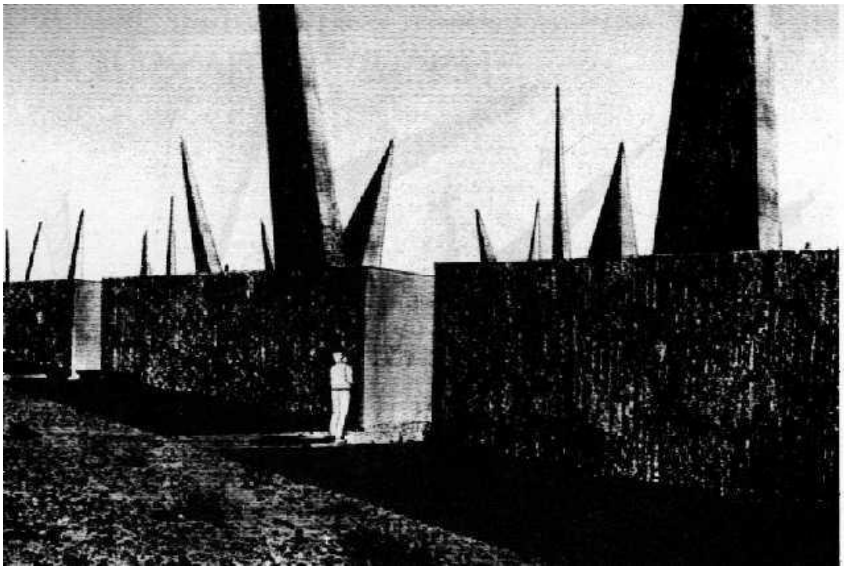

Figure 6: Field of thorns to mark WIPP (DOE).

These structures demonstrate the lack of understanding of desert topography. If the goal is to prevent intrusion, it seems counterintuitive to mark the desert so obviously. It is therefore ironic that marking the site will actually draw attention to it, or as Peter van Wyck has noted, the message must read, "*Look!, here lies nothing."* It is a memorial to the desert, where "what lies beneath must never be celebrated, yet in some fashion must always be remembered." [47] It is the ultimate expression of a wasted zone, where nothing should be done there again ever. Yet by marking it thusly, it makes it an attraction, or at least a curiosity for those traveling across the Chihuahuan.

There is one design that takes the desert into account:

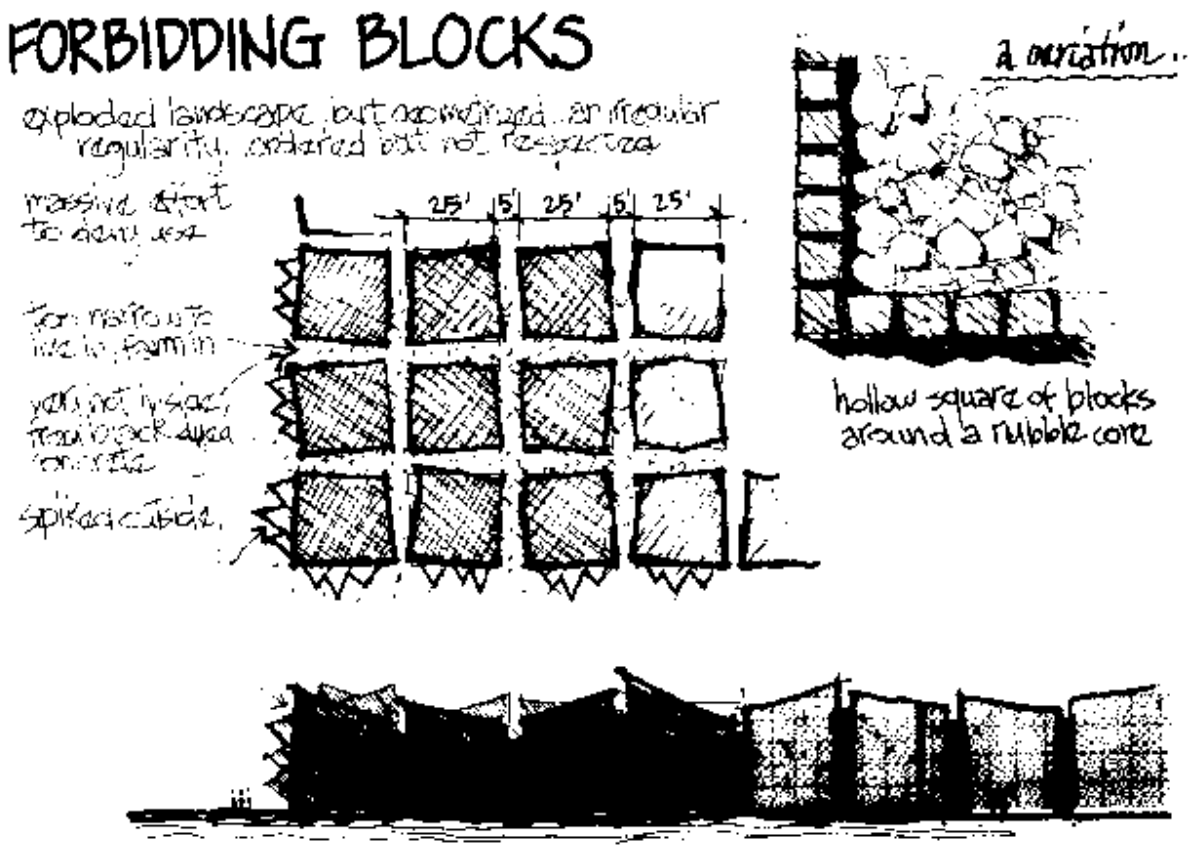

Figure 7: Forbidding Blocks (DOE).

The idea is described thusly:

> **"'Forbidding Blocks':** Stone from the outer rim of an enormous square is dynamited and then cast into large concrete/stone blocks, dyed black. Each is about 25 feet on a side. They are deliberately irregular and distorted cubes. The cubic blocks are set in a grid, defining a square, with 5-foot wide 'streets' running both ways. You can even get 'in' it, but the streets lead nowhere, and they are too narrow to live in, farm in, or even meet in. It is a massive effort to deny use. At certain seasons it is very, very hot inside because of the black masonry's absorption of the desert's high sun-heat load. It is an ordered place, but crude in form, forbidding, and uncomfortable."[48]

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[47] Peter van Wyck, *Signs of Danger: Waste, Trauma, and Nuclear Threat* (Minneapolis: University of Minnesota, 2005), xvi.

[48] "Forbidding Blocks (concept and art by Michael Brill), in Kathleen Trauth, Stephen Hora, Robert Guzkowski, *Expert Judgment on Markers to Deter Inadvertent Human Intrusion into the Waste Isolation Pilot Plant* (Albuquerque: Sandia National Laboratories, 1993) F-74 .

Here the desert imaginary remains a strong trope, as well as assumptions about human nature. The desert's heat will make the marker unbearable in the summer, and the unpalatable conditions of the desert that made it attractive for nuclear activities in the first place.

While these kinds of designs were only the first foray into marking design for the WIPP site, the DOE eventually established a "Permanent Markers Implementation Plan" in 2004.[49] The final design utilized a more methodical and orderly system than rough-hewn blocks or explosions of spikes. Instead, the WIPP site will be marked by several layers and levels of information. The floor plan will look like this:

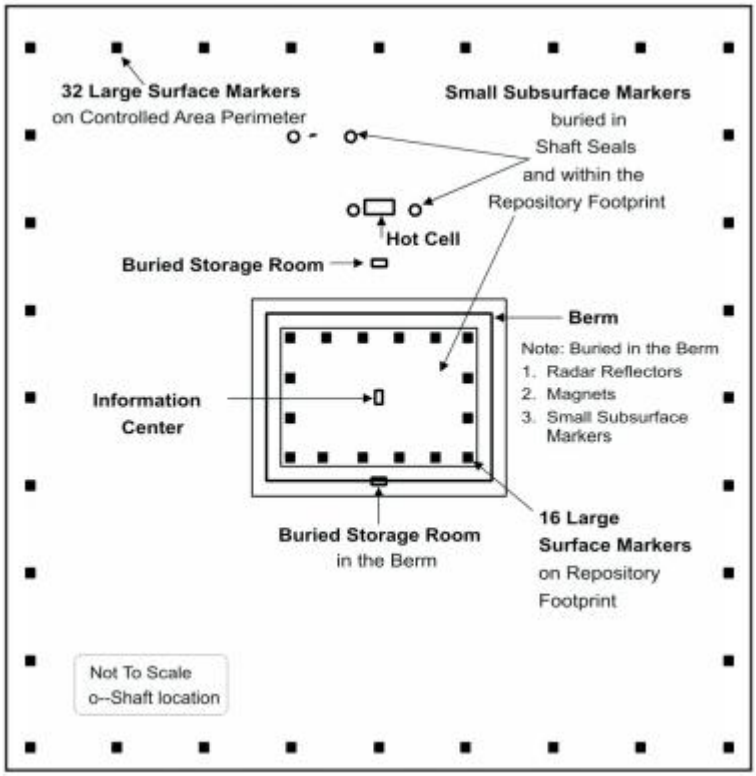

Figure 8: WIPP markers implementation plan (DOE).

[49] U.S. DOE, *Permanent Markers Implementation Plan* (Carlsbad: 2004), 14.

These various features include five layers of information. The first level consists of large, 25 foot tall markers, smaller subsurface markers meant to be encountered during drilling or mining, an information center with messages in six different languages, and a decontaminated "hot cell," the only original remnant of WIPP. According to the implementation plan, there are four criteria that these information levels are attempting to meet: 1) "To alert the intruder to the existence of the site, 2) "To convey a warning of the danger to an intruder, 3) "To inform an intruder about the degree and nature of the danger, and 4) "To endure in form and function for the longest time possible."[50] This last goal is perhaps the most complicated, as it relates to the myriad natures mentioned in this chapter. To endure is a lofty goal, especially when it requires being able to endure against "all foreseeable extreme natural conditions," be "able to resist vandalism," and lack "economic value to be of no interest for scavenging and salvage."[51] Finding a means of marking a spot physically against the elements and climate change is one thing, but dealing also with human curiosity and changing economic needs over successive centuries is another. This goal combines a perception of stability in environmental natures as well as for human natures, and it also has to make predictions on elements that will interest future societies, including what will have value, and most of all, what can be remembered about these nuclear sites that will be harmful to human and environmental health for centuries.

The WIPP markers project is a vast human undertaking that is meant to protect and safeguard against human intrusion into the waste site, much like the salt beds are meant to provide a barrier against natural disturbances. Yet what the markers ultimately demonstrate is the difficulty, and perhaps impossibility, of marking nuclear waste sites into the far future.

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[50] U.S. DOE, *Permanent Markers Implementation Plan* (Carlsbad: 2004), 7.
[51] U.S. DOE, *Permanent Markers Implementation Plan* (Carlsbad: 2004), 7-8.

It is a unique undertaking unlike any other in recorded human history, and the idea that modern science can be used to contain the threat of radiation for a 10,000 year period is made almost absurd in the shadow of metal thorns and forbidding blocks. Even the measured markers of the final design, with its layers of meaning, serves to highlight the impossibility of predicting what kinds of societies, technologies, and even species will exist in future millennia. What the WIPP markers do show is that the only guaranteed substance that will still be in existence at that time is the radioactive waste produced by humans in the 20th and 21st centuries.

Conclusion

The problem of marking WIPP for 10,000 years is an instructive project that looks at the questions raised in the rest of this chapter. It forces us to question what we know about the nature of salt, earth, water, and radioactive particles. It also raises the specter of what we simply cannot predict about future societies, not just 10,000 years in the future, but even 100 years on. Nuclear technologies are introducing elements into the air, water, earth, and human body that will linger for hundreds of generations, and as such, they require stringent control and long-term stewardship. Relegating this responsibility to sound scientific principles, while reassuringly clothed in empirical observations, objective language, and sophisticated computational models, leaves out many of the overarching concerns that public commenters still have over certainty and future change, as well as concerns about past contaminations and how local ecosystems will be affected. While sound science may use the best information and models that human societies can presently provide, when dealing with long-term radiation, it may not be enough to safeguard the environment and local populations and as well as communities outside of the local. Concerns over local ecologies, as well as present nuclear communities, collide with discrete geographical boundaries and

local mining expertise, making the WIPP project and any future project like it both local, and more than local simultaneously.

Because projects like WIPP draw into question present and future generations, environments, and geographies, it is worth spending more time and effort to find a way to deal responsibly with this waste. Scott Kovacs, of Nuclear Watch New Mexico, pointed out during the Carlsbad BRC meeting, that, "This time that we're spending on this process is just an instant compare to the tens of hundreds and thousands of years that the waste will be radioactive. Out of sight must not be out of mind."[52] Kovacs' words point to the greater responsibility of present generations to take the time to find more expansive and inclusive ways of dealing with nuclear technologies, so that future generations do not bear the needless burden of an irradiated desert wasteland. These kind of concerns call for a more transparent and public interactive process for siting nuclear waste sites and nuclear facilities in the future. The next chapter will discuss some of these efforts in the present.

[52]Blue Ribbon Commission, *Full Commission Open Meeting,* Carlsbad, NM, January 27, 2011 (Statement by Scott Kovacs).

Chapter 4: Democracy and Nuclear Technologies

Tense dialogues and interactions between members of the public and officials of federal programs during public meetings indicate sites of contestation that continue to plague nuclear waste projects. They also trouble the idea of consent-based siting as a means of finding sites for nuclear waste storage, as well as the open and democratic process the government wants to achieve through public dialogues. One of the most dramatic meetings that illustrated this tension was the Albuquerque BRC meeting on January 28, 2011. Given only two minutes of speaking time per person at the end of the meeting to make their comments, public commenters regularly ran over their allotted speaking time, and begged repeatedly to be able to finish their statements. The audience agreed, and shouts of "Let her finish" echoed throughout the audience during one elderly speaker's comments, as she spoke haltingly and measuredly through her prepared statements. After her comments, the moderator of the meeting declared that if people didn't behave themselves, he would cut short the meeting itself, effectively silencing the voices of the public that were supposedly a major part of the public hearing. He warned, "I would appreciate very much if we behaved in a more respectful manner, and if we don't behave in a more respectful manner we will close this meeting right now and be done with it. And you can send your comments in on the website, you can email them…but the outbursts need to stop." Much like a parent scolding his small, unruly, and overly emotional children, the moderator's warning was meant to make people to stick to their two minutes, a time determined by the large amount of public members who wanted to make comments. When the buzzer went off, people were supposed to stop speaking and relinquish the microphone.

Five more speakers with prepared comments critical of storing more nuclear waste in New Mexico, calmly delivered their statements. Applause followed each speaker, even as

the meeting chairman announced the next three speakers. But then Katherine Montano took the microphone, and armed with a map of the nuclear sites in New Mexico, she proceeded to lecture the members of the BRC present on the detrimental effect of nuclear technologies in New Mexico. She called it "the greatest crime to humanity, and all life on the planet," and blamed nuclear activity for rising temperatures globally. She continued to speak over the two minute mark, as her voice rose in volume, decrying the "nuclear holocaust" occurring in New Mexico. As BRC Chairman Brent Scowcroft repeated "Thank you, Ms. Montano" in an attempt to cut her off, Montano simply raised her voice higher, speaking over the chairman. He asked that her microphone be turned off, but she continued to shout, her voice growing hoarse with emotion, that the production of plutonium must stop, and that "we are drinking plutonium!" As members of the Albuquerque Police Department Gang Unit began to circle Montano, both Frazier and Scowcroft, perhaps realizing that the meeting was quickly slipping out of control and potentially becoming a public relations disaster, yelled out, "No, don't touch her." Scowcroft lectured her sternly, "Ms. Montano, you are hurting your cause," to which she yelled, "You know what, it's no cause, it's life on this planet. You guys come here and you say that WIPP is fine." In perhaps the most fascinating reply heard during the meeting, Scowcroft snapped, "We're not saying anything!"

Amidst scattered applause and comments from the audience, Montano turned her passionate critique to the Obama administration, and to the Commission itself, noting that half the members were absent, yelled to the commission that, "you should be in prison for what you have done to the state of New Mexico. You are a criminal for what you have done." An "amen" and more applause erupted from the crowd, as Frazier calmly noted, "Ok, ladies and gentlemen, we are now done for the day. Thank you very much. I would say

for those of you that were planning to make comments, please, please, please email them to me. We'll make sure that we get them up on the website." At that, the Commissioners and other members of the BRC delegation got up and filed put of the room, a woman cried out, "Why are we stopping early?" as another man yelled, "This process has no integrity!" Other distraught voices chimed in: "Just because of one person…You just lost your legitimacy…We've been following this process for thirty years and now you're not going to let us speak for two minutes?...Please let the people speak!" Even after the BRC had left and the microphones had been turned off, about 30 people stayed behind to deliver their comments, as a police presence also stayed in the room to monitor them. Afterwards, one woman sadly commented to me, "You know, they give us so little time after they've taken the most time."[1]

The "outbursts" that were decried at the BRC meeting in Albuquerque and that subsequently led to its abrupt and disappointing closure, run counter to an emerging emphasis from federal agencies on the democratic process and transparency when dealing with the public. The events of the Albuquerque BRC meeting, as well as other public meetings held concerning nuclear projects, raise important points about whether a technology that was conceived in the utmost secrecy and authoritarian control can achieve a level of democracy and transparency that will make it acceptable to the public. The display of managerial power which abruptly ended a public meeting justifies the distrust and negative feelings of members of the attending public. Ultimately, the BRC meeting in Albuquerque demonstrated a process by which the public is divested and ultimately erased from nuclear debates. It was reflective of an imperative that Brian Wynne has described as a "need to evacuate ordinary citizens of any recognized capacity for independent, different

[1] Blue Ribbon Commission, *Full Commission Open Meeting,* Albuquerque, NM, January 28, 2011.

collective meaning-making, and corresponding knowledge rooted in different social needs, visions and priorities from those of elites as underpinned by science."[2] Montano's passionate cries for the panel to recognize that nuclear technologies have had an adverse and disproportionate effect on certain groups is certainly part of a different vision for public meetings than the federal side. Though experts and public are both in attendance at these meetings, there is no discourse between the two, stunting conversation and discussion. Public meetings therefore present a deeply apolitical process that is antithetical to democratic representation for a number of reasons. Some of these reasons include what information is shared with the public, access to information, and how public comments are incorporated into shaping federal programs. Ultimately, the process does not fulfill the goals of democratic representation and participation that the BRC says is central and necessary to fairly siting nuclear projects and facilities.

This chapter therefore seeks to examine the purpose and point of public meetings relating to nuclear projects. In examining the ways that public meetings reflect different local expectations, hopes and fears regarding America's nuclear future on several regional levels, I explore how ideas and definitions of consent, community, and democracy emerge in these forums. Building on Langdon Winner's notion that nuclear technologies are inherently authoritarian, I wish to examine the ways that nuclear is now being positioned as a democratic technology, and is being remade through a political process from a national project into a community-driven act. The idea of democratic process, where different voices are heard, listened to, and incorporated into these federal projects, is crucial to community acceptance or rejection on a local level, but part of the project for the BRC and DOE is how

[2] Brian Wynne, "Public Participation in Science and Technology: Performing and Obscuring a Political-Conceptual Category Mistake," *East Asian Science, Technology and Society: an International Journal* 1, no.1 (2007): 101.

to create a process in the first place. How to inform the public, define consent and reconcile inherently authoritarian[3] nuclear technologies with the democratic process is a challenge that brings into focus the limitations of the democratic process of public hearings.

But it is also a problematic ideal, where several issues remain unexamined in the presumption that nuclear technologies can be made into tools of democracy. In order to examine how a consent-based siting approach can be seen as both a novel tool for government agencies while also a problematic approach for democratically siting nuclear waste sites, it is important to take into account several factors that thematically emerged at public meetings that shape how nuclear waste is imagined in the public arena. By looking at specific exchanges that occurred during meetings, several issues emerge that illustrate the limitations of public comment periods, where attendees have different expectations of the results of public hearings. They are meant to encompass a wide variety of functions on a governmental side, especially the dissemination of information, and ostensibly to gather public opinions. For the public, meetings are seen as a place where they can express their opinions and have their voices heard, and formally incorporating different stakeholders voices meant to represent the public. The regulatory and legal process by which decisions for siting nuclear sites are made are also points of contention in these discussions. One point of this process is bringing diverse voices to the table, from non-governmental organizations (NGOs) and tribal representatives in addition to voices claiming scientific expertise and exercising political power to shape nuclear discourses in the public sphere. But overall control of public meetings is granted to federal as the hosts of meetings, which draws into question the usefulness of public meetings themselves as an effective forum for democratic discussion. The abrupt closure of the Albuquerque BRC meeting is a powerful

[3] Langdon Winner, *The Whale and the Reactor: A Search For Limits in an Age of High Technology* (Chicago: University

reminder of who sanctions and controls public forums, power that always lies with the federal organizing bodies.

Concerns over access to information also plague the ideal of public meetings as a way of disseminating information and gathering public opinions. Many members of the public were concerned about how information that these meetings are based on is accessed by the public, and whether that is released in a timely manner. Comments made by the public consistently referred to not having the time to absorb the information in the documents released by the DOE, which often ran into hundreds of pages released only weeks before the meetings were scheduled. They asked for increased comment periods, and longer times to submit comments outside of public meetings. Issues of timely access to information and timing of meetings complicate the point of the meetings themselves, and even the structure and organization of the meetings can delimit interactions within the public sphere by physically separating federal representatives and scientific experts from the public.

At the crux of this issue is that, for the public, the public meeting is an important point of contact for the public to interface with government officials, while for government officials, the public hearing is simply a place to disseminate information and gather opinions. In terms of access, the DOE argues that other avenues for gaining information and making comments are available on the internet, but the public still feels that the DOE is responsible for sharing and simplifying complex technical and scientific information in a public meeting setting, and should be accommodating the public for scheduling. The public meeting therefore encompasses two different ideals- for the public, it is a rare space in the public sphere where the public and the state come together in order to communicate, while for governmental bodies, it is a stepping stone in the legal process of creating federal nuclear

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of Chicago Press, 1988), 19-39.

programs. It is a site for hearing concerns from the public in neat two minute sound bites, but not a site for debates over nuclear projects or where accountability is offered.

A third factor troubling the democratization of nuclear projects lies in the ways that public opinion is transformed into consent. Once comments are expressed in the public sphere, they are supposed to be incorporated into the documents and programs after the meetings. Yet the public rarely has any sense of direct accountability from federal agencies that their comments have been heard or incorporated into federal documents and programs. Scowcroft's telling comment, that "we're not saying anything!" is perhaps a central part of this problem. While members of the public can make comments, they must wait months, or even years to see a response to their concerns in an Environmental Impact Statement (EIS) or final report. In these documents, often hundreds of pages in length, the comments raised by the public are addressed in brief, and often with references to other government documents. Many comments are lumped together as well, creating generalizations in topic, out of very personal comments. The process of responding to public comments in this manner also problematically creates a discrete and monolithic public identity that is then articulated in public documents. In creating this public, the DOE can manufacture consent, by rejecting some comments raised by the public as outside of the scope of the public meeting itself and therefore not germane to the specific project they are discussing, whether it be a draft environmental impact statement for the Global Nuclear Energy Partnership (GNEP) or proposing alternatives to storing Greater-Than-Class-C (GTCC) waste in WIPP. But even the DOE notes the complicated process of understanding consent, noting that for future nuclear sites, "Defining consent, deciding how that consent is codified, and

determining whether or how it is ratified by Congress are critical first steps" in going forward with a process for future projects.[4]

The treatment of public concerns raises questions about the limits of public influence regarding complex technical and scientific questions. This is also a repeated concern raised by scientists in the past concerning nuclear technologies, who have wondered whether an inexpert public should have any say at all. This interesting aspect of nuclear debates takes into account the positions of both opposing and supporting sides of nuclear facilities and programs. Even if the public lacks expertise, public opinion has significant impact on whether nuclear facilities can be sited in a specific place, and the DOE and other regulators must walk a fine line between acknowledging both public consent and opposition, even as they rely on scientific expertise to make final decisions. This at times paradoxical position is reflected in the meetings held by the BRC and GNEP, and public comments at these meetings reflect this tension. By focusing on moments in public discourse throughout meetings for different nuclear programs, the public meeting as a site of democratic process is drawn into question as a useful forum for democratizing the nuclear siting process. Reconciling the unresolved and, in many ways unresolvable, nuclear past with the deeply politicized present will surely have deep ramifications for America's nuclear future.

Nuclear Technologies, Public Voices and Democratic Representation

After taking office in November 2008, one of President Obama's first mandates was to halt funding to a proposed commercial nuclear waste repository in Yucca Mountain, Nevada. He also established the Blue Ribbon Commission for America's Nuclear Future (BRC) in order to find a new, more scientifically- and less overtly politicized method for siting a commercial nuclear waste storage site. The BRC was predicated on the idea that the

[4]Department of Energy, *Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste*

political process that led to the selection and continued focus on Yucca Mountain as a repository for commercial nuclear waste was inherently flawed and scientifically unsound, and that most significantly, it represented a authoritarian, top-down approach for siting a facility by mandating which communities would be selected to hold nuclear sites. As noted in the BRC's Report to the Secretary of Energy, "The United States has traveled nearly 24 years down the current path only to come to a point where continuing to rely on the same approach seems destined to bring further controversy, litigation, and protracted delay"[5] for nuclear projects. The BRC instead emphasized that a new approach was needed, one that was focused on public attitudes towards nuclear technologies and on finding communities that would be supportive and consent to hosting nuclear sites.

One of the strongest suggestions made by the BRC in their final report in 2011 was that a new process was needed for siting nuclear facilities if nuclear is to make a more positive impression on the public in the future. In order to frame a new approach to siting nuclear waste, the BRC emphasized the importance of using a different model than previous administrations, one that "is explicitly adaptive, staged, and consent-based." For the BRC, "this means encouraging communities to volunteer to be considered to host a new nuclear waste management facility while also allowing for the waste management organization to approach communities that it believes can meet the siting requirements."[6] The Department of Energy (DOE) also recognized this issue in their response to the BRC report in 2013, noting that, "Public trust and confidence is a prerequisite to the success of the overall effort, as is a program that remains stable over many decades; therefore, public perceptions must be addressed regarding the program's ability to transport, store, and dispose of used nuclear fuel

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(Washington, DC: GPO, 2013), 9.

[5] Blue Ribbon Commission on America's Nuclear Future, *Executive Summary: Report to the Secretary of Energy* (Washington, DC: GPO, 2012), vi.

and high-level radioactive waste in a manner that is protective of the public's health, safety, and security and protective of the environment."[7] The DOE is in agreement with the BRC recommendations that the consent is crucial to successful nuclear waste programs. This approach stands in contrast with the ways that waste sites have been historically chosen, in a top-down, authoritarian manner that presumed acceptance and willingness by local communities.

The BRC suggestion is basically a warning to the federal agencies in charge of nuclear projects that, if they want to avoid community resistance that has plagued past nuclear projects, the Environmental Protection Agency (EPA), DOE, and Nuclear Regulatory Commission (NRC) need to use the consent-based approach in order to find willing communities at the beginning of the process. A consent-based siting process represents a recognition on the part of federal agencies of an indelible aspect of nuclear technologies, that the "arrangements of power and authority in human associations as well as the activities that take place within those arrangements"[8] are at the heart of public debates of any technological project. Communities that have rejected nuclear projects in the past, most notably in Nevada at Yucca Mountain, have resisted the ways that they felt nuclear projects were forced upon the community without their consent, ultimately blocking the project entirely. Finding a way to incorporate public opinion, both in support and dissent, in the federal process of siting nuclear facilities is now recognized as an important, if not crucial aspect, of continuing nuclear projects in the U.S.

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[6]Blue Ribbon Commission on America's Nuclear Future, *Executive Summary: Report to the Secretary of Energy* (Washington, DC: GPO, 2012), ix.
[7] Department of Energy, *Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste* (Washington, DC: GPO, 2013), 9.
[8] Langdon Winner, *The Whale and the Reactor: A Search for Limits in an Age of High Technology* (Chicago: University of Chicago Press, 1988), 22.

But while the idea of a consent-based approach is an interesting departure from previous methods of siting nuclear waste sites, it also raises questions about defining what consent looks like as well as the idea of the unified and monolithically-minded public itself. The BRC and DOE recognize that a top-down, hierarchical, expert-based method of forcing communities into accepting nuclear facilities has not been successful. To counter this historical pattern, the federal government wants its constituents to realize that this is a new era of nuclear activity, where the federal government is one actor in a constellation of groups trying to responsibly and proactively find communities willing to entertain the idea of hosting nuclear facilities. But in trying to find communities that are willing to consent to having spent nuclear fuel and high-level radioactive waste in their backyards, the BRC and DOE also have to contend with discontented communities, and how they shape conversations regarding the future of nuclear waste.

One aspect that has become central to the recent emphasis on the democratic process and transparency when dealing with the public is the role of the public hearing. With every nuclear project, the DOE and NRC are bound by a mandate from the EPA and the President's Council on Environmental Quality (CEQ) to solicit public comments and conduct a "public scoping process"[9] by which the government seeks to both "inform the public about a proposed action and the alternatives being evaluated, and to elicit public comments on the range of reasonable alternatives and potential environmental impacts."[10] The public scoping meeting has therefore become a central part of eliciting public opinions on these projects, as well as an important site for examining how the future of nuclear waste and other nuclear projects are shaped by public opinion, in terms of both resistance and

[9] DOE, *GNEP Draft PEIS* (Washington, D.C., January 2008), 1-13.
[10] DOE, *GNEP Draft PEIS* (Washington, D.C., January 2008), 1-13.

acceptance. Public meetings are an increasingly rare space in the public sphere, and it is the only place where community stakeholders can express themselves publicly and openly to government officials as well as their own community base.

BRC meetings show this reemphasis on the importance of public meetings within a democratic framework, including the Carlsbad meeting in 2011, when scientist and former WIPP director Wendell Weart reflected on the history and lessons learned from his tenure with the WIPP project. He noted that, "Being a scientist, I once thought if you do the science right that's what's needed, but I've learned since that that's only part of the issue. You must also convince the public and receive the support of the public in order to make it a going concern."[11] Weart's sentiment was echoed continuously during the meeting, with local politicians, business leaders, and citizens in Carlsbad, and the overall feeling was that, along with a trust in the science behind the WIPP project, there was also trust in the democratic system of siting a federal nuclear facility.

The idea that democracy not only can be, but should be, a deciding factor in where to site nuclear facilities is not a new concept for federal agencies even though it is one that has been practiced unevenly. Even though the first six decades of nuclear activity in the U.S. were defined by secrecy and forcing communities into hosting nuclear projects, the Atomic Energy Act (AEA) of 1954 recognized that "a technology with the potential to dramatically affect people's lives was too important to leave in the hands of any narrowly drawn body of elites…Important decisions involving tremendously powerful technologies such as nuclear power required a substantial measure of public participation and support, independent of

[11] Blue Ribbon Commission, *Full Commission Open Meeting,* Carlsbad, NM, January 27, 2011 (Statement by Wendell Weart).

whatever input might be realized through elected officials."[12] Amendments to the AEA in 1957 provided for public hearings during the nuclear siting and construction process, in order to inform the public and to hear concerns and issues the public may have in relation to nuclear power plants. Currently, with every nuclear project, the DOE and NRC continue to follow the National Environmental Policy Act (NEPA) mandate, which is regulated by the EPA and the CEQ, to solicit public comments and conduct a "public scoping process"[13] regarding any national project that may have adverse effects on the environment. The public scoping process seeks to both "inform the public about a proposed action and the alternatives being evaluated, and to solicit public comments on the range of reasonable alternatives and potential environmental impacts."[14] Federal nuclear projects therefore include an element of public involvement in order to legitimate their programs within a public sphere, and the public meeting has become the de facto space where public opinions are sought regarding these projects. Yet there are inherent limitations on the participation of the public- they can give their input, but the federal government always has the final say.

This emphasis on public hearings and scoping meetings reflect a paradoxical situation for the DOE and other federal agencies regarding the use of nuclear technologies in relation to the public. At the dawn of the nuclear age, nuclear projects were born in secrecy and for violent purposes, and omitting the public in those decisions was seen as not only necessary for military security but for political expedience as well. Now, nuclear energy is presently being positioned as a democratically-compatible energy source, refocusing attention on integrating the public in the process of utilizing nuclear technologies. The DOE, BRC, and other federal agencies are trying to reconcile these two paradoxical

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[12] Steven L. del Sesto, *Science, Politics and Controversy: Civilian Nuclear Power in the United States, 1946-1974* (Boulder: Westview Press, 1979), 119.
[13] DOE, *GNEP Draft PEIS* (Washington, D.C., January 2008), 1-13.

positions, which illustrate David Nye's point that, "The hegemony of large systems is culturally shaped."[15] Nuclear technologies may seem implacable, inexorable, and permanent, with their sprawling licensing processes, decade-long construction times, and waste products that defy human time scales. But they are also deeply affected by the social practices and values of the society within which they are used, whether they be authoritarian or democratic, or somewhere in between. The checkered social history of nuclear technologies reflects this contentious back-and-forth between viewing nuclear as an authoritarian energy (as it has historically been seen) or one shaped by values of public participation and democratic forums (as the DOE would like to see it conceptualized by the public in the present).

The BRC, and subsequently the DOE as well, are currently trying to make a case for reconfiguring nuclear energy as compatible with a different kind of political system, one with an emphasis on public participation and consent. In this situation, nuclear technologies demonstrate that "[n]o technological system is an implacable force moving through history; each is a part of a social process that carries from one time period to another and from one culture to another."[16] This is illustrated in the case of nuclear weapons- once thought to be necessary for the political strength of the U.S., which fell out of favor after the Cold War as a means of exercising military and political might. This was partly due to a shifting geopolitical sphere, but also because of a public shift in opinion in the U.S. due to the environmental and social issues that nuclear weapons production caused; issues that were brought to light through the work of community action groups and anti-nuclear protesters. But even though social movements have tempered the spread of nuclear weapons

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[14] DOE, *GNEP Draft PEIS* (Washington, D.C., January 2008), 1-13.
[15] David E. Nye, *Consuming Power: A Social History of American Energies*," (Cambridge: MIT Press, 1999), 5.
[16] Nye, *Consuming Power,* 5-6.

production and led to a decrease of weapons, Langdon Winner notes that the inherently political qualities of centralization and authoritarianism in nuclear technologies makes them inherently inimical to democratic value. He argues that, "To say that some technologies are inherently political is to say that certain widely accepted reasons of practical necessity- especially the need to maintain crucial technological systems as smoothly working entities- have tended to eclipse other sorts of moral and political reasoning."[17] In the case of nuclear, an emphasis on nuclear ism took precedence over public debate concerning the social and moral issues that nuclear technologies raise. Public attitudes were shaped in relation to a perceived political need for producing and maintaining nuclear technologies, rather than vice versa. A reliance on nuclear technologies therefore erodes democratic participation in deciding how complex and dangerous technologies are implemented in society, including concerns over a lack of information available in the public sphere. Federal and corporate emphases on expedience rather than political have made it difficult, if not impossible, to create a process that is open enough for the public to trust the government oversight agencies as having the public's best interest in mind, rather than a decision of corporate and governmental benefit. To combat this perception, the recommendations of the BRC is to re-emphasize a commitment on the part of the various agencies of the federal government to transparency and public consent for nuclear facilities and programs in the future.

The Albuquerque BRC meeting was a dramatic and ironic example of the limits of the democratic process that is the cornerstone of current recommendations of the BRC panel in their final report. Public participation is touted as being central to environmental policies in the U.S. under the National Environmental Policy Act (NEPA) which was passed into federal law in 1970. NEPA has two public aspects for any project that will likely have

[17] Langdon Winner, *The Whale and the Reactor: A Search for Limits in an Age of High Technology* (Chicago: University

significant environmental impacts, including a public scoping period and a public comment period. The BRC, as a commission tasked with suggesting non-legally binding solutions to nuclear waste, did not actually have to have meetings open to the public. But with nuclear projects still lingering under a cloud of mistrust, as evinced by Ms. Montano and dozens of other commenters at the BRC meeting, the more public and transparent the nuclear industry is, the better chance it has of countering a reputation of secrecy, deception, and authoritarian choices.

Defining consent itself is a difficult concept, one recognized by the BRC. Chairman Brent Scowcroft noted the issues of scale that make nuclear projects unwieldy to deal with in a public arena: "We talk about consensus, informed consent, societal issues, but you have expanding circles of interest from the site to the local community to the county to the state to the region to the American society as a whole, of maybe the world society. At what point do you draw the lines around informed consent? Whose informed consent? Because the interests of the various consenters is very different as you go from the site out in terms of their knowledge of it and so on."[18] Scowcroft's point here is related to scale; by asking these questions, he is raising the prickly issue of *how much* consent is required to safely say that the public is behind a particular project, and who should be considered in having a say. His questions raise other questions, ones that are impossible to answer at present: In the case of nuclear waste, if the town of Carlsbad is behind the project, what does it mean or matter if populations in Albuquerque or Santa Fe are not? How much weight does the BRC place on impassioned comments like Ms. Montano's, when they've already stated that she "is hurting her own cause" by raising her voice and being disruptive?

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of Chicago Press, 1988), 36.

[18] Blue Ribbon Commission, *Full Commission Open Meeting,* Carlsbad, NM, January 27, 2011 (Statement by Chairman Brent Scowcroft).

These kinds of questions divide the public sphere, where governmental decisions regarding scale and the limits of public discussion determine not only the extent of public discourse in terms of who constitutes the public that will define consent, but also who gets heard and which voices count. The very concepts of "consent" and "the public" are complicated by a turn to democratic values, which require more complex interactions between government officials and members of the public, interactions which may not be possible through the format of public meetings. But difficulties in conceptualizing these critical terms also illustrates the paradox of public meetings in general, as they are the only place where a public forum exists for members of the public to be heard and to make contact with the officials that they feel are determining the future of nuclear projects in the U.S. This severely delimited space is therefore a crucial site for understanding the potential and limits of nuclear technologies in a democratic political system.

Exercising Control in the Public Sphere

In defining the idea of "the public," it is helpful to use Jurgen Habermas' ideas regarding the formation and practice of the public sphere itself. In the ideal public sphere, "Citizens behave as a public body when they confer in an unrestricted fashion-that is, with the guarantee of freedom of assembly and association and the freedom to express and publish their opinions-about matters of general interest."[19] The governmental aspect of reflecting and carrying out projects is a part of that expression, but governmental representation is legitimated by the opinions and practices of public forum. Extending Habermas' ideas into environmental politics, Margarita Alario has noted that when the public sphere is denied, this lack of "[a]n active public life, invisibility, and hence lack of public recognition prevent[s] vital problems and social asymmetries from surfacing into the

public sphere and being recognized as legitimate political concerns."[20] When the public sphere is censored and delegitimated by governmental authority, it also delegitimizes the process of democratically siting nuclear technologies themselves, reducing them once again to technologies that are foisted upon the public, and not open for public debate. Without public meetings, the creation of nuclear sites slips into the realm of what Eric Swyngedouw has called the "post-political", where "the predominance of a managerial logic in all aspects of life, the reduction of the political to administration where decision-making is increasingly considered to be a question of expert knowledge and not of political position."[21] In a post-political world, consent is assumed, not sought, and it is neither asked for nor given. The public sphere is closed off to the public, and decisions are made outside of the public sphere in governmental and corporate circles with the backing of scientific expertise. Consensus is achieved at the expense of open and political debate. This familiar pattern emerges when looking at the history of siting nuclear facilities in the U.S., especially places like Los Alamos or Hanford, WA. In order to challenge this perception of nuclear technologies in the U.S., programs like GNEP and the BRC need to offer and maintain the public meeting as site of exchange for ideas about nuclear projects between the public and government agencies.

Bringing in different voices, such as NGOs like Concerned Citizens for Nuclear Safety (CCNS) or the Southwest Research and Information Center (SRIC) legitimates the public meeting as a place within the public sphere, even as it raises issues of representation for the groups themselves. For these groups, being invited to give input at federal meetings is a double-edged sword. They are aware that they can be seen as complicit with federal

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[19] Jurgen Habermas, Sara Lennox, and Frank Lennox, "The Public Sphere: An Encyclopedia Article" in *New German Critique*, No. 3. 1974), 49.

[20] Margarita Alario, "Environmental Destruction and the Public Sphere: On Habermas' Discursive Model and Political Ecology," in *Social Theory and Practice* 20, no. 3 (1994): 327.

agencies, or as being permitted by federal agencies to speak for the public. The friction that emerges during public meetings is due in part to one major problem with the processes by which public discussion over nuclear issues are made. Margarita Alario states it thusly: "[T]he state has control of the legal resources and other mechanisms of implementation for the protection of nature not available to private citizens. Because social movements usually lack the long-lasting financial and organizational resources and the loyalties enjoyed by political parties, they are vulnerable, in the absence of publicity, to oblivion."[22] For NGOs, then, it is a difficult task to address all of the various nuclear projects occurring in the U.S., or even in New Mexico. They are forced to be very selective about what programs to challenge, how to use funds, and how to engage the public and present a cohesive position to federal agencies at the same time. Joni Arends, Director of CCNS in Santa Fe, explained this problem to the BRC in her public comments: "It's a very difficult decision for NGO's to decide to sit at the negotiating table. And several times, our NGO colleagues call us sellouts for sitting at the table. An NGO must weigh a number of factors, including what may be gained or lost, whether we support the position of the regulators, or the DOE, or whether to promote another position, and how best to use our limited, limited resources to participate in a time-consuming process."[23] The severe discrepancy of funding and access to scientific information puts the efforts of NGOs at a disadvantage in getting information out to the publics that are involved, including populations that are at the most risk of not having access to government documents that may only be available online or at distant government

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[21] Eric Swyngedouw, "Apocalypse Forever? Post-political Populism and the Spectre of Climate Change" in *Theory Culture & Society* 27, no. 2-3 (2010): 225.

[22] Margarita Alario, "Environmental Destruction and the Public Sphere: On Habermas' Discursive Model and Political Ecology," in *Social Theory and Practice* 20, no. 3 (1994): 338.

[23]Blue Ribbon Commission, *Full Commission Open Meeting,* Carlsbad, NM, January 27, 2011 (Statement by Joni Arends).

offices. For NGOs, being asked to give statements in public meetings legitimates their involvement, but is can also undermine their credibility in the public sphere.

Linda Wiener, a member of CCNS, pointed to the difficulty for NGOs in leaving the public sphere and "ascending" to the big table of experts and government officials. She commented that, "People shoot arrows at you because you're inside, rather than outside protesting, but you can get more concessions when you're at the table."[24] For NGOs, to move from being members of the public (and having a voice only during the public comment period) to the more politically powerful realm of actually representing the public and speaking for disenfranchised groups, is not just a metaphorical division. The physical demarcations of space in public meetings always consists of large tables at the front of the room, with microphones and media equipment for designated speakers, and an audience space of rows of chairs separate from the officially designated speakers. This separation clearly shows which voices constitute expertise and political management, and who does not. When NGOs bridge this divide, they may gain more political clout, but by becoming part of the official table of experts, they run the risk of being seen as "insiders" to the invisible decision-making process for siting nuclear sites that occurs outside of the public sphere, even as their contributions to the official decision-making process are limited.

This paradoxical position was evident at the BRC meetings in New Mexico in 2011. The BRC had specifically sought out different stakeholder groups, including NGOs.[25] As invited speakers on BRC panels, NGOs had a presence at both BRC meetings held in New Mexico, and were especially useful in providing an overview of the history and effects of

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[24] Linda Wiener, Interview with author. Personal Interview. Santa Fe, September 13, 2010.

[25] Allison McFarlane and John Kotek, "Social Acceptance and the Blue Ribbon Commission: A Positive Experience in National Nuclear Waste Discussions," *Bulletin of the Atomic Scientists,* February 14, 2012, http://www.thebulletin.org/web-edition/op-eds/social-acceptance-and-the-blue-ribbon-commission-positive-experience-national-nuc. Accessed February 14, 2012.

community action regarding nuclear issues in New Mexico, and the value of bringing diverse perspectives to nuclear issues outside of technical aspects. Don Hancock, the director of SRIC, spoke on a panel entitled "WIPP Background and History Critique" at the BRC meeting in Carlsbad, where Margaret Carde, the former nuclear waste project director for CCNS, also gave a presentation during the WIPP Transportation Panel. Susan Gordon, of Americans for Nuclear Accountability (ANA) in Santa Fe, spoke on a panel entitled "State, Local, and Tribal Perspective" along with representatives from San Ildefonso Pueblo and the Secretary of the New Mexico Environmental Department, Dave Martin, in Albuquerque. The presence of these groups gave credence to the idea that voices from outside traditional governmental channels were being heard and recorded for the BRC's consideration. These different representatives shared their perspectives about the problems that nuclear technologies had brought to New Mexico, including the ways that WIPP has changed the political, environmental, and social landscape of the state. NGOs have played, and continue to provide, an essential part in pointing out potential issues from nuclear contamination, and in linking communities that have been affected by nuclear technologies together, not only in New Mexico, but nationally as well.

But their presence also serves as a reminder that the history of nuclear production in the U.S. has had a dangerous and uneven trajectory, especially in terms of environmental and social justice issues. NGO representatives engaged with BRC members with further questions and answers, sharing the viewpoints of activist and community members, as well as concerns about bringing more nuclear waste to New Mexico. As Hancock and BRC member Dr. Per Peterson exchanged ideas about radioactive waste classification and affected communities around the U.S., they were interrupted by BRC member Senator Pete Domenici. A former U.S. Senator from New Mexico, Domenici is an ardent supporter of

WIPP and of seeing Southeastern New Mexico becoming America's "Nuclear Corridor," and has been supportive of nuclear technologies in the state since the 1970's. His one-sided dispute with Hancock at the BRC meeting is therefore an illuminating and illustrative example of the clashing views between NGOs and governmental attitudes towards perceived outsiders to the political process of siting nuclear projects, and who gets to define the public as a political entity:

> I regret that I have to do this, but I'll just try to take two minutes. I really get kind of tired of hearing Mr. Hancock who I assume has a reputation of some significance as a scientist, but I really regret that whenever we're having a hearing of the type we're having, when we're talking about a willingness on the part of Congress and the President of the United States to spend literally billions of dollars cleaning up waste, and when we're talking about the tail end of the fuel cycle and how much we are going to improve it, to have somebody impose on us a long sermon about how we have sites in the United States that haven't been cleaned up, how are the ever going to get cleaned up if we can't finish WIPP kind of projects? Where are you going to put the waste? You have to do something before you can solve his problems and he doesn't want to solve the problems the way we do, so he wants to bring up before us how bad things are where he's over there holding up things.
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> Why do you think we're behind schedule on some of the proposals we're talking about...Because he and his people delayed it. Of course when it's delayed you don't get it done so you come here and say they're not doing their job. Well, who was it that caused them not to do their job? I bet on some of them he did. Now he'll come back here if you let him, go on all night telling you how he was doing it in a wonderful way that was terrifically good for the American people, and that's why he was delaying it.
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> But he isn't even willing to admit that before him here we have a site for low-level transuranic defense waste that is absolutely one of the most significant projects man has ever built, in all respects defies those people who say you can't do this by actually doing it, and doing it in such a way that countries are coming here quietly and borrowing that we're doing so they can do it themselves. We have Germany wanting to borrow what we're doing at WIPP and my friend Mr. Hancock talking about how many people are not yet cleared of all kinds of problems at Fernald and other places so he can get out into the public this notion of a relationship of radioactivity to people getting sick. Well, we're trying to make it so they won't get sick and yet we have that permeate when the American people had made up their mind in the last three or four years- some might be very angry about it- that they want us to move ahead in nuclear power. They have changed their mind and I would bet in terms of disposal if you could tell them what we have here and what we're spending our money to do, the American people would overwhelmingly support it. There's just no way we ought to be arguing any longer about [the] ability to have permanent underground disposal of waste, high-level, military, civilian or otherwise, because we can do it and WIPP proves that it can be done in a very, very special way. Excuse me for using so much time."[26]

Domenici's "outburst," which was met by applause from the decidedly split audience, is a fascinating speech that is worth quoting in its entirety because it encapsulates many of

[26] Blue Ribbon Commission, *Full Commission Open Meeting,* Carlsbad, NM, January 27, 2011 (Statement by Senator Pete Domenici).

the frustrations that governmental representatives have with outsider groups and activists. They see them as "thwarting" national plans to deal with nuclear issues and to increase the production of nuclear power by making unreasonable demands on reasonable solutions, such as WIPP. Taken in order, Domenici's concerns encompass several issues that would seem to make nuclear technologies compatible with democratic values: 1) There is government funding for the process of siting nuclear facilities, 2) There are technological models for dealing with nuclear waste, such as WIPP, to emulate, 3) Other countries want to emulate this process because it is so effective, and perhaps most importantly, 4) If only the public was better informed, they would support WIPP-like projects. It is simply a matter of getting the "correct" information to the public.

Domenici also shifts between representing a government interest in finding a democratic solution for nuclear waste, and representing the mindset of the American public here. He occupies an interesting role in the public sphere, shifting between BRC commissioner and therefore a government representative, but also as a former public servant who represented the interests of the New Mexican public at a national level. His presence and discourses complicate the idea of who represents "the public" and which publics have a say in this conversation. Domenici does not agree with the objections that anti-nuclear activists like Hancock are placing in the way, such as not "want[ing] to solve the problems the way we do" and a "notion of a relationship of radioactivity to people getting sick." For Domenici, these are simply not good reasons to block projects like WIPP. Domenici sees NGOs as standing in the way of politically, technologically, and economically progressive projects like WIPP, projects that will allow nuclear energy to emerge as wholly beneficial for society, with no adverse environmental effects related to the storage of nuclear waste. With WIPP and WIPP-like projects, the promise of nuclear energy can finally be achieved, and

past mistakes can be forgotten, taken care of by the salt caverns of Carlsbad. For nuclear proponents like Domenici, national nuclear projects are seen as an effort on the part of the government to address past ills and mistakes made while trying to implement nuclear technologies, while detractors are simply delaying solutions. These different representations of the public complicate the idea that there can ever be such a thing as public consent.

This tension bled into the next day's meeting in Albuquerque as well. Each presenter was given ten minutes to state their points regarding the panel topic. ANA director Susan Gordon gave her comments as part of an invited panel, describing ANA as representative of over 36 different community organizations affected by DOE nuclear programs. She noted also that ANA has been "working collaboratively since 1987, before there even was a cleanup program at the Department of Energy."[27] Gordon's remarks were somewhat critical of the DOE's cleanup efforts, but she emphasized that "Meaningful public participation processes that require early, continuous, and effective public involvement for tribes, states, and the public, and access to all historical and current data relating to the possible health and environmental effects at nuclear weapons sites" were critical to ANA's organizing principles. For ANA and other NGOs, there is no end-point to public involvement in nuclear projects; it is a desirable and necessary component, that, when missing, leads to government oversight of the ways that nuclear technologies erode the cultural, social and environmental rights of disenfranchised communities.

After speaking over her allotted time, Gordon was then interrupted by Senator Domenici, leading to this exchange: Domenici: "Ma'am, your time has expired." Gordon: "Thank you. I would like to finish two statements." Domenici: "How much longer do you have, please, ma'am?" Gordon: "I have two statements to make. Thank you, Mr.

Domenici." Gordon then complimented the process that led to the cleanup at the Fernald nuclear site in Ohio, commenting that it was a model for engaging community needs, while also acknowledging the need to clean up nuclear sites. But her next comment referred to Domenici's statements made the day before in Carlsbad regarding Hancock:

> "I was disturbed listening to the attacks on individuals who raised safety and environmental concerns about WIPP before it opened and continue to raise concerns about its operation now. I truly believe that if those issues had not been raised in the past, and if DOE and the State of New Mexico had not been pressured to improve the plans, build in the safety measures, build the bypass around Santa Fe, and meet environmental regulations, the people of Carlsbad, Lea County, and Eddy County would not have been praising the WIPP project but would have been lamenting environmental contamination in their neighborhood."[28]

After Gordon's comments, Domenici responded: "Thank you. Thank you very much, Susan. We would have given you the time. I wasn't intending to have an argument with you. I was just trying to find out how long you had. Thank you for your statement, appreciate it." This exchange is another indication of the tension over who has the right to speak within the public sphere. Even though time limits are in place for all speakers due to the nature of public meetings, the power to enforce those limits and to interrupt and ultimately control speech, demonstrates that this public sphere is open at the discretion of the government agency or program holding the meeting. More important than this exertion of control, however, is Gordon's point that NGOs haven't stood in the way of nuclear projects, but rather have made them safer and in turn have potentially allowed the nuclear industry to avoid making even more of a negative impact in nuclear communities.

Other commissioners were obviously aware of the discrepancy of power between the BRC and the public, and sought to assure not only NGOs, but also the rest of the public present that the BRC was invested in their right to speak. During the question-and-answer

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[27] Blue Ribbon Commission, *Full Commission Open Meeting,* Albuquerque, January 28, 2011 (Statement by Susan Gordon).

[28] Blue Ribbon Commission, *Full Commission Open Meeting,* Albuquerque, January 28, 2011 (Exchange between Susan Gordon, Pete Domenici).

period following this panel, BRC member Philip Sharp expressed to Gordon that, "I hope you did not get the impression from any of us that we thought it was not appropriate for citizens and citizen groups to raise tough challenges that needed to be answered and needed to be engaged with, however effectively and sometimes ineffectively that may have been done, because it seems to me it is central to both at the time of any decision process of deciding where to put stuff and the afterward in terms of monitoring to have mechanisms and ways in which people can raise questions."[29] Sharp's point here about the public's right to ask questions and demand information of those who are proposing nuclear technologies re-asserts the rights that Domenici is challenging in his admonishment and interruption of community groups as they attempt to bring nuclear issues back into the public sphere. Yet both still indicate that the power of controlling how disagreements are expressed in the public sphere resides in the BRC's hands. The ability to simply cut off, interrupt, or critique certain positions lies with the Commissioners, a power expressed with the closure of the Albuquerque meeting as described in the introduction of this chapter, but also reiterated throughout other meetings. The Albuquerque meeting obviously ended abruptly, but tensions ran high throughout the meeting with a decidedly unsympathetic public filling the room. The show of power by the BRC was an aggressive move to cut off an emotional speaker but also served to put an end to a host of voices that may have been unsympathetic to nuclear technologies. The closure of that meeting demonstrated a clear limit to public participation, by clearly showing that the public is always and only present because the federal agencies holding these meetings allow them to be there. The public sphere exists at their whim, so to speak.

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[29] Blue Ribbon Commission, *Full Commission Open Meeting,* Albuquerque, January 28, 2011 (Statement by Philip Sharp).

The BRC seems to desire the openness of the public sphere and seems to understand that it is an essential aspect of democratizing the process of siting nuclear facilities, which seems to dovetail with the idea that "the successful inclusion of an environmental constituency in the public sphere has become an index of democratic openness." Yet, the goals of BRC are troubled by the ideals of NGOs because the goals of citizen action groups still focus on "transforming the issue of environmental deterioration and risk into a contestable one, where there was no previous public consultation,"[30] and in expanding discussions and participation into the public sphere. While the BRC, as well as other federal programs that require public meetings, are ostensibly in favor of creating this space of contestation and debate, they are also overtly looking for a space to create consent for nuclear technologies. Ultimately, the central inimical tension that emerges during BRC meetings stems from the fact that the BRC has no non-nuclear option, a desire expressed by many anti-nuclear public commenters. While individuals on the BRC represent myriad backgrounds, approaches, and histories relating to nuclear, there is no doubt that their overall mission is to find a space where consent for nuclear technologies is not only probable but the only possible outcome. This major caveat to the public sphere is illustrated in how the process of siting nuclear facilities is managed, as well as access to information.

Access to Information

When to involve the public, and how to engage public comments are also critical parts of this conversation of defining consent. Former WIPP Program Manager Wendell Weart noted that,

> "On consensus, if you're going to be developing a process, not selecting a site, but developing a process, consensus is not going to be easy to obtain at the beginning of a site selection process. You take a poll of people where the question is, 'We're considering bringing dangerous radioactive waste into your site. Are you for it or against it?' Well, that

[30] Margarita Alario, "Environmental Destruction and the Public Sphere: On Habermas' Discursive Model and Political Ecology," in *Social Theory and Practice* 20, no. 3 (1994): 330.

> question alone is not going to get a favorable response so you need to think carefully about at what stage you ask for this opinion of the public and community. Perhaps… at the time you ask them you need to tell them about the benefits that might accrue from this, tangible benefits, jobs, ancillary programs that will increase employment, things that mean a great deal to the community and to the state. So I think you have to consider that in whether or not you need consensus at the beginning."[31]

Weart's concerns over the idea of consensus are an attempt to balance the inherent dangers of radioactive waste and the mistrust that the public still has regarding nuclear mismanagement with the benefits of having federal nuclear projects. In a sense, he is attempting to widen the conversation from wholly negative technical and scientific connotations to include the socially and economically beneficial aspects of nuclear technologies for communities who volunteer or accept them.

Weart's reflections on the idea of consensus also raise the issue of when the public should be included during the nuclear siting process. The clash between science and democracy has defined moments of passion between those who feel that anything nuclear is a detriment to the health of the environment and society, and those who feel that nuclear technologies are synonymous with social progress. Weart's middle ground, of highlighting the incentives instead of just focusing on the well-known history of mismanagement of nuclear waste as well the dangers of radioactive substances, changes the conversation about nuclear from the risks and dangers of handling, moving, and storing nuclear waste, to the economic and social benefits that are offered by federal programs in exchange for consent. These conversations draw into question the idea of "safety" and "control" as well as the limits of scientific knowledge and inherent uncertainties in these projects. Arguments over nuclear technologies are not a simple balance of known risks to economic benefits; rather

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[31] Blue Ribbon Commission, *Full Commission Open Meeting,* Carlsbad, NM, January 27, 2011 (Statement by

they are "over *ideas* and systems of norms and values which defined the meaning, use and significance of nuclear energy in society. [They are] also over how policy decisions ought to be made, and who should make them."[32] By moving policy decision into the realm of the public sphere, several sites of contestation emerge regarding access, meeting logistics, and the legality of moving more nuclear waste to WIPP or adjacent areas.

WIPP's site selection process of establishing criteria for the salt beds is indicative of the ways that science and policy are used to exclude the public from these conversations. Citizens Against Radioactive Dumping (CARD) Albuquerque Spokesman Jeff Nathanson noted that the best system "involves the establishment of criteria before a disposal site is selected." However, he argued that the DOE "recommend[ed[that the proposed WIPP project be constructed outside of this systems approach,"[33] effectively circumventing public debate on the project until after it was already in motion, and by choosing a site first and then creating criteria. CARD's issue with the selection process for nuclear sites like WIPP has been an issue since the Nuclear Waste Policy Act, and point to the complicated issue of both local consent and geographic suitability, versus a lack of long-term knowledge and uncertainty that many groups feel needs to be acknowledged in the DOE plans. By molding the site to specified needs, the selection process itself becomes questionable and untrustworthy, and it resolutely remains outside of the public sphere.

Other community-action groups are also critical of the process by which the DOE has framed WIPP. Don Hancock of SRIC sees many of the technical and public documents

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Wendell Weart).

[32] Steven L. Del Sesto, *Science, Politics and Controversy: Civilian Nuclear Power in the United States, 1946-1974* (Boulder: Westview Press, 1979), 182.

[33] Denise Tessier, "Groups Call for Halt to WIPP Project," *Albuquerque Journal*, November 10, 1978.

as "fatally flawed as a matter of law, as a matter of policy, and as a technical matter."[34] Public meetings are a nod towards to the democratic process, but he has habitually run into problems with getting information, including the untimely withholding of documents, and unwieldy technical documents that can run into the thousands of pages. Joni Arends of CCNS points out the discrepancy of transparency to the public, and things done in the safety of the federal web. She notes that in private industry practices, they would have to separate their waste streams of dangerous and toxic materials. "With DOE, they were allowed to put a trashcan at the end of the glovebox, and put everything in it. There was no distinction about the waste. And because it's a federal facility, it's a federal waste stream, and the federal government is ultimately responsible…and you have on top of that private corporations with private and unknown stockholders- there's no reporting. It becomes a morass of how do you find out information?"[35] Arends argues that this aspect of liability was originally omitted from WIPP documents, and if it had not been for the efforts of local watchdog groups like SRIC and CCNS, much of the language protecting local stakeholders would be missing, since these issues are not covered in the Environmental Impact Statements that are shared with the public. For these groups, the missing aspects of accountability and how to establish redressing victims of accidents concerning nuclear waste underscore the incalculability of the WIPP project. They are inherent and unique aspects stemming from nuclear activities precisely because they are unanswerable questions, which then draw into uncertainty the validity of the WIPP project itself.

Another consistent problem that emerged for public safety and environmental groups was a lack of timely or consistent access to documents the public needs to make

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[34] Department of Energy, *Public Hearing Draft Environmental Impact Statement for the Disposal of Greater-Than-Class-C (GTCC) Low-Level Radioactive Waste and GTCC-Like-Waste,* Albuquerque, April 27, 2011 (Statement by Don Hancock).

informed opinions about technical topics like WIPP. Dave McCoy, director of Citizen Action New Mexico, critiqued whether the idea of public meetings could be useful at all if the documents meant for the public are not released in a timely manner. Specifically, he criticized the NMED, who "sued Citizen Action to keep critical documents about computer models at Sandia for waste movement out of our hands. After we finally got that document, it was three years later, and we also got another 13,000 documents about hazardous waste throughout the state of New Mexico that was not made available to any of the citizens during the 10 years that the NMED withheld them."[36] Navigating the bureaucratic maze of documentation, whether it is a dearth of access, or being swamped with information, is a time-consuming process for NGOs as well.

Some groups have been more complimentary of recent efforts by the DOE regarding transparency, noting how the culture of secrecy has changed over time. Scott Kovac, of Nuclear Watch New Mexico, noted that he "had the opportunity to participate in [WIPP] renewal negotiations in the past year…[The DOE] provide continued and regular public updates, and opportunities for public input. They also allow computer model points to be replaced with actual data."[37] But even as NGOs have been offered more access and the DOE has provided more public information, it does not change another fundamental fact of WIPP. The DOE cannot legally put any other kind of waste into WIPP, and anti-nuclear NGOs have pointed out that expanding the mission of WIPP "would make it harder for future repositories because people would rightly distrust legal protections and

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[35] Joni Arends. Interview with author. Personal Interview, Santa Fe, September 13, 2010.
[36] Blue Ribbon Commission, *Full Commission Open Meeting,* Albuquerque, January 28, 2011 (Statement by Dave McCoy).
[37]Blue Ribbon Commission, *Full Commission Open Meeting,* Albuquerque, January 28, 2011 (Statement by Scott Kovacs).

promises."[38] If more and varied kinds of nuclear waste are brought to New Mexico, a fundamental legal issue arises. But additionally, the public sphere itself becomes a hollowed out space, lingering as a place where public ideas and arguments are expressed by those outside of governmental and corporate interests but not heeded or acknowledged though they may be invited to speak.

One final instance shows the limited opportunities for the public sphere to take hold. Noel Marquez was one of the few dissenting voices at the Carlsbad GTCC meeting. She wistfully noted, "I wish there was more people that had time. There's so many people at work, and they have families and they just do not have the time to come out and basically speak. So I speak for my community and for the people that are quiet and not voicing their opinion."[39] Holmes Brown, the moderator for the meeting, immediately noted that the public comment period was still open, and that people who were unable to attend the meeting could mail, email, or fax comments to the DOE. But Marquez' point, that for people with full-time jobs, families and other commitments, the ability to attend public meetings in order to have their voices entered as part of the public record, and perhaps more importantly, to see federal government representatives who may determine the nuclear future face to face, is an important part of developing the public sphere. Though emails and letters are also included in the public record and often catalogued on line, they are even more removed from public debate, and from seeing those accountable for nuclear projects.

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[38] Blue Ribbon Commission, *Full Commission Open Meeting,* Albuquerque, January 28, 2011 (Statement by Susan Gordan).

[39] Department of Energy, *Public Hearing Draft Environmental Impact Statement for the Disposal of Greater-Than-Class-C (GTCC) Low-Level Radioactive Waste and GTCC-Like-Waste*, Carlsbad, April 26. 2011 (Statement by Noel Marquez).

Incorporating Comments

A final aspect that complicates the public sphere and the ideal of democratic nuclear technologies is how public comments are incorporated into public records. The public sphere may include the public meetings that are part of siting nuclear projects, but once comments are made and submitted in public forums, hearings and meetings, or submitted online or via post, their incorporation is supposed to be reflected in the reports issued by government agencies. Often, this requires drastic action on the part of federal bodies to condense and reduce those comments into manageable and addressable comments. The 2009 WIPP Recertification document is an example of this process, and it lists all of the comments submitted to the EPA, and then responds to them in an appendix of the final recertification document, called the Compliance Recertification Application (CRA). The EPA response often refers to a specific section of the CRA that discusses that particular comment, without a link to where that document might be or how to access it. For instance, one comment listed was that "[A] major continuing longstanding concern is that the Comprehensive Inventory Database (CID) is not available." The EPA response is simply, "Availability of the CID is discussed about in Section 24.1.6" but doesn't actually explain how that section is relevant in this space. Going to that section of the document, the EPA notes that,

> "Many of the public comments received from stakeholders throughout the Recertification process addressed inventory isssues (sic). Multiple groups objected that the Comprehensive Inventory Database was not made public. In response to these comments, DOE provided both an Excel spreadsheet and PDF file of the inventory used for the 2009 (reference DOE letter). Other comments indicated that this was not satisfactory to all stakeholders. EPA determined that the information provided to the public was adequate for the purposes of recertification, and commits to continue to work to provide stakeholders with the most complete information available."[40]

[40] Environmental Protection Agency, *2009 Compliance Recertification Application (2009 CRA) Compliance Application Review Document (CARD) No. 24: Waste Characterization* (Washington, DC: GPO, 2009), 22-23.

Issues like the availability of documents like the CID, and whether it was actually able to answer questions that NGOs had about the waste streams intended for WIPP, is complicated by the fact that the EPA is the final arbiter as to whether information is adequate enough for the public. The issue here is that the power to create and make decisions based on federally-funded scientific information rests with the same federal agencies that are also responsible for disseminating information to the public and determining what information is adequate for the public to have access to.

This control over access to information troubles the idea of incorporating comments created in the public sphere, the operation of which "calls for social integration to be based on rational-critical discourse." Additionally, "[i]ntegration…is to be based on communication rather than domination."[41] The ability to dominate public discussions and control how discourse is framed is shown in the ways that government agencies determine which public comments count and which do not. The dismissal of comments that are deemed irrelevant and therefore do not need to be addressed by the EPA are also listed in the comments for the WIPP CRA. For instance, in the case of the WIPP CRA,

> "Some public comments objected to the mission of WIPP and to the shipment of wastes into New Mexico, and demanded closure of the facility. For the reasons described in the previous paragraph, these comments fell outside the scope of the recertification decision. They are included in Appendix 15-C. Commenters also raised issues related to karst in the 2009 CRA. EPA continues to agree that DOE appropriately ruled out karst as a feature that would occur at WIPP over the regulatory period."[42]

While the EPA does discuss controversial issues raised by the public, such as karst and water movement, it is only to effectively dismiss the concerns, noting that the absence of evidence that karst formations are having any effect on WIPP means that there is no need to revisit

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[41] Craig Calhoun, "Introduction: Habermas and the Public Sphere" in *Habermas and the Public Sphere* edited by Craig Calhoun (Cambridge: MIT Press, 1992), 29.

[42] Environmental Protection Agency, *2009 Compliance Recertification Application (2009 CRA) Compliance Application Review Document (CARD) No. 24: Waste Characterization* (Washington, DC: GPO, 2009).

the topic. In these cases, the agreement of two federal agencies based on the science done by federal scientists or mandated by federal programs overrides lingering public concerns. This omission points to the ways that consensus is built through the lumping together of comments, or by dismissing them as irrelevant, especially when science can be used as an arbiter in shaping what concerns should count, and which do not. But it also raises another concern: If public meetings and scoping periods are not the appropriate place for public discourse as to whether nuclear technologies are acceptable to society, then where is that place? The limitations of the public within the public sphere are evident in these exchanges, made through final documents and decisions sent out by federal agencies.

The GNEP program is another example of how public comments are used to shape federal program. In this case, however, the DOE showed how comments were used to refine the language and scope of the program, but also omitted if they were seen outside the scope of the project. For the final Notice of Intent (NOI) of the program, the DOE received 14,000 comments, including twelve petitions with 7,500 signatures (each petition was counted as only one comment). The DOE organized those into thirteen categories, including policy, programmatic purpose and need, and impacts. The latter category contained fourteen disparate subcategories, including visual resources, geology and soil, and environmental justice. Out of these 14,000 comments, the draft PEIS narrowed them down to just seven concerns. Of these seven, only two were not addressed directly in the draft PEIS, and only one led to the DOE changing its language within the PEIS. According to the DOE, "Commentors (sic) stated that the Purpose and Need was excessively narrow and limited reasonable alternative to only DOE's proposal to reprocess SNF [spent nuclear fuel]." In answer to this concern, "DOE has modified its statement of Purpose and Need to clarify that DOE did not intend to unduly limit the range of reasonable alternatives. DOE

reviewed the scoping comments and other available information carefully and, as a result, added both closed and open fuel cycle technologies to the range of reasonable programmatic alternatives."[43] The DOE therefore used to public comments to justify adding more nuclear technologies as possible options to an already complex program. It expands GNEP beyond reprocessing SNF, which is already a controversial technology because it produces weapons-grade plutonium, and would potentially require several new assessments on both a federal and a public level. In the case of GNEP, the comments garnered by the DOE in relation to the program were used to expand the scope of the program and to commit more attention, research and therefore funding to nuclear experiments, not to limit the program itself or scale it back.

Some rationales for omitting public comments presented in the draft GNEP PEIS are similarly narrow to that of the 2009 WIPP Recertification Process. For instance, comments that recommended focusing on alternative energy sources were not addressed because, "The Purpose and Need for agency action is focused in activities related to the nuclear fuel cycle. Other DOE programs address alternative electricity generation technologies."[44] This comment and response speak to the process of creating consensus, where the need for a program is already established somewhere outside of the public sphere, in governmental levels far above and outside of public debate. Yet public comments such as this one speak to a larger concern to create a more holistic approach and debate over energy policy in general, and to bring that debate into the public. Only after programs like GNEP emerge with NOIs and PEIS', is the program considered important enough in a national framework to warrant the involvement of the public. But at this point, it is difficult for the public to affect the momentum of federal nuclear programs.

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[43] Department of Energy, *Draft GNEP PEIS* (Washington, DC: GPO, 2008), H-5. Capitalization in text.

It wasn't the public, after all, that halted the GNEP program, which was a casualty of the shift in presidencies in 2008. President Obama's nuclear intentions were ambitious as well, as the newly appointed Secretary of Energy, Dr. Steven Chu, described nuclear energy as an essential aspect of any future energy plans for the United States. But the first step for the Obama administration was the formation of the BRC, whose final recommendation for the DOE and other federal agencies was to revisit the process by which nuclear facilities are sited. While the final document, released in January 2012, did not include the comments made in public forums, it did take into account the most pressing concerns made by commenters. These were also discussed in an open meeting on December 2, 2011 in Washington D.C., when the BRC met to discuss public comments and how to incorporate those comments into the public record and into the BRC's final recommendations. By making this meeting public, and having another public comment period included, the BRC had three rounds of public meetings to discuss how the nuclear future in the U.S.

The BRC, despite the Albuquerque public meeting debacle, has actually been the most proactive government program at making the public comment process as transparent as possible, offering transcripts of meetings and live webcasts. Commissioner Allison McFarlane felt that the process had been as positive as it could have been, and that in the future, "With a full-time management and staff devoted solely to nuclear waste management, the new organization would be able to undertake an even more extensive public involvement program than the commission could with its volunteer members and small staff."[45] The lofty

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[44] DOE, *Draft GNEP PEIS* (Washington, DC: GPO, 2008), H-2.

[45] Allison McFarlane and John Kotek, "Social Acceptance and the Blue Ribbon Commission: A Positive Experience in National Nuclear Waste Discussions," *Bulletin of the Atomic Scientists*, February 14, 2012, http://www.thebulletin.org/web-edition/op-eds/social-acceptance-and-the-blue-ribbon-commission-positive-experience-national-nuc.

goal of increasing public involvement is an acknowledged part of the BRC recommendations, but there are few details in the final report as to how to actually increase public involvement. One concrete suggestion was that any new waste management organization in the U.S. should "set aside funding for participation by citizens, citizen groups, and other NGOs."[46] Other suggestions revolved around some of the same ideas that were known to be stumbling blocks with the Yucca Mountain site, including the creation of "a generic disposal standard and supporting regulatory requirements," "a set of basic initial siting criteria," and then approaching "communities that have potentially suitable sites,"[47] or waiting for volunteer communities. However, these recommendations still do not mention public involvement in these first stages of nuclear siting, or bringing initial criteria into the public sphere. As for defining the concept of consent, the BRC leaves that question unanswered, commenting that, "The Commission takes the view that the question of how to determine consent ultimately has to be answered by a potential host jurisdiction, using whatever means and timing it sees fit."[48] Consent remains a vague and ill-defined term, and the BRC has no concrete recommendations for creating a meaningful and useful conversation in a public sphere. By simply delegating the definition of consent to local "jurisdictions" (another vague term that could delineate a number of scales from community to state), the concept remains unexamined.

The BRC recommendations at least recognize that mistakes were made in other siting processes, and that divesting the public from nuclear conversations is no longer appropriate or feasible in a search for democratically-sited nuclear facilities. Their recommendations, if somewhat vague, are a departure from former processes, and they

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[46] Blue Ribbon Commission, *Report to the Secretary of Energy*, (Washington, DC: 2012), 55.
[47] Blue Ribbon Commission, *Report to the Secretary of Energy*, (Washington, DC: 2012), 53.
[48] Blue Ribbon Commission, *Report to the Secretary of Energy* (Washington, DC: GPO, 2012), 57.

reflect a more democratic scope for engaging communities at all times through the nuclear siting process. Their suggestions include an emphasis on forming consent-based, transparent, phased, adaptive, and standards- and science-based, and finally, legally enforceable agreements. The BRC has been criticized for some aspects, including not allowing enough input into their process, not revealing how public comments were used to influence their report, and for not clearly delineating how to engage stakeholders.[49] But in general, their final recommendations at least lay a foundation for how to acknowledge diverse stakeholders, even if terms like "consent" and the "public" are still nebulous and ill-defined. This is problematic, because both concepts are central to democracy and the public sphere.

Conclusion

A central question that continually arises throughout the history of nuclear activity in the U.S. is whether the public should have any say at all in matters that are as technologically and scientifically complex as nuclear technologies. Dr. Graham Foster, a Los Alamos Labs nuclear physicist, testified at committee hearings in 1978, that, "As a professional scientist, I am close to shock at the proposal that technical questions should be resolved by public referendum."[50] From a scientific point of view, Dr. Foster has every reason to be hesitant towards public understandings of science. Yet the concern that his statement expresses is that our technoscientific society relies completely on scientific experts to bring order and function to our modern world. But the over-reliance on expertise often erodes the democratic ideals that are supposed to inform the production of nuclear technologies. Cultural and political aspects of applying science in society are not incidental to using science

[49] Seth P. Tuler, Eugene A. Rosa, and Thomas Weber, "America's Nuclear Future: Does the Public Have a Fair Say in It?" *Bulletin of the Atomic Scientists,* January 31, 2012, http://www.thebulletin.org/node/9007. Accessed February 1, 2012.

in society; rather, they are central and formative aspects of scientific practices and need to be acknowledged as such. Dr. Foster's comment makes an interesting point about how the public understands and sees scientific fact as shaping debates over the legitimacy of science, and his concern continues to undermine the ability to have nuclear conversations in the public sphere today.

In contrast to the technoscientific arguments that rationalize limiting the role of the public in nuclear discussions, community groups and NGOs contend with more abstract issues that are related to technoscience, but also lie outside of those arguments. They are more concerned with engaging the public sphere, as a site for debate, conversation, and intervention against the authoritarian use and implementation of nuclear technologies. One argument for the continued intervention of NGOs actually stands outside of the idea of successfully halting the use of nuclear technologies, where, "The administrative arena must be used as an educational forum to alert the public to the project's adverse effects on environmental quality….Viewed in this perspective, a losing environmental cause is worth fighting for because *it adds to the ecological enlightenment of the public*."[51] While this viewpoint was also expressed in the 1970's based on the difficulty in blocking untested nuclear power plant licenses, the same viewpoint can be applied to the uphill battle that NGOs face with limited resources, access to information, and from coming into the debate of siting nuclear facilities midway through the process, when many issues have already been decided at a higher governmental level. Yet the struggle to simply keep the public informed in order to have ability to speak knowledgeably in the public sphere consumes time and resources as well.

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[50]Torch, editorial, May 4, 1978.

[51] Steven L. del Sesto, *Science, Politics and Controversy: Civilian Nuclear Power in the United States, 1946-1974* (Boulder: Westview Press, 1979), 135. Italics in original.

Both of these viewpoints are still motivating discussions about nuclear technologies in the public sphere today. Examining the ways that nuclear projects engage the public sphere are important because not only are nuclear technologies indicative of large centralized constellations of power, they also have the power to reshape societal concerns. The potential catastrophic effects of nuclear accidents and waste mismanagement far exceed the technological and scientific boundaries that are relied upon by federal agencies. Democratic forums are therefore necessary for exposing the true social, political and environmental costs of nuclear technologies on the American landscape and body politic. They are also a place where the high social costs of nuclear technologies are found to be inimical to democratic intentions.

Epilogue: From Fukushima to Carlsbad

The first decade of the 2000's was declared an era of "nuclear renaissance" by both the nuclear industry and its political supporters. The 21st century has also witnessed new cultural and environmental conditions and priorities, including a focus on air quality, global pollution from unfettered carbon emissions from oil and coal use, and concerns about greater political instability stemming from radically changing environmental conditions. Because of these concerns, the nuclear industry is trying to reposition itself as not only a solution to power needs, but as the *only possible* solution to current global energy crises. In doing so, the industry has re-emphasized and re-imagined some of the facets of its nuclearist philosophy for a modern nuclear age, including the idea that nuclear energy is necessary for the nation to hold to environmentally conscious ideals, to remain economically viable and politically relevant in international nuclear discussions.

In a 2003 report entitled "The Future of Nuclear Power," the Massachusetts Institute of Technology (MIT) published a study reiterating the idea that increasing the production of nuclear energy is an essential aspect of curbing future greenhouse gas emissions. The study's support for nuclear power stemmed exclusively from the "carbon-free character of nuclear power,"[1] as the main justification for their narrow focus on nuclear energy. The MIT study pushed for a substantial increase of nuclear energy production in the next 30 years, noting that "such a deployment would avoid 1.8 billion tonnes of carbon emissions annually from coal plants, about 25% of the increment in carbon emissions otherwise expected in a

[1] Massachusetts Institute of Technology, "Executive Summary," *The Future of Nuclear Power: An Interdisciplinary Study* (Boston: MIT, 2003), 6.

business-as usual- scenario."[2] It also noted major road blocks that would prevent producing more nuclear energy, including cost, safety, waste, and proliferation issues. A final issue the report raised was that of public consent. The report found that, "Our survey results show that the public does not yet see nuclear power as a way to address global warming, suggesting that further public education may be necessary."[3]

The MIT study provides a window into the ways that backers of nuclearism continue to frame nuclear energy as the only realistic way to solve energy issues in the contemporary moment. The idea that public consent can be gained by simply (re)educating the public about the benefits of nuclear energy is a popular trope with nuclear proponents who feel that nuclear has been unfairly represented in the public media as a dangerous and risk-laden form of energy production. The language of the MIT study reflects this belief, that it merely requires the "reprogramming" of the public sphere that would then reflect the logics and rationality of the nuclear industry, a revelation that would allow society to combat global climate change and natural resource limitations for energy production. The MIT study is a testament to a continued faith in nuclearism, a belief in the power of nuclear energy to solve social problems like overconsumption of energy, waste and inefficiency, and the high hidden costs of using fossil fuels, despite the high economic, social, political, and environmental costs of nuclear.

But on March 11, 2011, optimism in the nuclear future was shaken when a 9.0 magnitude earthquake occurred seventy kilometers off the eastern coast of Japan. The

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[2] Massachusetts Institute of Technology, "Executive Summary," *The Future of Nuclear Power: An Interdisciplinary Study* (Boston: MIT, 2003), ix. The authors of the report represent faculty from MIT in the departments of chemistry, nuclear science and engineering, physics and management. Notably, no social scientists or cultural interests are represented.

[3]Massachusetts Institute of Technology, "Executive Summary," *The Future of Nuclear Power: An Interdisciplinary Study* (Boston: MIT, 2003), x.

Tohoku quake triggered 40 meter high tsunami waves that pounded the Japanese coast, sweeping inland and creating a swath of destruction. One of the hardest hit areas was the prefecture of Fukushima, where two nuclear power plants sit just inland of the coast. The northern plant, Fukushima Daini, escaped major destruction. But the second plant, Fukushima Daiichi, was completely submerged by the waves of the tsunami, leading to catastrophic failure of the plants primary generators, as well as its backup systems. Over the course of the next day, the Japanese government ordered the evacuation of residents within a 20 kilometer radius of the plant. Presently, over 80,000 people are still displaced from the Fukushima prefecture. In addition to the massive casualties, fatalities, and missing persons from the tsunami event itself, Japan is currently in the throes of trying to assess the extent of damage from radiation and displacement, and even two years after the accident the country has yet to chart a course forward for nuclear energy use.

The events surrounding the Fukushima nuclear disaster illuminate many of the points of this dissertation and as such, present a timely and relevant model for re-examining some of these ideas as they relate to nuclear endeavors in the U.S. They show the limits of human engineering in containing nuclear threats to human health and radiation, and how an ideal of nuclearism can neither predict nor temper the effects of radiation. Instead, the situation at Fukushima illustrates the limits of human preparation for the unexpected, unpredicted, and quite simply, unimagined (but not unimaginable) expulsion of radiation from nuclear plants. The ensuing efforts by Japanese officials to contain the threat of radiation in the area around Fukushima both physically and rhetorically, as well as the struggles by international scientists and governments to assess the spread of radiation in the air and water on a global scale two years after the incident, also demonstrate the limits of the production of certain and concrete knowledge the face of unexpected nuclear events. The very materiality of the radiation

being released by the Fukushima plant is threatening because it trumps human expectations of the worst-case scenario, creating a greater sense of confusion and emergency as the tragedy unfolded. Finally, the aftermath of Fukushima also demonstrates the limits of the public sphere in nuclear conversations, as the Japanese public overwhelmingly voted against using nuclear power in the future, even as the Japanese government turned the country's nuclear reactors back on.

This lack of accountability to the public spills over from the political obfuscation of Japanese officials at both the Tokyo Electric Power Company (TEPCO) in charge of the plant itself and at a higher government level in terms of transmitting information to the public about the state of the Fukushima plant itself and the radioactive threat it presented to surrounding communities. In the aftermath of the tsunami, the containment pools for spent nuclear fuel (SNF) literally blew apart, even as TEPCO assured the public that the plant was under control and that there was no reason to fear radiation releases. The obvious disconnect between visual and material evidence that something was seriously wrong at the plant and the reassurances of TEPCO underscored the divide between official messages and public mistrust in the information presented by those in control of nuclear technology and the messages being transmitted from official corridors. The meltdown of the Fukushima Daiichi plant also signified a meltdown of the social and political avenues of dealing with nuclear emergencies, even as it rendered useless and baseless the assurances of government officials that nothing was amiss.

This epilogue traces how the events at Fukushima reflect my concerns and arguments regarding nuclear projects in Southeastern New Mexico. While the two sites may seem geographically and culturally disparate at first glance, the events at Fukushima hold important warning signs for any nuclear project, past, present or future. Understanding how

the events at Fukushima occurred in the first place informs discussions of how humans continually rely on sophisticated technologies to control and defy natural events. By looking more closely at the rationales that attempt to assuage the public of the continued safety of nuclear technologies and also physically and psychologically contain the radioactive threats emanating from Fukushima after the disaster offer even more insight into the ways that a belief in nuclear technologies continues to defy the reality of disasters.

Fukushima is of great relevance to nuclear programs being carried out in the U.S. today, even if it is not acknowledged as such. Before the events at Fukushima, Japan held the same optimism in nuclearist principles as the U.S. Nuclear energy was seen as a necessity for the island nation, and a means of supplying the electricity necessary for a technologically advanced nation. But when the unpredicted occurs, technologies break down, and the subsequent breakdown of social and political infrastructures also escalated the tragedy at Fukushima and continues to be a threat whenever nuclear technologies are utilized. The events surrounding the plant and the aftermath revealed the limits of scientific categorizations of radiation, and the failure of technological redundancies to create fixed boundaries for the spread of radiation. Accidents like the one at Fukushima force nuclear regulators, federal officials, and citizens to imagine the unimaginable worst-case scenarios of nuclear technologies gone awry. They also draw into question how nuclear projects are inimical with democratic principles, and whether, once society has gone down the nuclear path, there is any way to go back. Fukushima therefore provides several different windows into looking at the issues and problems that develop from nuclear technologies gone awry.

From Fukushima to Carlsbad

In April 2012, the city of Carlsbad hosted the first National Nuclear Fuel Cycle Summit, organized by the Carlsbad Department of Development. The intention of the

Summit was to give an overview of nuclear activity presently occurring in the U.S., but it was also to showcase how central, open, and accepting Southeastern New Mexico is to nuclear projects. The optimism in the nuclear corridor of New Mexico was prevalent, as the Summit was opened by Governor Susana Martinez, whose remarks highlighted the history and importance of the nuclear industry to New Mexico. She thanked Senator Domenici for bringing the nuclear industry to New Mexico, and described the impact that nuclear has had on the region in economic terms, including over $500 million that the DOE has brought to nuclear projects in the state, and the 1500 jobs through government contractors and 750 permanent jobs. She also noted that the success of WIPP had led to new nuclear developments including the National Enrichment Facility in Eunice, operated by Louisiana Energy Services and URENCO, a multinational consortium, and the uranium deconversion plant soon to be constructed in Hobbs, which will be operated and owned by International Isotopes Incorporated, another private firm. Martinez' speech focused on the economic impacts of nuclear on the region, but not on the larger history of nuclear activity in the state. Her remarks painted a wholly positive and optimistic future for nuclear technologies in New Mexico, setting the tone for the summit.[4]

Speakers representing different roles in the nuclear industry, including academia, corporate, and government interests, gave talks on the heady future of uranium production and enrichment, new reactor technologies, and various options for nuclear waste. The optimism was punctured by the presence of invited speaker Takeshi Ota, a representative from TEPCO who gave a presentation on the Fukushima disaster. After presenting Carlsbad mayor Dale Janway with a present of origami paper, Ota then gave a talk on the disaster at the Fukushima Daiichi plant. He described the panic that ensued after the

[4] Governor Susana Martinez, Comments at the Carlsbad National Nuclear Fuel Cycle Summit, April 3, 2012.

earthquake and tsunami cut off power to the Daiichi plant. Ota spoke of employees tearfully calling home to say goodbye to family members, certain that they would never see them again. He described horrifying conditions at the plant, as workers' boots melted and stuck to overheating vents, employees almost drowned when they were trapped by flooding waters at the security gate to the plant, and volunteers who stayed behind had to enter rooms knowing that they could erupt in flames at any time. The blackout plus the debris left by the tsunami made it even more difficult to understand how the plant was functioning. Additionally, employees needed to use flashlights and temporary batteries in order to check the status of the plant, a deep irony in a nuclear power plant. But even after taking measurements, they had no additional power to actually do anything about the rising levels of radiation and buildup of hydrogen gas and radioactive steam in the reactors. Employees had to wear full radiation safety suits against the rising radiation levels in the main control room, further hampering their movement and vision in the main control room, once organized and orderly, now pitch-black and cluttered.

Ota also described the crippling issues of logistics and communication outside of the plant as well. Vehicles weren't allowed inside the plant grounds because they would impede fire hoses laid out to combat fires, even as other cars and trucks littered the grounds of the plant, washed in by the tsunami, impeding movement of rescue workers. Communication became one of the largest impediments to dealing with the disaster in a comprehensive manner, as communication was lost between the emergency response center and the main control room. After describing the continuing issues stemming from the disaster, Ota outlined the plan for cleaning up the crippled plant. In the aftermath of Fukushima, it will take ten years to remove the damaged fuel rods from the reactors themselves, and an additional thirty years to decommission the plants completely. The four decades it will take

to simply contain the radiation from Fukushima are a sobering reminder that nuclear accidents are unique in the ways they must be handled, and that their effects can make can mark out exclusionary zones that are uninhabitable for humans. These areas, such as the Fukushima plant, can be seen as sacrifice zones to the ideal of nuclearism. Rather than a safe and reliable form of energy, events like those at Fukushima are part of a different narrative about nuclear energy, one where the unpredictable quickly becomes uncontrollable, with long-term consequences that trump human experience with the aftermath of human disaster.

In stark contrast to Ota's recital of tragic and ongoing problems during and after the tsunami, the response to Ota's presentation in Carlsbad reflected a sense that the disaster had been blown out of proportion. The first question posed to Ota after his talk asked how many fatalities could be tied to the actual accident at the nuclear power plant, noting that the only reported fatalities so far had been a farmer who committed suicide rather than leave his farm. Ota, however, could not answer, apologizing that with his limited English he couldn't understand the question. The audience member repeated his question, getting to the heart of his concern: "If I may just clarify, to our best knowledge, there were no fatalities so far as a result of the disaster in the nuclear power plant at Fukushima. However, there are reports that there were indirect fatalities, people who did not die from radiation exposure, but people who died as a result of the fear of radiation and contamination. What can you tell us about other fatalities, not from radiation but from fear of radiation?" Ota replied that, "I have to say very sorry for the people that we had damaged from the releasing of radioactive materials. So we are very sorry for them."[5] Ota's reply, whether by design or because of not

[5] Carlsbad National Nuclear Fuel Cycle Summit, April 3, 2012. Exchange between Takeshi Ota and unidentified audience member.

fully understanding the question, turns the focus from fatalities to the general health of the populace and the lack of full understanding of the radiation emitting from the plant. But the original question is one that is often used in the nuclear industry to minimize the dangerous effects of radiation, by pointing to a lack of fatalities as proof that nuclear energy is safer than other forms of energy production, even including catastrophes like Chernobyl or Fukushima. But this reduction of danger to fatalities ignores how the spread of radiation not only moves unpredictably through the landscape, but also how a lack of access to accurate information exacerbates reactions to nuclear disasters.

Lessons from Fukushima: The Web of Radiation

As the events in Fukushima unfolded, uncertainty about the effects of the meltdown of the reactors at the Daiichi plant was to be expected in the immediate aftermath and tragedy of the earthquake and tsunami. However, the intentional obfuscation put forth by TEPCO and the Japanese government made matters worse, as local communities, the Japanese population, and global scientists struggled to understand how to react and plan in the absence of information. Even after the obvious problems at the plant, including the explosion of several reactors, TEPCO issued reassuring reports that there were no problems at the plant, and then radiation was being contained safely. As smoke poured from mangled reactors, and speculation increased about the exposure of SNF rods, which were known to be kept at the top of reactor fuel ponds, TEPCO finally admitted that in order to keep SNF ponds covered, they needed to pour sea water into the reactors to keep them covered and to prevent complete core meltdowns that would lead to complete containment breaches. When breached, the radioactive core would eject radiation directly into the atmosphere, blanketing hundreds of miles of land and sea in toxic radioactive particles. This is the worst case scenario for nuclear power plants, and TEPCO was basically throwing in the towel,

admitting that the situation was much worse than they had expected.[6] To pour corrosive salt water into a nuclear reactor containment unit is to damn the unit into eternity- it will never be able to operate again, and will have to be immediately decommissioned, and covered with a sarcophagus akin to the perpetual cement cover at Chernobyl.

Similar to the ways that radiation escapes the boundaries of scientific and technological definitions and efforts to contain it, the radiation releases at Fukushima continue to confound social categories defined by risk and exposure. The events at Fukushima have led to the creation of populations who have emerged as radioactive "biological citizens."[7] These groups, who are now defined by their exposure to radiation after Fukushima, include the "Fukushima 50," a group of volunteers who stayed at Fukushima to manually operate the plant, as well as the "nuclear nomads," sub-contracted workers who are not counted in the final tally of workers and whose presence isn't officially documented. Gabrielle Hecht notes that this attitude towards accounting for disasters in terms of fatalities, is common in the nuclear industry, where "[p]roponents focus on narrow statistics (such as death in the workplace) to claim that the nuclear industry does not carry exceptional risks. A single statistic like this however, discounts many other measurements and hides complex social and psychological realities." She calls this approach the "banalization of hazards," which "renders certain jobs, places, or people insufficiently 'nuclear' to qualify for attention, counting, mitigation, compensation, or care."[8] Much like raising the radiation dose for workers in the area, the banalization of hazards also narrowly

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[6] Larry Greenemeier, "Is Seawater a Last Resort to Cooling Japan's Nuclear Reactors?," *Scientific American,* March 15, 2011, **http://www.scientificamerican.com/article.cfm?id=japan-earthquake-tsunami-nuclear-seawater**.

[7] Adriana Petryna, *Life Exposed: Biological Citizens After Chernobyl* (Princeton University Press, 2002), 5.

[8] Gabrielle Hecht, "Nuclear Nomads: A Look at Subcontracted Heroes," *Bulletin of the Atomic Scientists*, January 9, 2012, http://www.thebulletin.org/web-edition/features/nuclear-nomads-look-the-subcontracted-heroes. Accessed January 14, 2012.

defines negative outcomes, leaving populations that have not been fatally exposed or that have been displaced out of the conversation.

The Fukushima 50 were heralded as heroes because of their willingness to risk the high levels of radiation in the plant in the immediate aftermath of the tsunami in order to avoid a complete meltdown of all the reactors. In contrast, the other 18,000 workers who, in the subsequent six months after the tsunami, have been trying to clean up the plant are treated as more akin to "day laborers," who, when they've reached the limit of exposure as measured by dosimeters, are fired and replaced with new workers. Gabrielle Hecht notes that these workers do not use dosimeters so they can work longer, and that for these workers, there is "no compulsory centralized system for tracing cumulative exposure and health data," and therefore, "the absence of interactions among labor, information, and health infrastructures means that workers' health problems are not collected and recorded in a centralized database- thus, many severe health problems never qualify as occupational diseases."[9] By not including these workers in the formal statistics of radiation exposure, their subsequent health is not part of the formal record of the effects of Fukushima, and any illnesses they may get from exposure will not be counted, ultimately erased from the final toll of Fukushima.

The arbitrary manner of treating potential radiation exposure was also reflected in the ways that exposure limits were altered in the aftermath of the tsunami. For clean-up workers at Fukushima, the radiation dose limit was raised from 100 mSv to 250 mSv on March 14 until November, in order to facilitate longer times for workers in the radioactive

[9] Gabrielle Hecht, "Nuclear Nomads: A Look at Subcontracted Heroes," *Bulletin of the Atomic Scientists*, January 9, 2012, http://www.thebulletin.org/web-edition/features/nuclear-nomads-look-the-subcontracted-heroes. Accessed January 14, 2012.

area.[10] Simply elevating the dose limits for workers does not address the actual effects of those doses on workers or the amount of elevated background radiation in the environment. Similar to workers at National Labs or residents who lived in the vicinity of National Laboratories during the Cold War, the incidental exposure to radiation is not a factor that is routinely measured, even as their exposure was hidden from them. These parties were rendered "insufficiently nuclear" (to use Hecht's phrase again) to count as part of tally of irradiated bodies, and their absence allows for descriptions of "perfectly safe" nuclear technologies. This incomplete tallying of radioactive exposures led to a greater erosion of trust for the residents of Fukushima, as well as citizens in Japan who felt there they could no longer trust official information.

Fukushima illustrates two of the principle concerns for those who oppose nuclear technologies. First, the creation of more nuclear communities from the disaster itself, not just in terms of exposure, but those displaced by the accident, are an inevitable part of nuclear disasters. Secondly, the unpredictable ways that radiation moves through the environment is also a serious concern. Radiation was not just detected in the human body, but also in the air, water, and earth, as well as other organisms intrinsically tied to those natural bodies. From wild monkeys outfitted with dosimeters who were used to track radiation in the afflicted region,[11] to fish hauls off the shore of Fukushima,[12] and traces of

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[10] "TEPCO announced the radiation exposure doses of 18,846 workers who had started working at the Fukushima Daiichi NPS from March to November (12/27). 171 workers received more that 100mSv…The radiation exposure dose limit for emergency workers was set at 250mSv as a special measure on March 14. The special measure was abolished making the limit original one, 100mSv, when the goal of 'Step 2' was achieved." Japan Atomic Industrial Forum, "Overview of the status of counter measures of Fukushima Daiichi Unit 1-4 (Dec. 22nd-27th)," Government Nuclear Energy Response Headquarters News Release, http://www.jaif.or.jp/english/news_images/pdf/ENGNEWS01_1319685981P.pdf.

[11] Danielle Demetriou, "Wild Monkeys to Measure Radiation Levels in Fukushima," *The Telegraph*, December 12, 2011, http://www.telegraph.co.uk/news/worldnews/asia/japan/8950513/Wild-monkeys-to-measure-radiation-levels-in-Fukushima.html. Accessed July 30, 2012.

elements from the plant still found in ocean currents 600 kilometers from Japan,[13] the spread of radiation continues to surprise and confound the predictability of nature. This compounds fears and suspicions that nuclear byproducts can be contained, even as the spread of radiation from Fukushima demonstrates how the entire Pacific is becoming a nuclear community exposed to the effects of Fukushima. The unpredictable nature of radiation continues to confound scientists, engineers, and even the medical community- the very authorities the public depends on to prevent nuclear accidents and safeguard the health of the public.

Lessons From Fukushima: Psychosocial Effects of Nuclear Emergency

On February 28, 2013, the World Health Organization (WHO) released a report listing several increases in cancer risks among certain groups in the two most affected areas of Fukushima, including a 70% increased risk for female infants exposed to radiation from Fukushima for thyroid cancer. The WHO report also noted that these estimates were rough at best, and that for most areas where radiation was detected, the doses themselves were below baseline levels for "deterministic effects" to occur, meaning that there was not enough radiation detected for scientifically noted health effects to occur. But the report issued the caveat that, "The relationship between radiation exposure and lifetime risk of cancer is complex and varies depending on several factors, mainly radiation dose, age at time of exposure, sex and cancer site. These factors can influence the uncertainty in projecting

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[12] Deborah Dupre, "Fukushima Hot Cod Stopped from Entering U.S.," *The Examiner*, August 30, 2012, http://www.examiner.com/article/fukushima-hot-cod-stopped-from-entering-u-s. Accessed September 3, 2012.

[13] Jonathan Amos, "Cruise Finds Fukushima Pollution," *BBC News: Science and Environment*, February 22, 2012, http://www.bbc.co.uk/news/science-environment-17124909. Accessed February 23, 2012.

radiation risks, in particular when assessing risks at low doses."[14] Knowing exactly how low-level radiation affects the human body is an inherent uncertainty in nuclear projects that should be taken into account when trying to imagine the worst-case scenarios from nuclear accidents. But the variances in exposure, depending on the type of radioactive isotope, as well as the individual's age, sex, and proximity to radiation all point to the difficulty of trying to pinpoint the effects of exposure. The WHO report can give general ideas about the effects on a population, but that offers little comfort to potential victims or those who don't know the nature of their exact exposure. Anyone from the Fukushima prefecture is now part of a distinct yet nebulous nuclear community, defined by their potential exposure to radiation, and living in fear of the potential ramifications.

The WHO report calls these "psychosocial effects," and noted that they "may extend far beyond the geographical area of impact because of people's worries about future risks. The size of population exhibiting chronic stress may be quite large and social stigma attached to residents of affected areas may exacerbate the problems."[15] Intriguingly, this was also the evaluation of the Japanese Reconstruction Agency (JRA), who noted that the majority of fatalities stemming from the nuclear plant meltdown itself were not related to radiation, but to psychological stress from the "disruption to the smooth operation of hospitals, the exacerbation of pre-existing health problems, and the general 'mental fatigue' from dramatic changes in life situation."[16] Harkening back to the first question after Tekeshi

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[14] World Health Organization, "Health risk assessment from the nuclear accident after the 2011 Great East Japan earthquake and tsunami, based on a preliminary dose estimation," 2013: 8, http://apps.who.int/iris/bitstream/10665/78218/1/9789241505130_eng.pdf.

[15] World Health Organization, "Health risk assessment from the nuclear accident after the 2011 Great East Japan earthquake and tsunami, based on a preliminary dose estimation." 2013: 91, http://apps.who.int/iris/bitstream/10665/78218/1/9789241505130_eng.pdf.

[16] World Nuclear News, "The Health Effects of Fukushima,." February 28, 2012, http://www.world-nuclear-news.org/RS_The_health_effects_of_Fukushima_2808121.html. Accessed March 15, 2012.

Ota's presentation in Carlsbad, the JPA is trying to show that it is not radiation that poses a threat to public health, but rather the panicked response to radiation that is taking more of a toll on human lives, and it is the act of trying to evacuate residents from Fukushima that is causing more problems than radiation poisoning. The JPA suggested that in the future, "it is essential for authorities to understand and communicate the direction that contamination is travelling and where it may be deposited on land. Given this information, as well as 'basic knowledge' of the risks of radiation, residents would not 'feel anxiety unnecessarily.'"[17] Much like the MIT's suggestion, the JPA is assuming that a well-informed public is a less-anxious public. But the JPA's suggestions also underscore how much trust must be given to government agencies regarding the appropriate behavior of the public during times of emergency. But these government agencies then become the sole authority over information and instructions on appropriate behavior in the face of nuclear disaster. This is problematic because they are also the body most invested in seeing nuclear accidents underreported and who are most likely to minimize threats and risks from nuclear accidents.

Much like with the Atomic Energy Commission realized in the 1950's, it is an extraordinarily difficult task for a governing body to be in charge of promoting nuclear energy, and also overseeing its security and safety operations. Communication between government and industry, as well as the population of the surrounding area in Fukushima, was one of the casualties that stemmed from TEPCO being too close to governing agencies. Problems in communication were highlighted in several reports regarding the accident. Fukushima was declared a wholly "man-made" disaster in one report delivered by an independent committee, headed by Yotaro Hatamura. Not only was information misinterpreted by the government and TEPCO officials, but information for the public was

[17] World Nuclear News, "The Health Effects of Fukushima," February 28, 2012, http://www.world-nuclear-

also limited because neither group wanted to incite panic amongst the public. They rationalized giving out limited information about radiation levels and exposure in order to maintain a veneer of control over the situation, but ultimately, tarnished the collective reputation of both government and the nuclear industry as colluding to protect nuclear technologies at the expense of public health.

Other reports, including a report commissioned but independently produced by the National Diet of Japan, were extremely critical of the governmental and corporate response to the disaster. In the Fukushima Nuclear Accident Independent Investigation Committee's (NAIIC) final report, the blame was placed solely on the collusion of government and industry. NAIIC Chairman, Kiyoshi Kurokawa, commented in the report, that "What must be admitted-very painfully- is that this was a disaster 'Made in Japan.' Its fundamental causes are to be found in the ingrained conventions of Japanese culture: our reflexive obedience; our reluctance to question authority; our devotion to 'sticking with the program'; our groupism; and our insularity."[18] But the very qualities that Kurokawa attributes to Japanese culture are also attributes that have been levied at the Nuclear Regulatory Commission and Department of Energy in the U.S.,[19] who work very closely with the nuclear industry at the same time they are supposed to be policing and regulating it. Because nuclear technologies seem to require so much expertise, insularity and "groupism" are seemingly inherent aspects of the nuclear industry. The technical expertise excises public interventions and circumvents public discussions over the safety of nuclear. Kurokawa's comments may be directed at Japanese regulators, but they are also a warning to other countries that are too complacent

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news.org/RS_The_health_effects_of_Fukushima_2808121.html. Accessed March 15, 2012.

[18] The Fukushima Nuclear Accident Independent Investigation Committee, *The Official Report of the Fukushima Nuclear Accident Independent Investigation Commission: Executive Summary* (The National Diet of Japan: 2012), 9. http://www.nirs.org/fukushima/naiic_report.pdf.

[19] Philip A. Greenberg, "Safety, Accidents, and Public Acceptance," in *Governing the Atom: The Politics of Risk*, ed. John Byrne and Steven M Hoffman (New Brunswick: Transaction Publishers, 1996), 136-137.

and unwilling to imagine the worst-case scenario because it is too inconvenient, or too difficult to manage, or in the case of Fukushima, because nuclear regulators do not want the public to think about the potential effects of a nuclear accident, lest they start to question the technology completely.

Lessons From Fukushima: The Nuclear Trap

This is the worst-case scenario for the nuclear industry, then- not the disaster of Fukushima, but the complete disavowal and rejection of nuclear power by the Japanese public. But even as they reject nuclear power, the Japanese government has already acknowledged that it is an inescapable trap. Despite overwhelming opposition to the continued use, production, and increase of nuclear energy post-Fukushima,[20] the Japanese government eventually elected to continue with nuclear power. After shutting off all reactors in the country for three months in May 2012, in order to run safety checks, most reactors were back online by the end of 2012, with extended licenses. The Japanese government argues that the nation simply cannot afford any other alternative. As an island nation, nuclear energy was seen as expedient solution to importing fossil fuels, and before Fukushima, the Japanese produced 30% of electricity through nuclear, and with plans to increase that percentage to 45% by 2030.

Plans are now scaled back in the face of monumental public opposition, but ultimately, there is no non-nuclear option. Ironically, the only country to reexamine their commitment to nuclear in a post-Fukushima world is Germany, whose prime minister, Angela Merkel, has promised to completely phase out nuclear by 2022 by closing all 17

[20] "In brief, the scenarios can be called the 0%, 15% and 20-25% options, representing the portion of electricity that would come from nuclear power plants. Before the accident at Fukushima Daiichi the portion was 26% and national policy was to increase that to 45% by 2030 as the main way to cut carbon dioxide emissions. Twelve polls conducted by national media showed support for the 0% option in the range of 31-49%, while the 15% option was preferred by 29-54% of people across all the polls." World Nuclear News, "Japan Moves

nuclear power plants in Germany. In Japan, the Environment and Energy Council (EEC) issued an initial plan to phase out all nuclear power by 2040. This report was issued in September 2012, and while it initially received backing from the Japanese government, it was quickly reevaluated and reduced to a "reference" paper only. In November, 2012, after elections were held, newly elected prime minister, Shinzo Abe, dissolved the EEC and announced that the government would be in charge of deciding how and when to restart nuclear energy after new safety measures were enacted.[21] The era of no-nuclear in Japan lasted just a few months, upended by the cost of importing fossil fuels and the threat of blackouts. The end of this era also marked the end of public debate over nuclear power as an appropriate or desired technology, supplanted by the immediate need for energy.

There is no space in Japanese discussions for alternatives to nuclear power. The goal of transitioning from fossil fuels and nuclear power to other alternatives that have less catastrophic effects on the environment and communities close to power plants is not an option, and the ideals of nuclearism do not allow it, since nuclear energy is the only viable option for creating clean energy quickly and on a large scale. The expansion of nuclear communities opposed to nuclear have no space or outlet to gain official attention for their position, and have no alternative to offer to replace nuclear. The events of Fukushima show the huge investment into nuclear made on national scales, both in Japan, and in other countries around the world. It is an investment they are finding impossible to get away from in the aftermath of Fukushima.

Aftermath: Imagining the Unimaginable

Towards a Strategy," 8/30/12. http://www.world-nuclear-news.org/NP_Japan_moves_towards_a_strategy_3008121.html. Accessed August 30, 2012.

[21] World Nuclear Association, "Nuclear Power in Japan," http://www.world-nuclear.org/info/Country-Profiles/Countries-G-N/Japan/#.UUN7LByk3Eo. Accessed March 3, 2013.

Ota's remarks and descriptions of the ensuing panic at the Daiichi plant should be a crucial aspect of any nuclear excursion, as the outcome of the Fukushima meltdowns is still undetermined, and the effects on humans and the environment may not be known for decades. Fukushima demonstrates the ways that nuclear disasters encompass different time frames and disasters, including those that have occurred, those that may occur, and those that will occur. These last two categories point to the ways that nuclear disasters are not unimaginable, but simply inconvenient or logistically unwieldy to imagine. Yet it is necessary to reach the limits of the human imagination in order to honestly evaluate the potential effects of nuclear power plants, waste sites, and other facilities and technologies on human ecologies.

One illustrative example of trying to plumb the depths of nuclear catastrophe comes from the Rebuild Japan Initiative Foundation, one of several independent committees and commissions that were convened in an attempt to understand how nuclear matters in the wake of earthquake and tsunami became so disastrous. Their "Independent Investigation Commission" outlined the extreme measures of a worst-case scenario. In this scenario, written by the Japanese Atomic Energy Commission, six cascading malfunctions in the power plant were described that would lead to a mass evacuation of residents in a 250 kilometer radius of Fukushima. The report also noted that, "If such a worst-case scenario becomes a reality, the document suggests, evacuation of the 30 million residents in the Tokyo metropolitan area could become necessary, depending on wind direction."[22] In a worst-case scenario, the mass evacuation of tens of millions of people would be almost impossible to logistically maneuver without vast resources and an explicit evacuation plan. Not only does neither of those contingencies exist, this "worst-case scenario" wasn't even

imagined or explored until *after* the events at Fukushima, when it was submitted to the prime minister of Japan on March 25th, 2011.

The inability or reluctance of TEPCO and the regulators of the Japanese nuclear industry to fully imagine the extent to which nuclear accidents can spread bookends the lack of imagination required to predict catastrophic earthquakes and tsunamis as well. Critiquing this approach, Yotaro Hatamura suggested two lessons that needed to be learned from Fukushima, including that "Possible phenomena occur. Phenomena that are considered impossible also occur," as well as "Acknowledge that risks exist, and create a culture able to debate the risks directly."[23] Hatamura's suggestions call for trying to imagine the unimaginable, much like trying to mark a nuclear site for 10,000 years. Because Japan sits on the edge of the "Ring of Fire," a notable area for seismic activity, and as a country that has a history of tsunamis, it would seem logical to prepare for these natural events. Yet a belief in the "absolute safety myth" of nuclear energy hampered these preparations, a myth propagated by the nuclear industry in Japan in order to "overcome the strong anti-nuclear sentiments connected to the atomic bombings of Hiroshima and Nagasaki" in 1945.[24] The idea of absolute safety cannot acknowledge any threat that may cause the public to question the use of nuclear power, such as tsunamis and earthquakes, and even when evidence existed that these were very real threats, TEPCO refused to make alterations to the design and operations of their plants. Yoichi Funabashi and Kay Kitazawa, members of the Rebuild Japan Initiative, noted that for TEPCO, "Making such changes…would be an admission that existing safety precautions and regulations were insufficient and that nuclear power

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[22] Yoichi Funabashi and Kay Kitazawa, "Fukushima in review: A complex disaster, a disastrous response," *Bulletin of the Atomic Scientists* 68, no. 2 (2012): 10.

[23] Nuclear Accident Independent Investigation Committee, *Investigation Committee on the Accident at Fukushima Nuclear Power Stations of Tokyo Electric Power Company*, 2012, 42-43.

plants did not possess 'absolute safety.' In this way, power companies found themselves caught in their own trap."[25] Instead of acknowledging the reality of the potentially disastrous effects from natural disasters, utilities and regulators simply ignored them, setting up an inevitable showdown between tsunami and nuclear power plant.

These twin traps, of nuclear power itself and the absolute safety myth that justifies its use, are part of nuclearist principles that firmly support nuclear power even in the wake of the disaster of Fukushima. This continued support flies in the face of reality, where these traps show the limits of safety, reliability, and predictability. Instead of being concrete terms defined by science and given parameters and boundaries by technological engineering, these terms are instead revealed as political categories, grounded in nothing but hope and optimism in science and technology to contain and tame the atom for human goals. But without accounting for the possibility of failure, and with no other options being explored, the trap of nuclear seems to be one that the Japanese government is comfortable with. Similarly with American nuclear endeavors, which still push for new power plant models and more efficient designs, there is little acknowledgement of the worst-case scenario. Framed only as a remote possibility, the discussion of preparing for the worst is placed in opposition with nuclear success, and is bracketed out of conversations for fear of alienating the public. Yet what Fukushima ultimately demonstrates is that it is not the technology that fails society, but rather that society fails itself by not acknowledging inherent human reluctance to imagine the worst case scenario if it threatens the idea of technological progress.

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[24] Yoichi Funabashi and Kay Kitazawa, "Fukushima in review: A complex disaster, a disastrous response," *Bulletin of the Atomic Scientists* 68, no. 2 (2012): 13-14.

[25] Yoichi Funabashi and Kay Kitazawa, "Fukushima in review: A complex disaster, a disastrous response," *Bulletin of the Atomic Scientists* 68, no. 2 (2012): 14.

Continuing Faith in Nuclear

At the GTCC meeting in Carlsbad, former mayor Bob Forrest described the effects of the Fukushima situation in a local context: "The Japan accident, what happened over there, you know, I thought there'd be an uproar, maybe a little backlash in Carlsbad, 'See, I told you what would happen.' But today, we look at their mistakes and what happened, and the two things that come out of that accident are, you better watch where you put it. If it's close to earthquakes or tsunamis, well, hell, you couldn't get further from it than southeastern New Mexico." By invoking the desert landscape of Southeastern New Mexico as a natural barrier to tsunamis, Forrest reiterated a familiar and comforting rationale for nuclear projects in New Mexico. Carlsbad and WIPP seem insulated by the salt caverns, far from the reach of tsunamis and earthquakes, and from the terror and tragedy of Fukushima. As for other nuclear projects in the U.S., the Blue Ribbon Commission's suggestions were to wait and see what suggestions the National Academy of Sciences had for nuclear regulators. They went on to note that, "Much of the concern about conditions at the Fukushima Daiichi Station were due to a lack of instrumentation in and knowledge conditions in the spent fuel area."[26] By reducing the problems at Fukushima to a lack of instrumentation is to deny the suggestions of the independent panels convened in Japan after the accident. For them, it was not the technology that broke down that day, but the very political system in place that was supposed to protect citizens and communities from nuclear accidents.

Yet almost exactly two years after the Fukushima Daiichi reactor meltdown, the Japanese government is still trying to piece together an explanation as to how the Daiichi plant was so tragically affected by the tsunami. Unpredictable and unexpected events

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[26] Blue Ribbon Commission on America's Nuclear Future, *Minutes of the Blue Ribbon Commission on America's Nuclear Future*, 2011 (Washington D.C.), http://cybercemetery.unt.edu/archive/brc/20120620235023/ http://brc.gov/sites/default /files/meetings/minutes/brc_may_13_2011_meeting_summary.pdf.

continue to occur, including on March 18, 2013, when power to the crippled and struggling reactors was again lost for several hours, halting the pumps that are continuing to cool the reactors.[27] TEPCO has no idea as to why the power outage occurred, and it is a reminder that the seemingly simple technologies needed to maintain nuclear are still prone to unpredictable behaviors. Yet even in the wake of Fukushima, the American government is pushing new nuclear projects through at an unabated rate, with barely a pause for acknowledging the Fukushima disaster.

As I have tried to illustrate in this dissertation, the unfettered optimism for nuclear projects in the U.S. and internationally is driven by several factors. Nationally, a discourse of the necessity to produce "clean" energy and energy independence are the basis for looking at nuclear as a solution for transitioning from fossil fuels. The concept of nuclearism posits nuclear energy as the only possible way to safely and reliably power the American economic juggernaut. On more local levels, nuclearism and the push for new nuclear sites, facilities, and technologies has created new nuclear communities, defined by their economic, environmental, and cultural relationships to nuclear activities, whether they are harmful or beneficial. What Fukushima shows us are the limits of nuclearism, and how limited human responses to nuclear accidents really are. The aftermath of Fukushima should make every country reevaluate its dependence on nuclear technologies, from the economic cost of an accident, to the long lag-times for decommissioning a plant, to the problems of dealing with radioactive waste in a serious and long-term manner, and the social erosion of political structures that should be in place to protect the public.

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[27] Ma Jie & Masaaki Iwamoto, "TEPCO says outage cause at Fukushima unknown," Bloomberg Press, March 19, 2013, http://www.bloomberg.com/news/2013-03-20/tepco-says-outage-cause-at-fukushima-nuke-plant-unknown.html. Accessed March 20, 2012.

Nuclear projects and the community of Carlsbad are connected through the webs of economics, environment, history and culture. In exploring these connections it is evident that even as local communities are defining themselves through their relationship to nuclear technologies, on a national level, nuclear imperatives seem to have an unstoppable momentum. Even the issues laid bare at Fukushima have not given nuclear proponents any hesitation. Yet in the face of the reality of disaster, it is evident that the local and the national are intimately connected, and the true cost of nuclear energy has yet to be accounted for. For those opposing nuclear energy, it is not questions of science and technology that should be at the center of nuclear discussions, but the exploration of the worst-case scenario. What are the potential costs of using nuclear, and who will pay for them, politically, environmentally, economically, and socially? It will take decades for the true cost of Fukushima to be counted, but these questions offer a starting point for at least articulating different questions that need to be asked before embarking on new nuclear projects in Carlsbad, New Mexico, the United States, and globally.

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