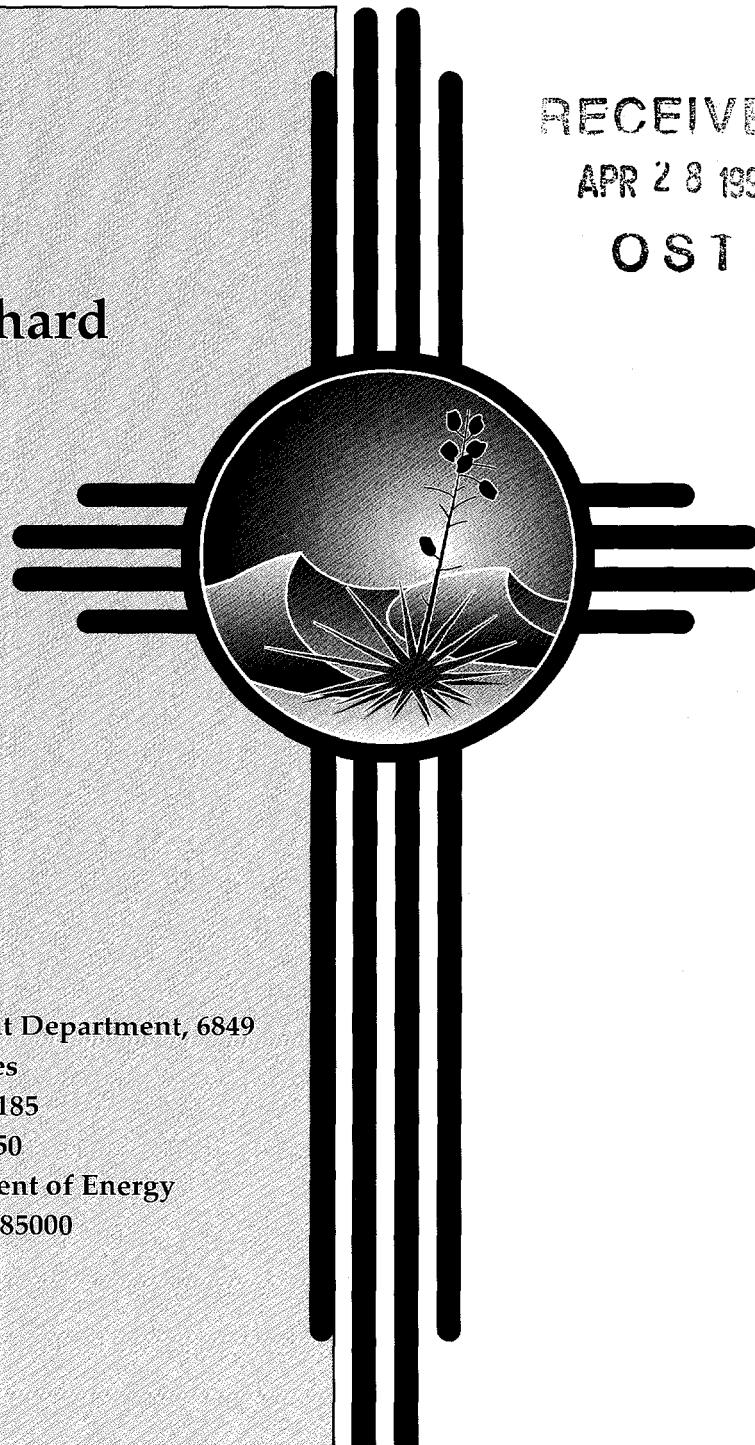


APR 24 1998

Milestones for Disposal of Radioactive Waste at the Waste Isolation Pilot Plant (WIPP) in the United States

Rob P. Rechard

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under contract DE-AC04-94AL85000

SAND98-0072 UC-721
Unlimited Release
Printed April 1998

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Abstract

Since its identification as a potential deep geologic repository in about 1973, the regulatory assessment process for the Waste Isolation Pilot Plant (WIPP) in New Mexico has developed over the past 25 years. (Concurrent in the 1980s, approximately 6 years were spent on construction.) National policy issues, negotiated agreements, and court settlements over the first half of the project had a strong influence on the amount and type of scientific data collected. Assessments and studies before the mid 1980s were undertaken primarily (1) to satisfy needs for environmental impact statements, (2) to develop general understanding of selected natural phenomena associated with nuclear waste disposal, or (3) to satisfy negotiated agreements with the State of New Mexico. In the last third of the project, federal compliance policy and actual regulations were sketched out, but continued to evolve until 1996. During this eight-year period, four preliminary performance assessments, one compliance performance assessment, and one verification performance assessment were performed.

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Preface

The milestones table for the Waste Isolation Pilot Plant (WIPP) Project was originally prepared as a section in the report, *An Introduction to the Mechanics of Performance Assessment Using Examples of Calculations Done for the Waste Isolation Pilot Plant Between 1990 and 1992*, SAND93-1378, by Rob P. Rechard. The milestones table, a particularly popular section, has been reproduced separately here and has been updated to include 1996 and 1997. As before, some text accompanies the milestone tables, but the emphasis remains on the tables because of their usefulness in providing a comprehensive but concise history of the WIPP. The usefulness of the milestones table is due in part to Anita Reiser and Wendell Weart, both of Sandia National Laboratories, who helped with verification of information; and Tech Reps, Inc., personnel, Carol Crawford, who verified references; Molly Minahan, who edited the text; and Kathy Best, who placed the text in tables.

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Milestones for Disposal of Radioactive Waste at the Waste Isolation Pilot Plant

New Mexico has a long history of involvement in nuclear phenomena: In 1942, the Manhattan Engineering District selected New Mexico for assembling the scientists, engineers, and technicians to develop the first atomic bomb and what was to become Los Alamos National Laboratory and Sandia National Laboratories (SNL). In 1945, the first atomic explosion occurred in the desert near Alamogordo, New Mexico. In 1961, the U.S. detonated a device to explore nonmilitary uses of nuclear explosives in bedded salt near Carlsbad, New Mexico (Gnome Project).^{T5} Since 1973, New Mexico has been a potential disposal site for waste contaminated with transuranic (TRU) nuclear elements created during the production of nuclear weapons.^{T22} A brief description of this latter aspect is presented below followed by a detailed tabulation of milestones of the Waste Isolation Pilot Plant (WIPP).

Early History of Nuclear Waste Disposal Related to the WIPP

Around 1944, the Manhattan Engineering District initially decided to bury solid nuclear waste in shallow trenches and augered holes at Los Alamos National Laboratory in New Mexico, and in railroad cars, trenches, and underground caissons at the Hanford Reservation in Washington. Liquid nuclear waste was stored in ponds at both sites. The Atomic Energy Commission (AEC), formed in 1946^{F1} and the precursor to the Department of Energy (DOE), continued the practices of the Manhattan Engineering District. The AEC also constructed storage tanks in the late 1940s at Hanford and completed a nuclear waste storage complex at Idaho National Engineering and Environmental Laboratory (INEEL) in 1952. The AEC spent the period from 1955 through the late 1960s exploring more permanent solutions for radioactive waste disposal in the United States. Studies of disposal options began in 1955 when the AEC asked the National Academy of Sciences (NAS) to examine the disposal issue.^{D2} In 1957, the NAS reported that while various options and disposal sites were feasible, disposal in salt beds was the most promising method to explore.^{T2} NAS reaffirmed that recommendation in 1961. Frustration at the lack of a formal waste policy at AEC caused the NAS to strongly criticize current AEC disposal practices in 1966.^{N2, T9, T22} In 1970, the Board of Radioactive Waste Management of the NAS concluded that bedded salt was satisfactory and was the safest choice now available for nuclear waste disposal.^{T3, T10, T11} From 1961 through the early 1970s, Oak Ridge National Laboratory (ORNL) conducted radioactive-waste disposal experiments, most notably Project Salt Vault in an abandoned salt mine near Lyons, Kansas from 1963 to 1967.^{T7, T8}

In June 1970, the AEC tentatively selected the Kansas mine as a repository.^{D6} Also in June 1970, the AEC told Idaho Senator Church that the waste stored in Idaho would be removed by 1980 and sent to the salt mine.^{D8} Later in 1970, a conceptual design was completed for a nuclear waste repository in salt. In 1971, the AEC directed that high-level waste (HLW) be solidified within five years, stored retrievably at all DOE facilities, and delivered to a federal repository within 10 years.^{D7} This directive also eventually affected transuranic nuclear waste, which was thereafter retrievably stored on the surface in Idaho and elsewhere rather than disposed of in trenches with low level waste. In the same year, a large number of drill holes and some solution mining were discovered at the proposed repository site near Lyons, Kansas.^{T12} Soon after, Congress directed the AEC to stop work on the Lyons project until safety was certified. In May of 1972, the AEC officially abandoned the Lyons project and announced plans for a Retrievable Surface Storage Facility (RSSF).^{D9} Anti-nuclear groups claimed that the RSSF proposed by the AEC to be de facto permanent disposal. This situation prompted the AEC to search again for a more suitable disposal site.^{T13-T20} Soon after, the AEC, ORNL, and the United States Geological Survey (USGS) recommended the extensive salt beds of southeastern New Mexico.^{T21}

Early Studies at the WIPP*

With the tacit approval of governor Bruce King of New Mexico, the AEC focused further attention on the Delaware Basin in New Mexico. After an initial investigation of existing information, a potential site near the edge of the basin was identified in 1973. The first large-scale field test was conducted in March 1974 when ORNL drilled AEC-7 and AEC-8.^{T89} Also, in 1974, ORNL conducted the first scenario development and deterministic analysis for the proposed repository.^{T22} In April 1975, SNL was chosen as the lead laboratory to (a) select and characterize,^{T24} (b) develop a conceptual design,^{T27} (c) draft an environmental impact statement (EIS)^{D20}, and (d) initiate scientific studies for the repository.^{T26} After some site characterization, SNL recommended locating the WIPP site nearer the basin center where the stratigraphy was more predictable.^{T12, T23, T24} (A minor repositioning of the disposal panels also occurred in 1982). That site was to become the current WIPP site, near Carlsbad, New Mexico.^{D10}

National policy issues, court settlements, and negotiated agreements have had a strong influence on the amount and type of scientific data collected during the early phase of the WIPP Project. The passage by Congress of the *National Environmental Policy Act of 1969*^{F3} established a broad national policy requiring an EIS on large federally funded projects. The EIS process exerted its influence during the 1970s as the AEC, which later became the Energy Research and Development Agency (ERDA) and later became the DOE,^{**} continued investigations on bedded salt in general and specifically, the salt deposit in New Mexico as a satisfactory medium for hosting a repository. SNL's support of the EIS consisted of (among other things) deterministic detailed computer modeling of diffusion through the salt of radioisotopes through human intrusion, release of radioactivity, and their potential transport of radioisotopes through the aquifer overlying the WIPP to the Pecos River over a 250,000-year time frame (~10 half-lives of ²³⁹ Pu) followed by dose calculations to humans.

During 1978 and early 1979 and without consultation with the State of New Mexico, the mission of the WIPP oscillated between including and not including commercial spent nuclear fuel (SNF) and high-level waste (HLW) in addition to TRU wastes.^{D13, D18} Also, the new Carter administration required a fresh look at sites and options for nuclear waste disposal.^{D14, D15, D17} Because some of the options considered generated distrust of the intentions of the DOE within the state and were counter to the ideas of Congress, Congress firmly established the purpose of the WIPP Project as a research and development facility for storage and disposal of TRU waste only (i.e., not commercial or defense SNF nor HLW). Congress also specifically exempted regulation by the NRC and thus by default granted self-regulation to the DOE.^{***} National advisory groups, particularly the WIPP Panel, which was set up under the Board of Radioactive Waste Management of the NAS,^{D10, T85} and an independent state-selected evaluation group, the New Mexico Environmental Evaluation Group, were established on the initiative of the DOE to monitor its self-regulation.

After the final EIS^{D20} was published in 1980 and a record of decision published in January 1981,^{D22} the DOE proceeded to the preliminary design of the WIPP. Planning activities included a site and preliminary design validation (SPDV) phase, consisting of drilling two shafts in 1981 and 1982 and mining an

* Because the Waste Isolation Pilot Plant (WIPP) Project spans more than 25 years, more events and milestones have occurred than can easily be covered in a few pages; thus, the description is selective to those issues that do not require extensive explanations. However, the large influence of national and regional policy on the type and extent of scientific studies conducted at the site is still evident.

** The Atomic Energy Commission (AEC) was formed by the *Atomic Energy Act of 1946*.^{F1} The Energy Research and Development Agency (ERDA) and the Nuclear Regulatory Commission (NRC) were formed by splitting the Atomic Energy Commission in the 1974 *Energy Reorganization Act*.^{F7} ERDA became the Department of Energy (DOE) in 1977.^{F11}

*** Although regulation by the Nuclear Regulatory Commission (NRC) would have been possible, the NRC had been established to regulate primarily commercial nuclear reactors and waste. Also, Congress did not favor NRC oversight of defense-related activities.

experimental area. Full construction of the WIPP surface facility, an extensive underground experimental area, and one underground disposal panel began in 1983 after meeting the terms of the “Consultation and Cooperation Agreement” with the State of New Mexico and continued to completion over the next five years. Simultaneously with design and construction, SNL began fielding many in situ salt creep experiments to characterize the local disposal system.^{T43, T44, T45} Although, from a practical standpoint, the predicted and measured values of creep were close, the measured salt creep was nevertheless about three times greater than the predicted values and so by 1985 an alternate mathematical expression for the creep phenomenon was developed.^{T47, T48, T61} In addition to developing a general understanding of selected natural phenomena as deemed prudent by SNL scientists (working with peers in waste management) and/or scientists on the WIPP Panel of the NAS,^{D10, T85} many of the geotechnical experiments conducted during the 1980s were undertaken to satisfy agreements with the State of New Mexico. Specifically, in 1981 in response to a lawsuit, a “Stipulated Agreement” and “Consultation and Cooperation Agreement” as mentioned earlier were negotiated that defined the relationship of the WIPP Project with the State of New Mexico and listed required geotechnical experiments.^{N6} These requirements and early drafts of the Environmental Protection Agency (EPA) nuclear waste disposal regulation in Title 40 of the Code of Federal Regulations Part 191 (40 CFR 191) greatly influenced the type of in situ experiments and activities initially planned at the WIPP. For example, while deepening WIPP-12 as part of the negotiated settlement with the State of New Mexico, the project encountered a brine reservoir in 1981,^{T39} which resulted in moving the disposal region ~1800 m to the south in 1982. Also, Sandia and the U.S. Geological Survey explored and dismissed the possibility of extensive dissolution disrupting the repository.^{T40, T41}

The decision by Congress in 1987 to characterize only Yucca Mountain, Nevada, for the first commercial spent-fuel and high-level waste repository^{F28} caused the DOE to cancel many of the experiments being performed at the WIPP in support of a potential commercial repository elsewhere in bedded salt. The presence or absence of additional pockets of brine below the repository became of concern to the New Mexico Environmental Evaluation Group (EEG) in the early 1980s. Therefore, some studies were conducted to try to dismiss their presence.^{T42} Though strongly suggesting brine pockets were not present below the waste rooms in the anhydrite layer where other brine pockets had been found, the studies were unable to unequivocally show that brine pockets were not present in deeper anhydrite layers in the Castile Formation. Long-term slow seepage of brine trapped in the salt into the repository became a topic of great interest in 1988^{T54} and the full Board of Radioactive Waste Management of the NAS examined the issue. Members of the NAS concluded that the rapid salt creep combined with low permeability of the salt meant that the repository would be fairly well consolidated before much brine could enter the repository.^{T55}

In preparation for the WIPP’s planned opening by the end of the 1980s, SNL summarized past work and data, and performed numerous bounding calculations to support a draft supplemental EIS in 1989.^{T59, D29} It identified gas generation—the gas being generated through anoxic corrosion of waste containers—as an important issue to study.^{T59} This issue had been identified in the mid 1970s, but it was dismissed based on the assumption that high salt permeability values obtained from measurement in boreholes drilled prior to excavating the repository would allow any gas generated to dissipate without producing large pressures. Studying gas generation became an important purpose of proposed tests using actual TRU waste within the repository during a monitored pilot phase after better in situ measurements of the salt permeability within the excavations in the mid 1980s suggested values three orders of magnitude less than those measured in the mid 1970s.^{T55} However Congress stipulated in 1992 that the waste could be brought to the WIPP only if the tests were necessary to show compliance. Although the tests would have been potentially reassuring as a demonstration, the monitored pilot phase was not necessary for compliance. Therefore, in October 1993, the NAS recommended^{T77} with DOE concurrence to eliminate the tests with actual waste at the WIPP (pilot phase) and to perform additional experiments in laboratories.^{D33} Without a pilot phase, the DOE decided to accelerate to the compliance phase for the WIPP and closed the in-situ experimental area in October 1995.

Compliance Setting for the WIPP

A major task of the second half of the WIPP project, which started near 1986, was spent developing evidence of compliance. The promulgation of 40 CFR 191 in 1985 established the primary probabilistic

regulation with which the WIPP would have to comply, yet a legal ruling in 1984^{F23} and regulations in 1986 and 1987^{D26} resulted in defining much of the waste destined for the WIPP as chemically hazardous. This legal ruling established another set of regulations that the WIPP also had to comply with—those for hazardous waste (40 CFR 260-270 and analogous New Mexico regulations) promulgated in response to the *Resource Conservation and Recovery Act (RCRA)*.^{F9} Then in 1992, Congress defined the process by which the WIPP compliance would have to be evaluated, transferred ownership of the WIPP site to the DOE, and designated the EPA (rather than the DOE) as the regulator of the WIPP (*Waste Isolation Pilot Plant Land Withdrawal Act*^{F37}). This act officially marked the transition from the construction and disposal-system-characterization phase to the compliance and testing phases. However, these latter phases began informally in 1985 and 1986 when the EPA issued 40 CFR 191^{F13} and its interpretation of mixed hazardous waste and in 1989 when SNL first assessed performance using the EPA standard.^{T63, T64} Finally, in 1996, the EPA promulgated 40 CFR 194, a regulation to implement its 40 CFR 191 standard, which imposed several new interpretations, such as expanded human intrusion activities (specifically, potash mining) and requirements such as peer review on waste characterization, engineered and natural barriers, and conceptual models.^{F45} Also in 1996, Congress removed one of the RCRA land disposal requirements (i.e., seeking a no-migration variance), which required similar calculations to that for 40 CFR 191.^{F46}

Development of Methodology for Assessing Compliance of the WIPP

The history of assessing performance of a geologic disposal system began formally in 1976 when the ERDA funded two conferences to bring engineers and geologists together to explore the modeling of geologic disposal systems. By 1977, demands for permanent solutions to nuclear waste provided an impetus for President Gerald Ford to request the EPA to more vigorously pursue applicable standards for proposed waste repositories.^{D11, D12}

During the EPA's development of 40 CFR 191 in the late 1970s and early 1980s, analysts at Sandia National Laboratories (SNL) were advocates for a thorough approach in evaluating the uncertainty caused by various parameters in models of the exposure pathways and uncertainty about various pathways as a way to gain insight about the behavior of a geologic waste repository. For example, analysis that SNL had conducted for the EIS had relied heavily on mathematical modeling. This position of SNL had developed indirectly from participation by a few Sandians on the 60-member team for the Nuclear Reactor Safety Study^{F51} and Sandia's direct involvement on several subsequent reactor accident studies for the NRC. In addition, SNL's advocacy for a probabilistic approach was influenced indirectly by its use in evaluating the reliability of weapons systems and externally by the growing acceptance for evaluating technological risks. During this period, the term performance assessment (PA) was adopted internationally to describe the process of evaluating whether a geologic disposal system complied with the regulatory criteria—criteria that were probabilistic in the United States and thus the assessment was similar to probabilistic risk assessments (PRA) for nuclear reactors.

Hence, in the United States, a performance assessment became a stochastic simulation of possible long-term behaviors of a real system with a computer-implemented mathematical model of that system. In this respect, performance assessment is similar to other large-scale simulations (such as PRAs) that have been used by federal agencies in the past to explore policy options and develop regulations. Performance assessments of systems for the disposal of radioactive wastes nevertheless differ from most simulations for policy analysis in two significant and related ways: the way results of a performance assessment are to be used and the nature of the real system that is being simulated. In contrast with simulations for policy analysis, the EPA chose to use PA results ultimately to test compliance of a real system with an existing environmental standard, not merely to gain insight into the behavior of the system. However, the fact that part of the disposal system is geologic introduces several differences with some types of risk assessments. For instance, the geologic portion of the disposal system introduces the necessity to characterize rather than design. In addition, both the engineered and geologic components of a waste disposal system are subject to natural processes over geologic time; hence, phenomenological models are needed in order to include geologic processes.

In August of 1986, SNL accepted DOE's formal request to take responsibility for showing compliance of the WIPP with 40 CFR 191. To gain proficiency and for the project to be able to adapt efforts to collect needed information on geologic processes, SNL conducted four preliminary performance assessments from 1989 through 1992, each one building upon the other.^{T63, T64, T68, T69, T72, T78} The use of mathematical models and the general long-term flow path for radioisotope release was similar to the initial EIS, but the simulations were stochastic and numerous complexities were added, such as human intrusion causing radioisotope releases from drill cuttings. Hence, between January 1988 and December 1991, much effort was expended developing a computational modeling system, CAMCON.^{T67, T90, T91, T92} Furthermore, vast amounts of records and documentation were produced to ensure that the reasoning behind choices for data and models was traceable and repeatable. In October 1996, the performance assessment for the Compliance Certification Application (CCA) was completed showing compliance with 40 CFR 191.^{T83, T84} While not responsible for evaluating compliance, the NAS also issued a report in October that noted the excellent features of the WIPP site for containing nuclear waste.^{T85, T86} These same conclusions were echoed in the 84,000 page second supplementary EIS issued in November.^{D37} Since 1995, significant effort has been made by the EPA and their contractors in evaluating the CCA and supporting documentation.^{F47} The Conceptual Model Peer Review Group (formed in response to requirements in 40 CFR 194) concluded in early 1997 that 22 of the 24 conceptual models were adequate. The panel thought that, though conservative, the model for spallings (particulates carried to the surface by pressurized gas and/or brine during a hypothetical drilling intrusion in the repository at a future time) lacked sufficient realism; hence, they required redevelopment. The panel also thought the description of the behavior of the magnesium oxide (MgO) backfill needed improvement.^{T87, T88} In addition, SNL, under the direction of the EPA, reran the PA calculations, using EPA-selected values and distributions for 26 parameters to help bolster EPA confidence in the results. Finally, in October 1997, the EPA published a draft rule proposing to approve the WIPP.^{F49, F50} This step initiated the 120-day public comment period.

Summary

The final decision about whether to open the Waste Isolation Pilot Plant is very near, the culmination of a regulatory assessment process that has thus far taken about 25 years. If the WIPP is opened, the regulatory process for the disposal facility will continue through its operational phase and final closure some 35 years later. National policy issues, negotiated agreements, and court settlements during the first 15 years of the project had a strong influence on the amount and type of scientific data collected up to this point. Assessment activities before the mid 1980s were undertaken primarily (1) to satisfy needs for environmental impact statements, (2) to satisfy negotiated agreements with the State of New Mexico, or (3) to develop general understanding of selected natural phenomena associated with nuclear waste disposal. In the last 10 years, federal compliance policy and actual regulations were sketched out, continuing to evolve until 1996. During this period, four preliminary performance assessments, one compliance performance assessment, and one verification performance assessment were performed. Thus, many activities performed throughout the history of the WIPP Project cannot be neatly categorized in terms of fulfilling the specific needs of the final compliance process established in 1996. In general, stochastic simulations were introduced as a tool for the assessment of the WIPP's performance only recently (~8 yr ago).

Detailed Tabulation of WIPP Milestones

In the following tabulation of WIPP milestones, the history of the WIPP is divided into four main categories. One category highlights technical milestones, and three categories highlight the major political events that have influenced the WIPP Project, as briefly summarized above. Noteworthy events from all four categories are also shown schematically. The tabulation also indicates two temporal categories of the WIPP Project—one used officially by the DOE for the project as a whole and one used informally by SNL to describe its various activities.

Milestones for Disposal of Radioactive Waste in the United States

Time Line	Noteworthy Events	Technical Milestones Related to the WIPP	U.S. President and DOE: Directives and Regulatory Decisions	Federal Legislation, Judicial Decisions, and Regulatory Requirements Related to Nuclear Waste Disposal	New Mexico Administration, Regional Issues, and Legal Challenges
1942	1942 LANL Site chosen		★ 1942 - Manhattan Engineering District Corps of Engineers selects site for Los Alamos National Laboratory (LANL) to develop nuclear weapons.		Miles Admin.
1943	1943 AEC's 1st Waste decision	● 1943 - Plutonium operations begin and disposal of nuclear waste begins on site at Oak Ridge National Lab (ORNL) in trenches. Water has saturated the bottoms of the trenches and migration of radionuclides has been observed.	★ In 1940's - Atomic Energy Commission's (AEC's) earliest decision on managing waste store high-level waste (HLW) as liquids in tanks and bury other waste (solid or liquid) in trenches.	Roosevelt Administration	Dempsey Administration
1944		● 1944 - Disposal of nuclear waste begins on site at LANL (using trenches, ponds, augered holes) and Hanford Reservation (using railroad cars, trenches, ponds, tanks, underground cisterns). ¹¹		● 1946 - AEC Chairman: Lilienthal (Director of Tennessee Valley Authority)	Mabry Administration
1945	1945 Atomic test in NM	★ 1945 - Atomic bomb exploded at Trinity Site near Alamogordo, NM.		● 1949 - Truman asks AT&T to manage the recently formed Sandia Laboratory.	Mechem Administration
1946					Simrins Admin.
1949					Mechem Admin.
1951					Burroughs Admin.
1952		● 1952 - Idaho National Engineering and Environmental Lab (INEEL) completes Radioactive Waste Management Complex (RWMC) for storing and burying waste; migration of radionuclides downward into the alluvium has been observed.		● 1953 - AEC Chairman: Strauss	
1953		● 1953 - Savannah River Plant (SRP) begins waste storage and disposal on site at "Old Burial Ground" water in trenches from precipitation has caused migration of radionuclides.		● 1953 - AEC Chairman: Strauss	
1955		● 1954 - Rocky Flats Plant, CO begins shipping transuranic (TRU) waste to INEEL for disposal at RWMC.		● 1955 - AEC asks National Academy of Sciences (NAS) to examine issue of permanent disposal of radioactive wastes. ¹²	
1957	1957 NAS recommends disposal in salt beds	★ 1957 - NAS recommends radioactive waste disposal in salt as most promising method. ¹² ORNL begins research in salt (1957-61). ¹³		● 1957 - Plowshare program started to look at peaceful uses of nuclear explosives. ¹³	
1959				● 1958 - NAS commission on oceanography reports on coastal disposal of low-level radioactive waste. ¹⁴	
1960					

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Mechem Admin. Bolack Admin. Campbell Administration				Cargo Administration				King Administration			
1961 Ghone Test											
1962											
1963	1963 ORNL project salt vault										
1965											
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1968											
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1972											
1973											

Milestones for Disposal of Radioactive Waste in the United States

Time Line	Noteworthy Events	Technical Milestones Related to the WIPP	U.S. President and DOE: Directives and Regulatory Decisions	Federal Legislation, Judicial Decisions, and Regulatory Requirements Related to Nuclear Waste Disposal	New Mexico Administration, Regional Issues, and Legal Challenges
1974		● 1974 - ORNL conducts first scenario development and deterministic analysis for WIPP. ⁷²² Mar: ORNL begins field investigations by drilling AEC-7 and AEC-8. ¹⁹⁰	● 1974 - AEC promises Idaho that wastes will be shipped in the 1980's. May: WIPP work suspended until 1975 because AEC wished to emphasize RSSF and AEC Chairman Ray would not withdraw land from oil exploration because of oil embargo. ¹¹²	● 1974 - Energy Reorganization Act ^{F7} splits AEC into Nuclear Regulatory Commission (NRC) and Energy Research and Development Agency (ERDA).	● 1974 - Gov. King establishes Governor's Technical Excellence Committee; created WIPP oversight subcommittee. ● 1975 - AG: Ahaya.
1975	1975 WIPP moved toward basin center	★ 1975 - Mar: SNL receives funding and starts four tasks: selecting site and characterizing, producing conceptual design, drafting EIS, initiating scientific studies. May: ERDA-6 drilled at NW corner of original ORNL site; encounters deformed salt beds and hits brine much deeper. ¹²³ SNL recommends relocation and project moves site ~11 km (7 mi) toward center of Delaware Basin to avoid deformed salt beds as indicated by oil well logs. ^{712,724}	● 1975 - ERDA removes WIPP from commercial repository program. Jan: ERDA asks Sandia National Laboratories (SNL), located in NM, to oversee investigations rather than ORNL and suggests an opening date of 1992.	● 1975 - NRC promulgates "As Low As Reasonably Achievable" (ALARA) policy for limiting radiation exposure. ^{F8} Oct: final PPA for Nuclear Reactors. ^{F61}	King Administration Apodaca Administration
1976	1976 ERDA-9 drilled at center of WIPP site	★ 1976 - SNL begins site characterization and engineering design program at new site; various natural backfills such as asphalt or salt-bentonite considered for use in repository. Apr: ERDA-9 drilled into Castile Formation near center of new site. Tests on TRU waste behavior and HLW packages initiated. ^{725,726}	● 1976 - Resource Conservation and Recovery Act (RCRA) ^{F9} seeks to reduce or eliminate hazardous waste generation to minimize present and future threat to human health and environment. Dec: EPA announces intent to develop radiation protection standards for HLW disposal. ^{F10}	● 1976 - NM Hazardous Waste Act ^{N3} seeks to maintain environmental quality.	Apodaca Administration
1977	1976 Ford orders demonstration of nuclear waste disposal	● 1977 - Jun: WIPP conceptual design report issued. ¹²⁷ SNL plugs ERDA-10 to test plugging boreholes in salt. ¹²⁸	● 1977 - Oct: DOE Organization Act ^{F11} creates cabinet-level Department of Energy (DOE) from ERDA. Feb: In response to Ford's directive, EPA conducts 1st public workshop to understand public concerns and technical issues of waste disposal. ^{F12, F13}	● 1977 - Oct: DOE Organization Act ^{F11} creates cabinet-level Department of Energy (DOE) from ERDA. Feb: In response to Ford's directive, EPA conducts 1st public workshop to understand public concerns and technical issues of waste disposal. ^{F12, F13}	Carter Administration
1978	1978 Oversight by WIPP panel of NAS and NM EEG begins	● 1978 - SNL begins design of the Transuranic Package Transport, design I (TRUPACT-I) using standard cargo box concept. ^{729,730,731} Bechtel National starts as WIPP Architect/Engineer (A/E). Westinghouse Electric Corp. starts as Tech Support Contractor. SNL raises concern about gas generation and Los Alamos begins tests. ⁷³² Jun: WIPP Panel of BRWM of NAS (component of outside oversight DOE recommends) report written for DOE recommends (1) disposing TRU waste at WIPP without planning for retrieval, and (2) demonstrating spent nuclear fuel (SNF), HLW, and TRU disposal at WIPP. ^{734,735} DOE Deputy Sec. J. O'Leary presses on with 2nd recommendation until 1979 enabling law for WIPP as a way to satisfy California law banning nuclear power plants until SNF disposal demonstrated. ⁷³⁶ Mar: President forms Interagency Review Group (IRG), in response to Deutch report to recommend type of nuclear waste disposal.	● 1978 - DOE announces public forum to develop protection criteria for radioactive wastes. Feb: Nov: EPA publishes "Criteria for Radioactive Wastes" as guidance for federal agencies and seeks comments. ^{F14}	● 1978 - DOE contracts with NM to establish Environmental Evaluation Group (EEG) to provide a full-time, independent assessment of WIPP and oversee environmental, public health and safety. Although DOE-funded, EEG is initially made a part of Environmental Improvement Division of the NM Health & Environment Department. The general understanding is neither DOE nor NM would attempt to bias or interfere in EEG's technical conclusions. EEG becomes second permanent outside oversight group set up by DOE (first was NAS WIPP Panel of BRWM). NM House almost passes ballot proposal for constitutional amendment to keep nuclear waste from NM.	

		King Administration			
				1979	1980
1979	Draft EIS on WIPP	<ul style="list-style-type: none"> 1979 - To develop necessary predictive capability ³⁴ SNL begins 3-yr preliminary test programs on thermal/structural effects in nearby potash mine, is and Louisiana dome salt. ³⁵ ³⁶ 1st in-situ permeability measurement of Salado Formation salt from AEC-7 well (values 1000 times larger than found when measured within repository in 1988). ³⁷ Bechtel identifies 7 potential horizons for WIPP. 	<ul style="list-style-type: none"> 1979 - Mar: IRG recommends disposal of SNF, HLW and TRU in mined geologic repositories in final report. ³⁸ Report also suggests making WIPP candidate for commercial SNF repository. ³⁹ Apr: DOE defines project as a combination military/commercial repository in Draft EIS. ⁴⁰ ⁴¹ Oct: DOE decides to begin Test I (preliminary) design of WIPP. Based on salt permeability tests, DOE cancels all gas generation experiments and backfill analyses. 	<ul style="list-style-type: none"> 1979 - May: House Armed Services Committee cuts WIPP funding in response to O'Leary's (DOE's) expansion of the project to a repository for commercial SNF and thus requiring NRC licensing (even if for demonstration only). ⁴² Dec: Congress defines mission ⁴³ of WIPP: <ul style="list-style-type: none"> - sets up WIPP as a research and development facility for disposal of only TRU radioactive waste from DOE facilities - exempts WIPP from NRC licensing - requires DOE to sign a "Consultation & Cooperation" (C&C) Agreement with NM. 	<ul style="list-style-type: none"> 1979 - May: House Armed Services Committee cuts WIPP funding in response to O'Leary's (DOE's) expansion of the project to a repository for commercial SNF and thus requiring NRC licensing (even if for demonstration only). ⁴² Dec: Congress defines mission ⁴³ of WIPP: <ul style="list-style-type: none"> - sets up WIPP as a research and development facility for disposal of only TRU radioactive waste from DOE facilities - exempts WIPP from NRC licensing - requires DOE to sign a "Consultation & Cooperation" (C&C) Agreement with NM.
1980	Congress passes WIPP bill	<ul style="list-style-type: none"> 1980 - Mar: IRG recommends disposal of SNF, HLW and TRU in mined geologic repositories in final report. ⁴⁴ Report also suggests making WIPP candidate for commercial SNF repository. ⁴⁵ Apr: DOE defines project as a combination military/commercial repository in Draft EIS. ⁴⁶ ⁴⁷ Oct: DOE decides to begin Test I (preliminary) design of WIPP. Based on salt permeability tests, DOE cancels all gas generation experiments and backfill analyses. 	<ul style="list-style-type: none"> 1980 - Mar: Carter orders SNF reprocessing to stop. ⁴⁸ Mar: Carter rescinds 1980 funds for WIPP and announces interim strategy to set aside money for possible future waste disposal projects at WIPP. ⁴⁹ Oct: DOE issues final EIS eliminating SNF & HLW disposal and thereby reinstates WIPP mission defined by Congress in 1979. ⁵⁰ Nov: DOE applies to Department of Interior (DOI) for administrative withdrawal of land for Site and Preliminary Design Validation (SPDV) experiments at WIPP. ⁵¹ 	<ul style="list-style-type: none"> 1980 - Feb: Carter orders SNF reprocessing to stop. ⁴⁸ Mar: Carter rescinds 1980 funds for WIPP and announces interim strategy to set aside money for possible future waste disposal projects at WIPP. ⁴⁹ Oct: DOE issues final EIS eliminating SNF & HLW disposal and thereby reinstates WIPP mission defined by Congress in 1979. ⁵⁰ Nov: DOE applies to Department of Interior (DOI) for administrative withdrawal of land for Site and Preliminary Design Validation (SPDV) experiments at WIPP. ⁵¹ 	<ul style="list-style-type: none"> 1980 - Feb: Carter orders SNF reprocessing to stop. ⁴⁸ Mar: Carter rescinds 1980 funds for WIPP and announces interim strategy to set aside money for possible future waste disposal projects at WIPP. ⁴⁹ Oct: DOE issues final EIS eliminating SNF & HLW disposal and thereby reinstates WIPP mission defined by Congress in 1979. ⁵⁰ Nov: DOE applies to Department of Interior (DOI) for administrative withdrawal of land for Site and Preliminary Design Validation (SPDV) experiments at WIPP. ⁵¹
1981	First shaft drilled	<ul style="list-style-type: none"> 1981 - May: WIPP begins augering for 1st shaft, which ushers in SPDV phase of WIPP. ⁵² Jul: Drilling on 1st shaft begins. ⁵³ Nov: Project Manager McGough rekindles disagreements between DOE and NM by stating HLW could be placed by 1983 and remain during the operating phase of WIPP. ⁵⁴ Sep: After reviewing preliminary design, DOE okays detailed design phase. ⁵⁵ 	<ul style="list-style-type: none"> 1981 - May: WIPP begins augering for 1st shaft, which ushers in SPDV phase of WIPP. ⁵² Jul: Drilling on 1st shaft begins. ⁵³ Nov: Project Manager McGough rekindles disagreements between DOE and NM by stating HLW could be placed by 1983 and remain during the operating phase of WIPP. ⁵⁴ Sep: After reviewing preliminary design, DOE okays detailed design phase. ⁵⁵ 	<ul style="list-style-type: none"> 1981 - Feb: NRC promulgates licensing procedures for SNF and HLW disposal in geologic repositories. ⁵⁶ District Court denies SPDV motion for a preliminary injunction against constructing WIPP. 	<ul style="list-style-type: none"> 1981 - Feb: NRC promulgates licensing procedures for SNF and HLW disposal in geologic repositories. ⁵⁶ District Court denies SPDV motion for a preliminary injunction against constructing WIPP.
1982		<ul style="list-style-type: none"> 1981 - DOE Sec: Edwards. Jan: DOE publishes Record of Decision to proceed with SPDV phase. ⁵⁷ Jun: DOE WIPP Project Manager McGough rekindles disagreements between DOE and NM by stating HLW could be placed by 1983 and remain during the operating phase of WIPP. ⁵⁸ Sep: After reviewing preliminary design, DOE okays detailed design phase. ⁵⁹ 	<ul style="list-style-type: none"> 1981 - DOE Sec: Edwards. Jan: DOE publishes Record of Decision to proceed with SPDV phase. ⁵⁷ Jun: DOE WIPP Project Manager McGough rekindles disagreements between DOE and NM by stating HLW could be placed by 1983 and remain during the operating phase of WIPP. ⁵⁸ Sep: After reviewing preliminary design, DOE okays detailed design phase. ⁵⁹ 	<ul style="list-style-type: none"> 1981 - Jul: Southwest Research & Information Center (SWRIC) files "lawsuit" and begins strategy of filing numerous interrogatories to which DOE must respond. In response to lawsuits, ⁶⁰ DOE Sec. Edwards visits NM and talks to Gov. King and accedes in a "Stipulated Agreement (SA)" to demands for (1) geotechnical experiments, (2) state & public review of WIPP changes, and (3) creation of a state/federal task force to oversee transportation issues (e.g., emergency response and highway upgrades). C&C Agreement attached as Appendix A. ⁶¹ "Working Agreement" as Appendix B. ⁶² U.S. Dist. Judge Burcraig stays lawsuit in accordance with SA. Coalition for Direct Action at WIPP demonstrates against construction. EEG recommends relocating TRU storage away from WIPP. ⁶³ 	<ul style="list-style-type: none"> 1981 - Jul: Southwest Research & Information Center (SWRIC) files "lawsuit" and begins strategy of filing numerous interrogatories to which DOE must respond. In response to lawsuits, ⁶⁰ DOE Sec. Edwards visits NM and talks to Gov. King and accedes in a "Stipulated Agreement (SA)" to demands for (1) geotechnical experiments, (2) state & public review of WIPP changes, and (3) creation of a state/federal task force to oversee transportation issues (e.g., emergency response and highway upgrades). C&C Agreement attached as Appendix A. ⁶¹ "Working Agreement" as Appendix B. ⁶² U.S. Dist. Judge Burcraig stays lawsuit in accordance with SA. Coalition for Direct Action at WIPP demonstrates against construction. EEG recommends relocating TRU storage away from WIPP. ⁶³

SPDV - Disposal System Characterization - DOE Passes

Milestones for Disposal of Radioactive Waste in the United States

Time Line	Noteworthy Events	Technical Milestones Related to the WIPP	U.S. President and DOE: Directives and Regulatory Decisions	Federal Legislation, Judicial Decisions, and Regulatory Requirements Related to Nuclear Waste Disposal	New Mexico Administration, Regional Issues and Legal Challenges
1982	1982 USGS dismisses concerns about Breccia pipes	★ 1982 - 2nd shaft completed (~80m [270ft] of drilling fluid left in the shaft). Underground excavation started to connect the two shafts. Following evaluation of WIPP-12 TRU disposal area moved ~1800 m (6000 ft) further south (experimental area left in original area). Dec: SNL completes interim report on dissolution of evaporates in and around the Delaware Basin. ¹⁴⁰ (part of SA). USGS completes braccia pipe report (part of SA) and dismisses concerns. ¹⁴¹	1982 - Courts decline to relieve DOE from responding to numerous SWRC interrogatories. Mar: DOI approves DOE's application for administrative withdrawal of $36 \times 10^6 \text{ m}^2$ (8960 ac) for conducting SPDV experiments for 8 yr. ¹⁴² Dec: Nuclear Waste Policy Act (NWPA) passed. ¹⁴³	● 1982 - Dec: Supplemental SA signed (1) committing DOE to seek funds for upgrading highways in NM, (2) committing DOE to more geotechnical studies, and (3) making DOE liable for WIPP-related accidents. ¹⁴⁴	King Administration
1983	1983 Full construction begins	★ 1983 - DOE Sec: Hodel. Mar: DOE gives SPDV reports to NM and allows 60 day comment period. ¹⁴⁵ Jul: DOE announces decision to proceed with construction. Dec. Sep: DOE sets Oct 1988 as WIPP opening date.	1983 - DOE Sec: Hodel. Mar: DOE gives SPDV reports to NM and allows 60 day comment period. ¹⁴⁵ Jul: DOE announces decision to proceed with construction. Dec. Sep: DOE sets Oct 1988 as WIPP opening date.	● 1983 - AG: Bardalake. May: after reviewing results from SPDV program, EEG concludes that "...the Los Medanos site has been characterized in sufficient detail to warrant confidence in the validation of the site for permanent emplacement of approximately 6 million t^3 ($1.75 \times 10^6 \text{ m}^3$) of defense TRU waste," but also recommends additional studies to resolve outstanding geotechnical issues such as evaluation of potential for brine seepage. ¹⁴⁶ Aug: EEG issues report and Governor holds press conference on concerns about potentially explosive hydrogen gas in TRUPACT-1. ¹⁴⁷ Sep: CAR and Sierra Club allege that DOE and EEG are collaborating to deceive NM about safety of WIPP; they also insist on NRC licensing of WIPP.	Anaya Administration
1984	1984 SNL begins fielding many underground experiments	★ 1984 - SNL begins many thermal/structural and waste package (e.g., defense HLW) field tests defined in 1982, ushering in the system characterization phase of project. ^{148,149,150} Pumping tests at DOE 2 suggest fracture flow in Culebra. General Atomic completes one TRUPACT-1 container; SNL sends it to ORNL test facility because container exceeds SNL weight limit for 30 ft drop and puncture test, etc., required in 10 CFR 71. ¹⁵¹ container passes tests.	1984 - Feb: SAB endorses probabilistic approach but states performance criteria too restrictive and recommends several changes. ¹⁵² Apr: Legal Environmental Assistance Foundation (LEAF) vs. DOE ¹⁵³ requires DOE to apply both the technical and procedural requirements of RCRA to DOE facilities even though AEA exempted DOE from many environmental and human health laws. Nov: Hazardous & Solid Waste Amendments (HSWA) ¹⁵⁴ to RCRA ban land disposal of hazardous waste without treatment unless disposal site and generator demonstrate no migration of constituents for as long as waste remains hazardous.	● 1984 - Mar: Manager of Albuquerque Operations Office (AL) moves WIPP Project Office (WPO) to Carlsbad.	Reagan Administration

Full Construction Phase Disposal System Characterization Phase

1985		Anaya Administration		Carruthers Administration	
1985	1985 EPA promulgates 40 CFR 91	1985 - Jan: Pillar creep test begins in room H. General Atomic disassembles TRUPACT-I and cuts in half; half with door rebuilt; while rebuilding, puncture damage replicated to match damage in original TRUPACT-I. With the definition of a 5-km boundary to the disposal system in 40 CFR 191, project begins to focus more on near-field hydrologic modeling rather than regional modeling. SNL observes discrepancy between measured and predicted salt creep. ^{747, 748}	1985 - Office of Technology Assessment (OTA), an agency of Congress, concludes no insurmountable technical obstacles for geologic repositories. ⁷⁴⁹ Sep: EP promulgates 40 CFR 191 for disposal of SNF HLW, and TRU in a geologic repository. ⁷⁵⁰ uses 1000 deaths/10,000-yr criterion from NWPA of 1982; promulgation begins the transition of the WIPP to compliance phase.	1985 - EEG notifies DOE that the single-shelled, vented rectangular transportation container for TRU waste, "TRUPACT-I", is unacceptable for NM. ⁷⁵¹ Jan: NM receives EPA authorization to regulate hazardous wastes. ⁷⁵² Feb: Natural Resources Defense Council (NRDC) sues EPA to issue 40 CFR 191 as mandated in NWPA of 1982. ⁷⁵³	1985 - Mar: NRDC and others sue EPA over groundwater and individual protection standards in 40 CFR 191.
1986	1986 EPA states mixed waste subject to RCRA (potentially 60% of WIPP waste)	1986 - Feb: TRUPACT-I passes first test at SNL. ⁷⁵⁴ Aug: SNL accepts task of assessing performance of WIPP against 40 CFR 191 criteria (Performance Assessment [PA]).	1986 - EPA states that mixed waste (radioactive waste also meeting hazardous waste definition) is subject to RCRA and hazardous waste regulations. ⁷⁵⁵ Aug: DOE promulgates probabilistic safety goals for nuclear reactors that are similar to 40 CFR 191. ⁷⁵⁷	1986 - Mar: DOE issues report on potential conflicts between radioactive & hazardous waste regulations. NM legislature exempts WIPP from hazardous waste regulations. ⁷⁵⁸ Aug: 2nd modification to CAC Agreement committing DOE to comply with all applicable laws & regulations and discourage WIPP compliance by way of grandfathering, variance, exemption, or waiver; and use 40 CFR 191 as 1st issued for evaluating WIPP compliance until reissuance by EPA. NRC and Department of Transportation (DOT) regs apply to WIPP transport.	1986 - Mar: EEG issues report on potential brine reservoirs under WIPP. ⁷⁵⁹ Oct: ID Gov. Andrus bars shipments of radioactive waste into state because WIPP not open. ⁷⁶⁰ Dec: ID Gov. Andrus, CO Gov. Romer, and NM Gov. Carruthers meet in Salt Lake City to discuss WIPP and options to avert shutdown of DOE Rocky Flats Plant from lack of authorized storage imposed by CO, and inability to ship to ID because of imposed ban by Gov. Andrus; DOE agrees to vigorously pursue both administrative and legislative land withdrawal for WIPP. ⁷⁶¹
1987	1987	1987 - Brine pockets cannot be dismissed	1987 - Jul: In response to legal challenges to individual and groundwater protection requirements in subpart B, Court of Appeals for 1st Circuit in Boston vacates and demands all of 40 CFR 191 to EPA. ⁷⁷² Sep: Court reinstates Subpart A of 40 CFR 191 in response to EPA request. ⁷⁷³ Dec: Nuclear Waste Policy Amendment Act (NWPA) ⁷²⁸ selects Yucca Mt., NV, to undergo site characterization for potential SNF and HLW disposal; because brined salt not being considered, SNF and HLW tests at WIPP unnecessary.	1987 - May: DOE redefines "by-product material" to exclude everything except radionuclides, and thereby TRU waste is subject to RCRA (& HSWA). ⁷²⁵ Jul: Agreement between Department of Labor (DOL) and DOE on mine inspections. ⁷²⁷ Oct: DOE selects Nuclear Packaging conceptual design for TRUPACT-II.	1987 - Jan: EEG issues report on potential brine inflow controversy. With continued technical problems (e.g., TRUPACT-I not yet licensed), NM Congressional delegation cannot get consensus among themselves and WIPP Land Withdrawal legislation dies. NM Congressman get Congress to reassign EEG to the New Mexico Institute of Mining and Technology in Socorro in Sep. because of conflicts between NM state government and EEG. ⁷⁵⁸
1988	1988	1988 Brine seepage into WIPP big issue	1988 - May: DOE announces that WIPP won't open as scheduled in Oct. DOE abruptly cancels SNF and HLW experiments because of NWPA (no funds available to remove disposal containers).	1988 - Sep: DOE reevaluates 4th shaft after reevaluating 1981 decision to eliminate it. SNL reports in-situ permeability (1000 times lower than 1979) and small potential brine inflow. ⁷⁵⁵ Members of NAS BRWM (not WIPP Panel) study brine inflow, conclude no problem but suggest brine inflow test. 1st prototype of TRUPACT-II passes structural tests, but fails engulfing fire test at seals. SNL begins work on CAMCON to link detailed consequence models in probabilistic PA. ⁷⁵² SNL completes pumping tests at H-11 ⁷⁵⁶ and begins using results to calibrate regional flow model. ⁷⁵⁷	1988 - Aug: DOE Sec: Carruthers withdraws half of land allowed by 40 CFR 191. ⁷⁵⁸ Mar: DOE issues Draft Supplemental EIS. ⁷⁵⁹ Watkins creates "Blue Ribbon Panel" to examine WIPP readiness. ⁷⁶⁰ Watkins announces an indefinite delay in opening of WIPP. Watkins creates tiger teams to examine environment, safety, and health issues throughout DOE defense complex. ⁷⁶⁰
1989	1989 Draft supplemental EIS	1989 Berlin wall falls	1989 - Jan & Feb: Redesigned seals of TRUPACT-II pass engulfing fire test. ⁷⁵⁸ SNL completes documentation to support Draft Supplemental EIS; report identifies generation of gases as containers and waste corrode as issue (see 1978) because salt permeability lower than thought in 1979. Different flow direction in past during wet climate hypothesized to cause discrepancy between geochemical analysis and current hydrologic flow in Culebra. ⁷⁵⁹ Jan - Aug: Mine and instrument brine inflow experiment in Q Tunnel. ⁷⁶⁰ Feb: SNL resolves discrepancies between measured and predicted salt creep. ⁷⁶¹ Westinghouse completes No-Migration Feltion for test phase activities. ⁷⁶² Dec: SNL issues 1st annual WIPP PA outlining process for future PA's. ^{763, 764}	1989 - Aug: NFC approves the pressurized transportation container for shipping contact-handled (CH) TRU to TRUPACT-I.	1989 - Aug: Legislature unanimously removes "WIPP exemption" in hazardous waste laws so EPA will grant authority to regulate radioactive mixed waste. ⁷⁶⁵ Nov: Berlin Wall falls signaling the end of the Cold War and greatly changing future demands for nuclear weapon material and thus type of waste going to WIPP.

Milestones for Disposal of Radioactive Waste in the United States

Time Line	Noteworthy Events	Technical Milestones Related to the WIPP	U.S. President and DOE: Directives and Regulatory Decisions	Federal Legislation, Judicial Decisions, and Regulatory Requirements Related to Nuclear Waste Disposal	New Mexico Administration, Regional Issues, and Legal Challenges	King Administration
1990	1990 First full PA of WIPP (1989 PA was demo) 1990 Supplemental EIS 1990 Construction officially complete	★ 1990 - SNL and Westinghouse complete report on the pilot test phase of WIPP ¹⁶⁵ suggesting that a waste amount equal to 0.5% of capacity be brought to WIPP for gas generation experiments. May: "Final" Supplemental EIS stating construction is officially complete, testing phase (~5yr) should proceed, and then another Supplemental EIS should be prepared before going to full operation. ¹⁶²	★ 1990 - Jan: DOE issues Final Supplemental EIS. Dec. 1 Jun: DOE issues "Record of Decision" on WIPP Final Supplemental EIS stating construction is officially complete, testing phase (~5yr) should proceed, and then another Supplemental EIS should be prepared before going to full operation. ¹⁶²	● 1990 - Oct: EPA issues no-migration variance for test phase of WIPP. ¹⁶⁰	● 1990 - Jul: NM granted authority by EPA to regulate radioactive mixed waste and thus WIPP waste becomes subject to NM regulations. W. NM Environmental Improvement Division requests submittal of Parts A & B of RCRA permit. Oct: NM designates "preferred route" for waste transport from northern border to WIPP.	
1991	1991 Major models linked in WIPP PA	★ 1991 - Westinghouse completes Parts A & B of RCRA permit application. ^{170, 171} Apr. Aug, Sep: To extend life of room 1, panel 1 for gas generation tests, internal and external panels need to recommend roof support. Dec: SNL issues 3rd PA, highlighting major components of the PA process and documents. ¹⁷² Westinghouse completes construction of roof support. ^{173, 174}	● 1991 - Jan: DOE modifies administrative land withdrawal order to allow test phase of WIPP. Feb. 1, 1991 Mar: House Interior Committee adopts NM Congressman Richardson's resolution to nullify DOI-modified land withdrawal order (action allowed under Federal Land Policy & Management Act (FLPMA)). Sep: 9th Circuit Court of Appeals rules state ban on radioactive waste shipments imposed by Gov. Andrus of Idaho is illegal. ¹⁶³ Oct: DOI again grants administrative land withdrawal after Watkins certifies all environmental permitting requirements have been met. ¹⁶⁴	★ 1992 - Aug: DOE submits application to New Mexico Environment Department (NMED) for RCRA permit for test phase.	● 1991 - Oct: AG Udall files 100-page lawsuit in U.S. District Court for the District of Columbia to delay start of test phase at WIPP by challenging the administrative land withdrawal. ¹⁶⁵	
1992	1992 Refinements to models (e.g., transmissivity fields) in WIPP PA	★ 1992 - SNL & Westinghouse complete work necessary to modify Test Phase Plan. ¹⁷⁵ Westinghouse completes work necessary for modifying Waste Retrieval Plan. Jun: NAS WIPP Panel sends letter to DOE questioning scientific need for in-situ waste tests at WIPP. ¹⁷⁶ Dec: SNL issues 4th PA refining models and data used in the PA. ¹⁷⁶	● 1992 - SNL & Westinghouse complete work necessary to modify Test Phase Plan. ¹⁷⁵ Westinghouse completes work necessary for modifying Waste Retrieval Plan. Jun: NAS WIPP Panel sends letter to DOE questioning scientific need for in-situ waste tests at WIPP. ¹⁷⁶ Dec: SNL issues 4th PA refining models and data used in the PA. ¹⁷⁶	● 1992 - Aug: DOE submits application to New Mexico Environment Department (NMED) for RCRA permit for test phase.	● 1992 - Oct: WIPP Land Withdrawal Act (LWA). ¹⁷³ - transfers land from DOI to DOE - establishes EPA as regulator for WIPP (removing self regulation by DOE); compliance requirements (different than WIPP Panel or EEG) to be set in 40 CFR 194 - requires re-enterring site every 5 yr - reinstates Subpart B of 40 CFR 191 except disputed aspects of individual and groundwater protection requirements - requires DOE cooperation and consultation with EEG. Energy Policy Act Feb. asks NAS to recommend disposal criteria for Yucca Mt.: - requires EPA & NRC to reevaluate their disposal criteria for Yucca Mt. Federal Facility Compliance Act. ¹⁷⁷ - waives federal sovereign immunity for civil and criminal liability for RCRA violations and thus brings DOE facilities under jurisdiction of states but exempts mixed waste stored by DOE. - Washington DC District Court Judge Penn grants preliminary injunction to stop testing with TRU waste at WIPP. Penn rules WIPP does not qualify for interim status under RCRA, thus must get permits before rather than during operation.	King Administration

		King Admin.		Johnson Administration	
		1993	1994	1995	1996
1993	<p>DOE decides not to test waste at WIPP.</p> <p>1993 EPA promulgates 40 CFR 191</p>	<ul style="list-style-type: none"> 1993 - Apr: SNL seeks permits to drill new wells for tracer test in Culebra. 1995 - Feb: Drilling of walls for tracer tests begin. Oct: IT Corp. completes cost/benefit study of engineered barrier alternatives suggested by 40 CFR 194. ¹⁸⁹ Dec: DOE publishes updated revision of WIPP inventory. ¹⁹⁰ 	<ul style="list-style-type: none"> 1993 - DOE Sec: Hazel O'Leary. Oct: DOE concurs with NAS and decides not to implement waste in a pilot phase at WIPP – lab tests instead. ¹⁹¹ DOE decides to make draft application to EPA. Dec: O'Leary disbands WPO in Albuquerque and selects new personnel for Carlsbad Area Office (CAO) (old WPO with new function) and direct report to Undersecretary T. Grumbly. ¹⁹² 	<ul style="list-style-type: none"> 1995 - Mar: DOE submits Draft Compliance Application (DCA) to EPA. ¹⁹³ Nov: DOE issues 84,000 - page 2nd supplemental draft EIS. ¹⁹⁴ 	<ul style="list-style-type: none"> 1996 - Oct: DOE sends 400 lb. Compliance Certification Application (CCA) to EPA. ¹⁹⁵ Nov: DOE issues 84,000 - page 2nd supplemental draft EIS. ¹⁹⁶
1994					
1995				<ul style="list-style-type: none"> 1995 - Mar: DOE submits Draft Compliance Application (DCA) to EPA for review. ¹⁹⁴ May: DOE submits Part B of RCRA permit application to NMED. ¹⁹⁷ Oct: DOE halts all in-situ experiments and closes area in repository. 	
1996	<p>1996 SNL completes PA for WIPP certification; moving van required to send copies to EPA</p> 	<ul style="list-style-type: none"> 1996 - Apr: Completed tracer test in Culebra; decided dual porosity model reasonable and single porosity transport alternative model could be ruled out. ¹⁹⁸ Oct: SNL completes PA for Compliance Certification Application (CCA) of WIPP that includes MgO backfill mining scenario, and greater intrusion rate; except for few vectors, drill cuttings only release pathway. ¹⁹⁹ Calculation was run 3 times with 100 samples each and took 35,500 CPU hrs on 20 DEC alphas and created 100 GBbytes of data in 165,000 files. ²⁰⁰ Nov: NAS reports that WIPP site excellent choice "geologically." 	<ul style="list-style-type: none"> 1996 - Aug: SNL seeks permits to drill new wells for tracer test in Culebra. 1995 - Feb: Drilling of walls for tracer tests begin. Oct: IT Corp. completes cost/benefit study of engineered barrier alternatives suggested by 40 CFR 194. ¹⁸⁹ Dec: DOE publishes updated revision of WIPP inventory. ¹⁹⁰ 	<ul style="list-style-type: none"> 1996 - Apr: NM AG Udall sues EPA alleging improper meetings were held between EPA and DOE about requirements in proposed 40 CFR 194 regulation. ¹⁹¹ 	<ul style="list-style-type: none"> 1996 - Apr: NM AG Udall sues EPA alleging improper meetings were held between EPA and DOE about requirements in proposed 40 CFR 194 regulation. ¹⁹¹
1997					
1998					
1999					

Acronyms/Initialisms

A/E –	architect/engineering firm.
AEA –	<i>Atomic Energy Act</i> , either 1946 (Pub. L. 585) or 1954 (Pub. L. 703).
AEC –	Atomic Energy Commission, the forerunner of the DOE that was formed in 1946 (August 1, 1946, 60 Stat. 755).
AG –	attorney general.
AL –	Albuquerque Operations Office, DOE.
ALARA –	As low as reasonably achievable with costs and benefits taken into account; a basic NRC policy of radiation protection initially promulgated in 1975.
BRWM –	Board of Radioactive Waste Management, a permanent Board formed in 1968 in the National Research Council, the principal operating agency of the U.S. National Academy of Sciences (NAS).
C&C –	Consultation and Cooperation Agreement Between the State of New Mexico and the DOE.
CAG –	Compliance Application Guide, a non-binding guidance document developed by the EPA to supplement the 40 CFR 194 implementing regulation.
CAMCON –	Compliance Assessment Methodology CONtroller, computational system for assessing the performance of a disposal system (usually for nuclear wastes). This complex information management system provides for (1) the interfacing of individual computer codes of the WIPP PA modeling system, and (2) quality assurance.
CAO –	Carlsbad Area Office, DOE office for managing WIPP Project, formed in 1993 to replace the WIPP Integration Office (WPIO) that had been established in 1991, and the WIPP Project Office (WPO), which had been created in the 1980s, moving to Carlsbad, NM, in 1984.
CARD –	Citizens Against Radioactive Dumping, New Mexico special interest group.
CCA –	Title 40 CFR Part 191 Compliance Certification Application for the Waste Isolation Pilot Plant, coordinated by Westinghouse for the DOE with input from Sandia National Laboratories, sole author on Chapter 6 and numerous appendices.
CH-TRU –	contact-handled TransUranic waste, packaged TRU waste whose external surface dose rate does not exceed 200 mrem per hour.
DCCA –	Draft Compliance Certification Application prepared in 1995.
DHLW –	Defense high-level waste, that is, high-level waste (HLW) that has been generated by the DOE in reprocessing spent nuclear fuel from experimental and military reactors. Because the possibility of commercial reprocessing was stopped under the Carter Administration in 1980 and never initiated thereafter, only about 72 MTHM equivalents from the West Valley Demonstration Project in New York or 0.75% is commercial HLW in the United States. Hence, the distinction between defense and commercial HLW is usually unimportant except when highlighting the source of HLW or when discussing reprocessing and disposal plans for HLW in the United States prior to 1980.
DOE –	U.S. Department of Energy, formed by <i>DOE Organization Act</i> (Public Law 95-91, 91 Stat. 565), which replaced the Energy Research and Development Agency (ERDA). ERDA was formed by the 1974 <i>Energy Reorganization Act</i> (Public Law 93-438) and replaced the Atomic Energy Commission (AEC), which was formed in 1946 (August 1, 1946, 60 Stat. 755).

DOI –	U.S. Department of Interior.
DOL –	U.S. Department of Labor.
DOT –	U.S. Department of Transportation.
EEG –	Environmental Evaluation Group, formed in 1978 by New Mexico from funds provided by the DOE to conduct independent technical evaluation of the WIPP. <i>The National Defense Authorization Act, Fiscal Year 1989</i> , Public Law 100-456, Section 1433 assigned administrative oversight of EEG to the New Mexico Institute of Mining and Technology.
EIS –	Environmental Impact Statement, environmental documentation required by federal law (NEPA) for large, federally-funded programs.
EPA –	U.S. Environmental Protection Agency, formed by Congress on December 2, 1970, in Reorganization Plan No. 3 of 1970 (5 U.S.C. 903, n 19; 40 CFR 1). In this act, Congress transferred to EPA the tasks of monitoring research, setting standards, and performing enforcement activities related to pollution abatement and control that allow the environment to be considered as a single, interrelated system.
ERDA –	Energy Research and Development Agency, a forerunner of the DOE that was formed in 1974 (Pub. L. 93-438).
FLPMA –	Public Law 94-579. 1976. <i>Federal Land Policy and Management Act of 1976</i> (43 U.S.C. 1701 et seq.; 90 Stat. 2743).
GA –	General Atomic, Inc.
HLW –	High level (radioactive) waste, "... the highly radioactive material [fission products and some actinides,] resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations . . ." (NWPA, 1982, §2[12]) ^{F18} . Although not used in this manner in this report, general articles regarding radioactive waste use the term high level waste to imply any combination of spent nuclear fuel and HLW (and sometimes transuranic [TRU] waste) that requires disposal in a deep, geologic repository. 10 CFR 60, which was promulgated by the NRC prior to NWPA, also includes spent nuclear fuel in its definition of high level waste.
HSWA –	Hazardous and Solid Waste Amendments of 1984 (Pub. L. 98-616) (see also RCRA).
INEEL –	Idaho National Engineering and Environmental Laboratory, a multiprogram laboratory in Idaho Falls, Idaho, furnishing engineering services and products on primarily nuclear energy and related technologies. The Idaho Chemical Processing Plant (ICPP) at the Idaho site processes highly enriched uranium fuel from spent nuclear fuel stored at the site. In addition to receiving spent nuclear fuel from throughout the DOE defense complex, it stores a large volume of TRU waste from Rocky Flats destined for the WIPP. Prior to 1970, it buried this TRU waste, but now stores it on the surface.
IRG –	Interagency Review Group on Nuclear Waste Management; The Carter Administration formed this group on the recommendation of Secretary of Energy, Schlesinger. The group consisted of the DOE and eight other agencies together with several entities within the Executive Branch, including the Council on Environmental Quality.
LANL –	Los Alamos National Laboratory, a multiprogram laboratory in Los Alamos, NM, conducting research and development on all facets of nuclear weapon design and basic research in a variety of areas. A large volume of TRU waste stored on site is destined for the WIPP.
LEAF –	Legal Environmental Assistance Foundation.
MIT –	Massachusetts Institute of Technology.

MRS –	monitored retrievable storage facility for spent fuel from commercial power reactors, proposed in 1982 in NWPA and 1987 in NWPAA (see also RSSF).
NAS –	National Academy of Sciences, is a private, nonprofit, self-perpetuating society of distinguished scholars engaged in scientific and engineering research. The Academy was chartered by Congress in 1863 with the mandate to advise the federal government on scientific and technical matters.
NEPA –	<i>National Environmental Policy Act of 1969</i> , federal law that sets environmental policy by requiring an environmental impact statement on all major federal projects; Public Law No. 91-190, 83 Stat. 852.
NMED –	New Mexico Environment Department.
NRC –	Nuclear Regulatory Commission, formed by the 1974 <i>Energy Reorganization Act</i> (Public Law 93-438) from the Atomic Energy Commission.
NRDC –	National Resources Defense Council, U.S. environmental special interest group.
NWPA -	<i>Nuclear Waste Policy Act of 1982</i> , provides a national policy for the interim storage, monitored retrievable storage, and eventual disposal of radioactive waste.
NWPAA –	<i>Nuclear Waste Policy Amendments Act of 1987</i> , amendments to the <i>Nuclear Waste Policy Act of 1982</i> specifying that only one repository site at Yucca Mountain was to be characterized by the DOE and placing less emphasis on the monitored retrievable storage option.
ORNL –	Oak Ridge National Laboratory, Y-12 Plant, Oak Ridge Reservation, Oak Ridge, TN. A large volume of TRU waste in storage is destined for the WIPP.
OTA –	Office of Technology Assessment, U.S. Congress.
PA –	Performance assessment, the <i>process</i> of assessing whether a <i>system</i> meets a set of <i>performance criteria</i> . For the WIPP PA, the <i>process</i> is a stochastic simulation. The <i>system</i> is a deep geologic repository disposal system (in salt) for DOE TRU waste. The <i>performance criteria</i> are various long-term environmental metrics in U.S. government regulations (not short-term operational safety issues).
PRA –	Probabilistic risk assessment, the process of assessing, through a stochastic simulation, the risks from a system. In theory, a PRA is identical to a performance assessment (PA) in the United States. In practice, the two differ because a PRA usually connotes (a) a system composed solely of human-engineered components, and (b) performance criteria that include risk to health over a short time (e.g., human lifetime) relative to geologic time. A PA usually connotes a system composed of both natural and human-engineered components over geologic time. Because the time frame is different, many phenomena for a PRA can be termed events (short-term phenomena); because the components are all human engineered, measured failure rates of components are often available. The modeling tools in a PRA can include elaborate event and fault trees and can substitute empirical data for mechanistic models. For a WIPP PA, the event trees are simpler, fault trees are not used, and mechanistic models are used directly.
QA –	quality assurance, all those planned and systemic actions necessary to provide adequate confidence that a structure, system, or component will perform satisfactorily in service. Quality assurance for a product is ensuring that the product does what it is supposed to do to meet the specifications of the customer. The customer expectation, as related to a performance assessment, is that the analysis results present an adequate view (from a legal standpoint) of the WIPP performance based on currently available data and information.
RCRA –	<i>Resource Conservation and Recovery Act of 1976</i> (Public Law 94-580) and, as used herein, subsequent amendments (e.g., HSWA, <i>Hazardous and Solid Waste Amendments of 1984</i> , Public Law 98-616). RCRA establishes a procedure to track and control

	<p>hazardous wastes from time of generation to disposal. Regulations in 40 CFR Parts 260-281 implement RCRA with respect to hazardous waste and hazardous waste treatment.</p>
RH-TRU -	remotely-handled Transuranic waste, packaged TRU waste whose external surface dose rate exceeds 200 mrem per hour, but not greater than 1000 rem per hour.
RSSF -	Retrievable surface storage facility for spent nuclear fuel and high-level waste proposed in 1972 by the AEC.
RWMC -	Radioactive Waste Management Complex, a nuclear waste storage facility for the DOE complex that has been at Idaho National Engineering and Environmental Laboratory (INEEL) since it was first built in 1952.
SA -	Stipulated Agreement between the State of New Mexico and the DOE.
SAB -	EPA's Science Advisory Board
SAR -	Safety Analysis Report.
SNF -	spent nuclear fuel, ". . . fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing" (NWPA, 1982) ^{F18} . Spent fuel can include intact and failed fuel assemblies, consolidated fuel rods, non-fuel components that are a part of a fuel assembly (such as neutron sources, instrumentation, and fuel channels). Although spent nuclear fuel has fissionable ^{235}U , it contains too many radionuclides (primarily short-lived) that adsorb neutrons from the fission process for it to be usefully left in the reactor. Because of spent nuclear fuel's high value, some countries choose to recycle it (recycling becomes more attractive after the short-lived fission products have decayed away). It is also designated separately from other high-level and transuranic wastes in the U.S. Environmental Protection Agency's standard on disposal of radioactive wastes, 40 CFR 191.
SNL -	Sandia National Laboratories, a multiprogram laboratory located in Albuquerque, NM, and Livermore, CA. SNL is operated and managed for the DOE by the Sandia Corporation. From 1949 until October 1993, Sandia Corporation was a wholly owned subsidiary of AT&T. Sandia Corporation is currently a wholly owned subsidiary of Lockheed-Martin Corp.
SPDV -	Site and preliminary design validation phase performed by Bechtel National.
SRP -	Savannah River Plant Laboratory Production Reactors Defense Waste Processing Facility, located southeast of Augusta, Georgia. A large volume of TRU waste produced and stored on site is destined for the WIPP.
SWCF	Sandia WIPP Central Files.
SWRIC -	Southwest Research and Information Center.
TRU -	TRansUranic, all elements of the periodic table having atomic numbers greater than 92.
TRUPACT-I -	Transuranic Package Transport design I, designed to be a vented package in the same shape and size as standard shipping containers to facilitate shipment. The EEG objected to a vented container; so the package was completely redesigned (see TRUPACT-II).
TRUPACT-II -	Transuranic Package Transport design II, designed to be a pressurized hemispherical package for use on flatbed trucks.
USGS -	U.S. Geological Survey, Department of Interior (DOI).
WIPP -	Waste Isolation Pilot Plant, a full-scale research and development repository for transuranic wastes near Carlsbad, NM; authorized in 1979 (Pub. L. 96-164) for the management, storage, and eventual disposal of waste generated by DOE defense programs that is contaminated with transuranic radionuclides and some RCRA hazardous chemicals.

WIPP LWA – Public Law 102-579. 1992. *Waste Isolation Pilot Plant Land Withdrawal Act* (106 Stat. 4777).

WPIO – WIPP Project Integration Office, formed in 1989, forerunner of the Carlsbad Area Office (CAO).

WPO – WIPP Project office, forerunner of the Carlsbad Area Office (CAO).

References

References for Administrative Directives and Regulatory Decisions

D1 DOE (U.S. Department of Energy). 1980. *Final Environmental Impact Statement: Waste Isolation Pilot Plant*. DOE/EIS-0026. Washington, DC: U.S. Department of Energy. Assistant Secretary for Defense Programs p. 1-1.

D2 Boffey, P.M. 1975. "Radioactive Waste Disposal: The Atomic Energy Commission Brings the Academy to Heel," *The Brain Bank of America: An Inquiry into the Politics of Science*. P.M. Boffey. New York, NY: McGraw-Hill Book Company. 89-111.

D3 Teller, E. 1959. "The Plowshare Program," *Proceedings of the Second Plowshare Symposium, San Francisco, CA, May 13-15, 1959*. UCRL-5675. Livermore, CA: Lawrence Radiation Laboratory. 8-13. (Copy on file in the Sandia WIPP Central Files (SWCF), Sandia National Laboratories, Albuquerque, NM as WPO#44080.)

D4 Wheeler, B.R., B.R. Dickey, G.E. Lohse, D.E. Black, D.W. Rhodes, and J.A. Buckingham. 1967. "Storage of Radioactive Solids in Underground Facilities: Current ICPP Practices and Future Concepts," *Disposal of Radioactive Wastes into the Ground, Proceedings of a Symposium Jointly Organized by the International Atomic Energy Agency and the European Nuclear Energy Agency of the OECD, Vienna, Austria, May 29-June 2, 1967*. Vienna: International Atomic Energy Agency. 421-440. (Copy on file in the SWCF as WPO#48156.)

D5 Lakey, L.T., and J.R. Bower, eds. 1963. *ICPP Waste Calcining Facility Safety Analysis Report*. IDO-14620. Idaho Falls, ID: Phillips Petroleum Co., Atomic Energy Division. (Available from the U.S. Department of Energy, Idaho Operations Office Public Reading Room, University Place, 1776 Science Center Drive, Idaho Falls, ID 83402-2300, Telephone: 208/526-9162, <http://www.inel.gov/resources/library/doepr.htm>, Accession Number 200.)

D6 AEC (Atomic Energy Commission). 1971. *Environmental Statement: Radioactive Waste Repository, Lyons, Kansas*. WASH-1503. [Washington, DC]: United States Atomic Energy Commission. (Copy on file in the SWCF as WPO#47929.)

D7 NRC (Nuclear Regulatory Commission). 1970. "Title 10—Atomic Energy Chapter I—Atomic Energy Commission Part 50—Licensing of Production and Utilization Facilities, Siting of Fuel Reprocessing Plants and Related Waste Management Facilities," *Federal Register*. Vol. 35, no. 222, 17530-17533.

D8 Lipschutz, R.D. 1980. *Radioactive Waste: Politics, Technology, and Risk*. Cambridge, MA: Ballinger Publishing Company, A Division of Harper & Row. 119, 144.

D9 Metlay, D.S. 1978. "History and Interpretation of Radioactive Waste Management in the United States," *Essays on Issues Relevant to the Regulation of Radioactive Waste Management*. W.P. Bishop, I.R. Hoos, N. Hilberry, D.S. Metlay, and R.A. Watson. NUREG-0412. Washington, DC: Division of Fuel Cycle and Material Safety, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission. 6-9.

D10 NAS/NRC (National Academy of Sciences/National Research Council). 1984. *Review of the Scientific and Technical Criteria for the Waste Isolation Pilot Plant (WIPP)*. DOE/DP/48015-1. Washington, DC: National Academy Press.

D11 EPA (U.S. Environmental Protection Agency). 1985. "40 CFR 191: Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes; Final Rule," *Federal Register*. Vol. 50, no. 182, 38066-38089.

D12 Ford, G.R. 1976. "The White House Fact Sheet: President's Nuclear Waste Management Plan." October 28, 1976. Washington, DC: Office of the White House Press Secretary. (On file at Gerald R. Ford Library, 1000 Beal Avenue, Ann Arbor, MI, Telephone: 313/741-2218.)

D13 McAuliffe, D. 1978. "Licensing Impasse and New Mexico Emotions May Force DOE to Bury WIPP," *Nucleonics Week*. Vol. 19, no. 36, 2-3.

D14 DOE (U.S. Department of Energy). 1978. *Report of Task Force for Review of Nuclear Waste Management. Draft*. DOE/ER-0004/D. Washington, DC: U.S. Department of Energy, Directorate of Energy Research.

D15 Carter, L.J. 1978. "Trouble Even in New Mexico for Nuclear Waste Disposal," *Science*. Vol. 199, no. 4333, 1050-1051.

D16 Carter, L.J. 1987. *Nuclear Imperatives and Public Trust: Dealing with Radioactive Waste*. Washington, DC: Resources for the Future, Inc.

D17 IRG (Interagency Review Group on Nuclear Waste Management). 1979. *Report to the President by the Interagency Review Group on Nuclear Waste Management*. TID-29442. Washington, DC: U.S. Department of Energy. (Copy on file in the SWCF as WPO#47934.)

D18 Weart, W.D. 1979. "WIPP: A Bedded Salt Repository for Defense Radioactive Waste in Southeastern New Mexico," *Radioactive Waste in Geologic Storage, 176th Annual Meeting of the American Chemical Society, Miami Beach, FL, September 11-15, 1978*. Ed. S. Fried. SAND78-0934C. ACS Symposium Series No. 100. Washington, DC: American Chemical Society. 13-36.

D19 Carter, J.E. 1982. "Appendix A: Presidential Message and Fact Sheet of February 12, 1980," *The Politics of Nuclear Waste*. Ed. E.W. Colglazier, Jr. New York, NY: Pergamon Press. 220-241.

D20 DOE (U.S. Department of Energy). 1980a. *Final Environmental Impact Statement: Waste Isolation Pilot Plant*. DOE/EIS-0026. Washington, DC: U.S. Department of Energy, Assistant Secretary for Defense Programs. Vols. 1-2.

D21 DOE (U.S. Department of Energy). 1980b. "New Mexico; Proposed Withdrawal and Reservations of Lands," *Federal Register*. Vol. 45, no. 223, 75768-75769.

D22 DOE (U.S. Department of Energy). 1981. "Waste Isolation Pilot Plant (WIPP): Record of Decision," *Federal Register*. Vol. 46, no. 18, 9162-9164.

D23 DOE (U.S. Department of Energy). 1992. "Definitive Design (Title II)," *Project Management System*. DOE Order 4700.1. Washington, DC: U.S. Department of Energy. V-40 through V-41. (Copy on file in the SWCF as WPO#48333.)

D24 DOE (U.S. Department of Energy). 1983a. *Summary of the Results of the Evaluation of the WIPP Site and Preliminary Design Validation Program*. WIPP-DOE-161. Albuquerque, NM: U.S. Department of Energy. (Copy on file in the SWCF as WPO#48675.)

D25 DOE (U.S. Department of Energy). 1983b. "Announcement of Decision to Proceed with Construction of the Waste Isolation Pilot Plant (WIPP)," *Federal Register*. Vol. 48, no. 128, 30427-30428.

D26 DOE (U.S. Department of Energy). 1987. "10 CFR Part 962 Radioactive Waste—Byproduct Material," *Federal Register*. Vol. 52, no. 84, 15937-15941.

D27 "Memorandum of Understanding between the U.S. Department of Energy and the U.S. Department of Labor," signed by R.L. Bernard, DOL Administrator for Metal and Nonmetal Mine Safety and Health, and R.G. Romatowski, DOE Manager of Albuquerque Operations Office, dated July 9, 1987. (Copy on file in the SWCF as WPO#9992.)

D28 EPA (U.S. Environmental Protection Agency). 1982. "40 CFR Part 191: Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes; Proposed Rule," *Federal Register*. Vol. 47, no. 250, 58196-58206.

D29 DOE (U.S. Department of Energy). 1989. "Waste Isolation Pilot Plant; Availability of Draft Supplement to the Final Environmental Impact Statement," *Federal Register*. Vol. 54, no. 76, 16350-16352.

D30 McCutcheon, C. 1989. "Embattled WIPP Won't Open in '89," *Albuquerque Journal*. June 28, 1989. Section A, pages 1, 3.

D31 DOE (U.S. Department of Energy). 1990a. *Final Supplement Environmental Impact Statement, Waste Isolation Pilot Plant*. DOE/EIS-0026-FS. Washington, DC: U.S. Department of Energy, Office of Environmental Restoration and Waste Management. Vols. 1-13.

D32 DOE (U.S. Department of Energy). 1990b. "Record of Decision; Waste Isolation Pilot Plant," *Federal Register*. Vol. 55, no. 121, 25689-25692.

D33 Anonymous. 1993. "Reversal on Nuclear Waste Tests," *Science News*. Vol. 144, no. 19, 303.

D34 DOE (U.S. Department of Energy). 1995a. *Draft 40 CFR 191 Compliance Certification Application for the Waste Isolation Pilot Plant. Phase II Review*. DOE/CAO-Predecisional Draft-2056. Carlsbad, NM: U.S. Department of Energy, Waste Isolation Pilot Plant, Carlsbad Area Office. (CD-ROM of the CCA is on file in the SWCF as WPO#48940.)

D35 DOE (U.S. Department of Energy). 1995b. *Resource Conservation and Recovery Act Part B Permit Application*. DOE/WIPP 91-005, Rev. 5. Carlsbad, NM: Waste Isolation Pilot Plant. Vols. I-X.

D36 Taugher, M. 1996. "Key WIPP Document Exceeds 400 Lbs," *Albuquerque Journal*. November 21, 1996. Section D, page 3.

D37 Chiri, T.W. 1996. "Documentation Puts WIPP Opening Closer," *Carlsbad Current-Argus*. November 21, 1996. Section A, pages 1, 2.

D38 Spohn, L. 1997. "Last Series of WIPP Hearings to Begin Monday," *Albuquerque Tribune*. January 4, 1997. Section A, page 3.

D39 DOE (U.S. Department of Energy). 1979. *Draft Environmental Impact Statement: Waste Isolation Pilot Plant*. DOE/EIS-0026-D. Washington, DC: U.S. Department of Energy. Vols. 1-2.

D40 EPA (U.S. Environmental Protection Agency). 1985. *Background Information Document for Final Rule. High-Level and Transuranic Radioactive Wastes*. EPA 520/1-85-023. Washington DC: Office of Radiation Programs, U.S. Environmental Protection Agency.

References for Federal Legislation and Judicial Decisions

F1 Public Law 585. 1946. *Atomic Energy Act of 1946*. (60 Stat. 755). (Copy on file in the SWCF as WPO#43711.)

F2 Public Law 703. 1954. *Atomic Energy Act of 1954*. (68 Stat. 919). (Copy on file in the SWCF as WPO#43705.)

F3 Public Law 91-190. 1970. *National Environmental Policy Act of 1969*. (83 Stat. 852; 42 U.S.C. 4321 et seq.).

F4 EPA (U.S. Environmental Protection Agency). 1993. "Part 1—Statement of Organization and General Information," *Code of Federal Regulations 40, Part 1*. Washington, DC: Superintendent of Documents, U.S. Government Printing Office.

F5 Reorganization Plan No. 3 of 1970. 1970. *Federal Register*. Vol. 35, no. 194, 15623-15626. (5 U.S.C. §903, Paragraph 301, Section 2(a); 84 Stat. 2086).

F6 Calvert Cliffs' Coordinating Committee, Inc., et al., Petitioners v. United States Atomic Energy Commission and United States of America, Respondents. Nos. 24839, 24871. 1971. *449 Federal Reporter, 2d Series 1109*. (Copy on file in the SWCF as WPO#47278.)

F7 Public Law 93-438. 1974. *Energy Reorganization Act of 1974* (88 Stat. 1233; 42 U.S.C. 5801 et seq.).

F8 NRC (Nuclear Regulatory Commission). 1975. "10 CFR Part 50, Appendix 1—Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low as Practicable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents," *Federal Register*. Vol. 40, no. 87, 19442-19443.

F9 Public Law 94-580. 1976. *Resource Conservation and Recovery Act of 1976*. (90 Stat. 2795 and subsequent amendments; 42 U.S.C. 6901 et seq.).

F10 EPA (U.S. Environmental Protection Agency). 1976. "40 CFR Part 260: Environmental Radiation Protection Standards for High-Level Radioactive Waste; Advance Notice of Proposed Rulemaking," *Federal Register*. Vol. 41, no. 235, 53363.

F11 Public Law 95-91. 1977. *Department of Energy Organization Act*. (91 Stat. 565; 42 U.S.C. 7101 et seq.).

F12 EPA (U.S. Environmental Protection Agency). 1978. "Environmental Protection Criteria for Radioactive Wastes: Announcement of Public Forum," *Federal Register*. Vol. 43, no. 10, 2223.

F13 EPA (U.S. Environmental Protection Agency). 1985. "40 CFR 191: Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes; Final Rule," *Federal Register*. Vol. 50, no. 182, 38066-38089.

F14 EPA (U.S. Environmental Protection Agency). 1978. "Criteria for Radioactive Wastes; Invitation for Comment: Environmental Protection," *Federal Register*. Vol. 43, no. 221, 53262-53268.

F15 Public Law 96-164. 1979. *Department of Energy National Security and Military Applications of Nuclear Energy Authorization Act of 1980*. (93 Stat. 1259).

F16 NRC (Nuclear Regulatory Commission). 1981. "Disposal of High-Level Radioactive Wastes in Geologic Repositories: Licensing Procedures," *Federal Register*. Vol. 46, no. 37, 13971-13987.

F17 DOI (U.S. Department of the Interior). Bureau of Land Management. 1982. "43 CFR Public Land Order 6232. New Mexico; Withdrawal of Lands," *Federal Register*. Vol. 47, no. 61, 13340.

F18 Public Law 97-425. 1983. *Nuclear Waste Policy Act of 1982*. (96 Stat. 2201; 42 U.S.C. 10101 et. seq.).

F19 EPA (U.S. Environmental Protection Agency). 1982. "40 CFR Part 191: Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes; Proposed Rule," *Federal Register*. Vol. 47, no. 250, 58196-58206.

F20 DOI (U.S. Department of the Interior). Bureau of Land Management. 1983. "43 CFR Public Land Order 6403. New Mexico; Withdrawal of Lands," *Federal Register*. Vol. 48, no. 130, 31038-31039.

F21 NRC (Nuclear Regulatory Commission). 1983. "10 CFR Part 60 Disposal of High-Level Radioactive Wastes in Geologic Repositories: Technical Criteria; Final Rule," *Federal Register*. Vol. 48, no. 120, 28194-28229.

F22 SAB (EPA Science Advisory Board). 1984. *Report on the Review of Proposed Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes* (40 CFR 191). Washington, DC: High-Level Radioactive Waste Disposal Subcommittee, Science Advisory Board, U.S. Environmental Protection Agency.

F23 Legal Environmental Assistance Foundation, Inc. and Natural Resources Defense Council, Inc., State of Tennessee on behalf of Tennessee Department of Health and Environment (Intervening Plaintiff) v. Donald Hodel, Secretary, United States Department of Energy and United States Department of Energy. No. CIV. 3-83-562. 1984. 586 *Federal Supplement* 1163. (Copy on file in the SWCF as WPO#48129.)

F24 Public Law 98-616. 1984. *The Hazardous and Solid Waste Amendments of 1984*. (98 Stat. 3221).

F25 U.S. Congress. Office of Technology Assessment. 1985. *Managing the Nation's Commercial High-Level Radioactive Waste*. OTA-O-171. Washington, DC: Superintendent of Documents, U.S. Government Printing Office. (Copy on file in the SWCF as WPO#48316.)

F26 EPA (U.S. Environmental Protection Agency). 1986. "State Authorization To Regulate the Hazardous Components of Radioactive Mixed Wastes Under the Resource Conservation and Recovery Act; Notice," *Federal Register*. Vol. 51, no. 128, 24504-24505.

F27 NRDC (Natural Resources Defense Council, Inc.) v. United States Environmental Protection Agency, et al. 1987. 824 *Federal Reporter*, 2d Series 1258. (Copy on file in the SWCF as WPO#43240.)

F28 Public Law 100-203. 1987. *Nuclear Waste Policy Amendments Act of 1987*. (101 Stat. 1330; 42 U.S.C. 10101 et seq.).

F29 Public Law 100-456. 1988. *National Defense Authorization Act, Fiscal Year 1989*. (102 Stat. 1918).

F30 EPA (U.S. Environmental Protection Agency). 1990. "Conditional No-Migration Determination for the Department of Energy Waste Isolation Pilot Plant (WIPP)," *Federal Register*. Vol. 55, no. 220, 47700-47721.

F31 DOI (U.S. Department of the Interior). Bureau of Land Management. 1991a. "43 CFR Public Land Order 6826. Modification of Public Land Order No. 6503; New Mexico," *Federal Register*. Vol. 56, no. 18, 3038-3039.

F32 DOI (U.S. Department of the Interior). Bureau of Land Management. 1991b. "Record of Decision (ROD), Waste Isolation Pilot Plant (WIPP) Project; New Mexico," *Federal Register*. Vol. 56, no. 18, 3114-3115.

F33 DOI (U.S. Department of the Interior). Bureau of Land Management. 1991c. "43 CFR Public Land Order 6826. Modification of Public Land Order No. 6403; New Mexico," *Federal Register*. Vol. 56, no. 29, 5731.

F34 Public Law 94-579. 1976. *Federal Land Policy and Management Act of 1976*. (90 Stat. 2743; 43 U.S.C. 1701 et seq.).

F35 State of Idaho, Petitioner, Shoshone-Bannock Tribes, Intervenors, v. U.S. Department of Energy, Respondent, Public Service Company of Colorado, Intervenor. No. 91-70094. United States Court of Appeals, Ninth Circuit. Decided September 20, 1991. 945 *Federal Reporter*, 2d Series 295. (Copy on file in the SWCF as WPO#48323.)

F36 DOI (U.S. Department of the Interior). Bureau of Land Management. 1991. "Notice to Proceed, Waste Isolation Pilot Plant (WIPP) Project, New Mexico," *Federal Register*. Vol. 56, no. 196, 50923-50924.

F37 Public Law 102-579. 1992. *Waste Isolation Pilot Plant Land Withdrawal Act*. (106 Stat. 4777).

F38 Public Law 102-486. 1976. *Energy Policy Act of 1992*. (106 Stat. 2776; 42 U.S.C. 13201 et seq.).

F39 Public Law 102-386. 1992. *Federal Facility Compliance Act of 1992*. (106 Stat. 1505).

F40 EPA (U.S. Environmental Protection Agency). 1993a. "Criteria for the Certification of Compliance with Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes; Advanced Notice of Proposed Rulemaking," *Federal Register*. Vol. 58, no. 27, 8029-8030.

F41 EPA (U.S. Environmental Protection Agency). 1993b. "40 CFR Part 191: Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes, Final Rule," *Federal Register*. Vol. 58, no. 242, 66398-66416.

F42 Public Law 103-160. 1993. *National Defense Authorization Act for Fiscal Year 1994*. (107 Stat. 1547).

F43 EPA (U.S. Environmental Protection Agency). 1995a. "40 CFR Part 194: Criteria for the Certification and Determination of the Waste Isolation Pilot Plant's Compliance With Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes; Proposed Rule," *Federal Register*. Vol. 60, no. 19, 5766-5791.

F44 EPA (U.S. Environmental Protection Agency). 1995b. "Draft Compliance Application Guidance (CAG) Document; Notice of Availability," *Federal Register*. Vol. 60, no. 201, 53921-53922.

F45 EPA (U.S. Environmental Protection Agency). 1996. "40 CFR Part 194: Criteria for the Certification and Re-Certification of the Waste Isolation Pilot Plant's Compliance With the 40 CFR Part 191 Disposal Regulations; Final Rule," *Federal Register*. Vol. 61, no. 28, 5224-5245.

F46 Public Law 104-201. 1996. *National Defense Authorization Act for Fiscal Year 1997. Subtitle F—Waste Isolation Pilot Plant Land Withdrawal Act Amendments*. (110 Stat. 2851).

F47 Nichols, M.D. 1996. "Aspects of the CCA Requiring More Documentation for Completeness and Technical (Particularly Computer Codes) Concerns Before Rulemaking." Recipient: A.L. Alm. Date 12/19/96. (Copy on file in the SWCF as WPO#47192.)

F48 Taucher, M. 1997. "Appeals Court Rules WIPP Criteria Meetings OK," *Albuquerque Journal*. June 7, 1997. Section D, page 3.

F49 EPA (U.S. Environmental Protection Agency). 1997. "40 CFR Part 194: Criteria for the Certification and Re-Certification of the Waste Isolation Pilot Plant's Compliance With the 40 CFR Part 191 Disposal Regulations: Certification Decision; Proposed Rule," *Federal Register*. Vol. 62, no. 210, 58792-58838.

F50 Taucher, M. 1997. "Agency Finds Disputed WIPP Safe to Open," *Albuquerque Journal*. October 24, 1997. Section A, page 1.

F51 Rasmussen, N.C. 1975. *Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants*. NUREG-75/014, WASH-1400. Washington, DC: U.S. Nuclear Regulatory Commission.* (Available from the NTIS as PB-248 200-Set.)

References for New Mexico and Regional Issues Concerning Nuclear Waste Disposal

N1 "Environmental Improvement Act," *New Mexico Statutes 1978 Annotated (1993 Repl.)*. Vol. 13, Chapter 74, Article 1, Sections 74-1-1 through 74-1-10. Charlottesville, VA: The Michie Company. (Copy on file in the SWCF as WPO#47578.)

N2 Carter, L.J. 1987. *Nuclear Imperatives and Public Trust: Dealing with Radioactive Waste*. Washington, DC: Resources for the Future, Inc.

N3 "Hazardous Waste Act," *New Mexico Statutes 1978 Annotated (1993 Repl.)*. Vol. 14, Chapter 74, Article 4, Sections 74-4-1 through 74-4-14. Charlottesville, VA: The Michie Company. (Copy on file in the SWCF as WPO#47585.)

N4 "Article 4A Radioactive Materials," *New Mexico Statutes 1978 Annotated (1993 Repl.)*. Vol. 13, Chapter 74, Article 4A, Sections 74-4A-1 through 74-4A-19. Charlottesville, VA: The Michie Company. (Copy on file in the SWCF as WPO#47586.)

N5 SRIC (Southwest Research and Information Center, Inc.). 1981. "Nuclear Waste Disposal," *The Workbook*. Vol. VI, no. 2, 44. (Copy on file in the SWCF as WPO#47565.)

N6 State of New Mexico, ex rel., Jeff Bingaman, Attorney General of the State of New Mexico, Plaintiff, v. The United States Department of Energy, et al., Defendants. 1981. "Stipulated Agreement." Civil Action No. 81-0363 JB. (United States District Court for the District of New Mexico). July 1, 1981. (Copy on file in the SWCF as WPO#42008.)

N7 SRIC (Southwest Research and Information Center, Inc.), Peter Montague; Michael Rutherford; Bill Pierce; and June Naylor, Plaintiffs, v. United States Department of Energy; James Edwards, Secretary of the United States Department of Energy; United States Department of Interior; United States Bureau of Land Management; and Robert F. Burford, Director of the Bureau of Land Management, Defendants. Civil No. 81-0537-JB. United States District Court, District of New Mexico. Action filed July 10, 1981. Judgment rendered October 1, 1984, by U.S. District Judge Juan C. Burciaga. (Copy on file in the SWCF as WPO#47567.)

N8 Documents Related to State of New Mexico v. U.S. Department of Energy Including the Supplemental Stipulated Agreement Resolving Certain State Off-Site Concerns Over WIPP and the Opinion of the General Counsel of the Department of Energy on Application of the Price-Anderson Act to the Waste Isolation Pilot Plant. 1982. (Copy on file in the SWCF as WPO#48652.)

N9 Neill, R.H., J.K. Channell, L. Chaturvedi, M.S. Little, K. Rehfeldt, and P. Spiegler. 1983. *Evaluation of the Suitability of the WIPP Site*. EEG-23. Santa Fe, NM: Environmental Evaluation Group, Environmental Improvement Division.

N10 Neill, R.H., and J.K. Channell. 1983. *Potential Problems from Shipment of High-Curie Content Contact-Handled Transuranic (CH-TRU) Waste to WIPP (Waste Isolation Pilot Plant)*. EEG-24. Santa Fe, NM: New Mexico Health and Environment Department, Environmental Evaluation Group.

N11 Channell, J.K., J.C. Rodgers, and R.H. Neill. 1986. *Adequacy of TRUPACT-I Design for Transporting Contact-Handled Transuranic Wastes to WIPP*. EEG-33. Santa Fe, NM: New Mexico Health and Environment Department, Environmental Evaluation Group.

N12 EPA (U.S. Environmental Protection Agency). 1985. "40 CFR Part 271: New Mexico; Decision on Final Authorization of State Hazardous Waste Management Program: Notice of Final Determination on New Mexico's Application for Final Authorization," *Federal Register*. Vol. 50, no. 8, 1515-1516.

N13 NRDC (Natural Resources Defense Council, Inc.) v. United States Environmental Protection Agency, et al. 1987. *824 Federal Reporter, 2d Series 1258*. Nos. 85-1915, 86-1096 to 86-1098. United States Court of Appeals, First Circuit. July 17, 1987. As Amended August 12, 1987. (Copy on file in the SWCF as WPO#43240.)

N14 Cummings, R.G. 1988. *New Mexico Waste Isolation Pilot Project (WIPP): An Historical Overview*. DOE/NV/10461-T15. Albuquerque, NM: University of New Mexico for State of Nevada, Agency for Nuclear Projects/Nuclear Waste Project Office. 9-11. (Copy on file in the SWCF as WPO#47158.)

N15 EPA (U.S. Environmental Protection Agency). 1990. "40 CFR Part 271: State of New Mexico: Final Authorization of State Hazardous Waste Management Program; Final Rule," *Federal Register*. Vol. 55, no. 133, 28397-28398.

N16 State of New Mexico, ex rel., Tom Udall, Attorney General, Plaintiff, Natural Resources Defense Council, et al., and State of Texas, ex rel., Dan Morales, Attorney General, Plaintiffs-Intervenors, v. James D. Watkins, Secretary of the Department of Energy, et al., Defendants. Environmental Defense Fund, et al., Plaintiffs, v. James D. Watkins, Secretary of the Department of Energy, et al., Defendants. Civ. A. Nos. 91-2527, 91-2929. United States District Court, District of Columbia. December 13, 1991. 783 *Federal Supplement* 628.

N17 State of New Mexico, ex rel., Tom Udall, Attorney General, Plaintiffs, Natural Resources Defense Council, et al., and State of Texas, ex rel., Dan Morales, Attorney General, Plaintiffs-Intervenors, v. James D. Watkins, Secretary of Energy, et al., Defendants. v. James D. Watkins, Secretary of the Department of Energy, et al., Defendants. Civ. A. No. 91-2527, 91-2929. United States District Court, District of Columbia. February 3, 1992. 783 *Federal Supplement* 633.

N18 McCutcheon, C. 1993. "WIPP Staff Won't Move to Carlsbad," *Albuquerque Journal*. June 11, 1993. Section D, page 3.

N19 Welch, B. 1993. "Local Group to Meet Energy Secretary over WIPP Standstill," *Carlsbad Current-Argus*. August 23, 1993. Section A, pages 1, 2.

N20 NMED (New Mexico Environment Department). 1993. *Resource Conservation and Recovery Act Draft Hazardous Waste Facility Permit Waste Isolation Pilot Plant (WIPP)*. EPA I.D. Number NM4890139088. [Santa Fe, NM]: New Mexico Environment Department. Vols. 1-4. (Copy on file at Zimmerman Government Publications, University of New Mexico, Albuquerque, NM as #E 1.28:DOE/WID 93-RCRA/DRAFT.)

N21 Eichstaedt, P. 1996. "Udall: WIPP Unsafe, Lawsuit Alleges EPA Eased Rules," *Albuquerque Journal*. April 9, 1996. Section C, page 3.

References for Technical Milestones

T1 Hacking, I. 1975. *The Emergence of Probability: A Philosophical Study of Early Ideas About Probability, Induction and Statistical Inference*. London; New York: Cambridge University Press.

T2 NAS/NRC (National Academy of Sciences/National Research Council). 1957. *The Disposal of Radioactive Waste on Land: Report of the Committee on Waste Disposal of the Division of Earth Sciences*. Publication 519. Washington, DC: National Academy of Sciences/National Research Council. (Available from the National Technical Information Service (NTIS), Springfield, VA as DE92017903/XAB.)

T3 U.S. Congress. 1970. "National Academy of Sciences-National Research Council," *Congressional Record*. Vol. 116, pt. 10, 13570-13589.

T4 NAS/NRC (National Academy of Sciences/National Research Council). 1959. *Radioactive Waste Disposal into Atlantic and Gulf Coastal Waters*. Publication 655. Washington, DC: Working Group of the Committee on Oceanography of the National Academy of Sciences - National Research Council. (Copy on file in the SWCF as WPO#47431.)

T5 Gard, L.M. 1968. *Geologic Studies, Project Gnome, Eddy County, New Mexico*. Professional Paper 589. Washington, DC: U.S. Geological Survey. (Copy on file in the SWCF as WPO#48945.)

T6 Pierce, W.G., and E.I. Rich. 1962. *Summary of Rock Salt Deposits in the United States as Possible Storage Sites for Radioactive Waste Materials*. Geological Survey Bulletin 1148. Washington, DC: Geological Survey. (Copy on file in the SWCF as WPO#48688.)

T7 Bradshaw, R.L., and W.C. McClain, eds. 1971. *Project Salt Vault: A Demonstration of the Disposal of High-Activity Solidified Wastes in Underground Salt Mines*. ORNL-4555. Oak Ridge, TN: Oak Ridge National Laboratory. (Copy on file in the SWCF as WPO#48808.)

T8 McClain, W.C., and R.L. Bradshaw. 1970. "Status of Investigations of Salt Formations for Disposal of Highly Radioactive Power-Reactor Wastes," *Nuclear Safety*. Vol. 11, no. 2, 130-141.

T9 Boffey, P.M. 1975. "Radioactive Waste Disposal: The Atomic Energy Commission Brings the Academy to Heel," *The Brain Bank of America: An Inquiry into the Politics of Science*. P.M. Boffey. New York, NY: McGraw-Hill Book Company. 89-111.

T10 U.S. Congress. 1970. "Radioactive Waste Management: An Interim Report of the Committee on Radioactive Waste Management," *Congressional Record*. Vol. 116, pt. 10, 13592-13593.

T11 NAS/NRC (National Academy of Sciences/National Research Council). 1970. *Disposal of Solid Radioactive Wastes in Bedded Salt Deposits*. Washington, DC: Committee on Radioactive Waste Management, National Academy of Sciences/National Research Council; U.S. Government Printing Office. (Copy on file in the SWCF as WPO#43139 and available from the NTIS as PB-265 197/4.)

T12 Carter, L.J. 1987. *Nuclear Imperatives and Public Trust: Dealing with Radioactive Waste*. Washington, DC: Resources for the Future, Inc.

T13 Brokaw, A.L., C.L. Jones, M.E. Cooley, and W.H. Hays. 1972. *Geology and Hydrology of the Carlsbad Potash Area, Eddy and Lea Counties, New Mexico*. Open-file report USGS-4339-1. Denver, CO: United States Department of the Interior, Geological Survey. (Copy on file in the SWCF as WPO#43356.)

T14 Anderson, R.E., D.H. Eargle, and B.O. Davis. 1973. *Geologic and Hydrologic Summary of Salt Domes in Gulf Coast Region of Texas, Louisiana, Mississippi, and Alabama*. Open-file report USGS-4339-2. Denver, CO: United States Department of the Interior, Geological Survey. (Copy on file in the SWCF as WPO#43862.)

T15 Mytton, J.W. 1973. *Two Salt Structures in Arizona: The Supai Salt Basin and the Luke Salt Body*. Open-file report USGS-4339-3. Denver, CO: United States Department of the Interior, Geological Survey. (Copy on file in the SWCF as WPO#48691.)

T16 Bachman, G.O., R.B. Johnson, and F.A. Swenson. 1973. *Stability of Salt in the Permian Salt Basin of Kansas, Oklahoma, Texas, and New Mexico, With a Section on Dissolved Salts in Surface Water*. Open-file report USGS-4339-4. Denver, CO: United States Department of the Interior, Geological Survey. (Copy on file in the SWCF as WPO#41298.)

T17 Merewether, E.A., J.A. Sharps, J.R. Gill, and M.E. Cooley. 1973. *Shale, Mudstone, and Claystone as Potential Host Rocks for Underground Emplacement of Waste*. Open-file report USGS-4339-5. Denver, CO: United States Department of the Interior, Geological Survey. (Copy on file in the SWCF as WPO#48204.)

T18 Hite, R.J., and S.W. Lohman. 1973. *Geologic Appraisal of Paradox Basin Salt Deposits for Waste Emplacement*. Open-file report USGS-4339-6. Denver, CO: United States Department of the Interior, Geological Survey. (Copy on file in the SWCF as WPO#48650.)

T19 Jones, C.L., M.E. Cooley, and G.O. Bachman. 1973. *Salt Deposits of Los Medaños Area, Eddy and Lea Counties, New Mexico, With Sections on Ground Water Hydrology*. Open-file report USGS-4339-7. Denver, CO: United States Department of the Interior, Geological Survey. (Copy on file in the SWCF as WPO#43835.)

T20 Bachman, G.O. 1973. *Surficial Features and Late Cenozoic History in Southeastern New Mexico*. Open-file report USGS-4339-8. Denver, CO: United States Department of the Interior, Geological Survey. (Copy on file in the SWCF as WPO#41293.)

T21 Barnes, H. 1974. "Geologic and Hydrologic Background for Selecting Site of Pilot-plant Repository for Radioactive Waste," *Bulletin of the Association of Engineering Geologists*. Vol. XI, no. 1, 83-92.

T22 Claiborne, H.C., and F. Gera. 1974. *Potential Containment Failure Mechanisms and Their Consequences at a Radioactive Waste Repository in Bedded Salt in New Mexico*. ORNL-TM-4639. Oak Ridge, TN: Oak Ridge National Laboratory. (Copy on file in the SWCF as WPO#41224.)

T23 Sandia National Laboratories and U.S. Geological Survey. 1983. *Basic Data Report for Drillhole ERDA 6 (Waste Isolation Pilot Plant - WIPP)*. SAND79-0267. Albuquerque, NM: Sandia National Laboratories.

T24 Powers, D.W., S.J. Lambert, S-E. Shaffer, L.R. Hill, and W.D. Weart, eds. 1978. *Geological Characterization Report, Waste Isolation Pilot Plant (WIPP) Site, Southeastern New Mexico*. SAND78-1596. Albuquerque, NM: Sandia [National] Laboratories. Vols. I-II.

T25 Molecke, M.A. 1978. *Waste Isolation Pilot Plant Transuranic Wastes Experimental Characterization Program: Executive Summary*. SAND78-1356. Albuquerque, NM: Sandia [National] Laboratories.

T26 Sandia [National] Laboratories. 1979. *Summary of Research and Development Activities in Support of Waste Acceptance Criteria for WIPP*. Comp. T.O. Hunter. SAND79-1305. Albuquerque, NM: Sandia [National] Laboratories.

T27 Sandia [National] Laboratories. 1977. *Waste Isolation Pilot Plant (WIPP) Conceptual Design Report*. SAND77-0274. Albuquerque, NM: Sandia [National] Laboratories.

T28 Gulick, C.W., Jr. 1979. *Borehole Plugging Program, Plugging of ERDA No. 10 Drill Hole*. SAND79-0789. Albuquerque, NM: Sandia National Laboratories.

T29 Lamoreaux, G.H., L.E. Romesberg, S.H. Sutherland, and T.A. Duffey. 1980. "Contact-Handled Transuranic Transportation System Structural Analysis (TRUPACT)," *Patram 80, 6th International Symposium on Packaging and Transporting Radioactive Material, Berlin, Germany, November 10-14, 1980*. Ed. H.W. Hübner. Berlin: Bundesanst für Materialprüf (BAM). Vol. 2, 1214-1221.

T30 May, R.A., L.E. Romesberg, H.R. Yoshimura, W.E. Baker, and J.C. Hokanson. 1980. "Analytical and Empirical Evaluation of Low-Level Waste Drum Response to Accident Environments," *Patram 80, 6th International Symposium on Packaging and Transporting Radioactive Material, Berlin, Germany, November 10-14, 1980*. Ed. H.W. Hübner. Berlin: Bundesanst für Materialprüf (BAM). Vol. 2, 1321-1328.

T31 Romesberg, L.E., S.H. Sutherland, G.H. Lamoreaux, and R.G. Eakes. 1981. "Design of Packaging for Transporting Transuranic Contaminated Wastes," *Damage Prevention in the Transportation Environment, Proceedings of the 34th Meeting of the Mechanical Failures Prevention Group, National Bureau of Standards, Gaithersburg, MD, October 21-23, 1981*. Ed. T.R. Shives. NBS Special Publication 652; SAND81-1308C. Washington, DC: U.S. Department of Commerce, National Bureau of Standards; Albuquerque, NM: Sandia National Laboratories. 16 pp.

T32 Kosiewicz, S.T., B.L. Barraclough, and A. Zerwekh. 1980. *Studies of Transuranic Waste Storage Under Conditions Expected in the Waste Isolation Pilot Plant (WIPP), Interim Summary Report, October 1, 1977-June 15, 1979*. LA-7931-PR. Los Alamos, NM: Los Alamos Scientific Laboratory. (Copy on file in the SWCF as WPO#48813.)

T33 NAS/NRC (National Academy of Sciences/National Research Council). 1984. *Review of the Scientific and Technical Criteria for the Waste Isolation Pilot Plant (WIPP)*. DOE/DP/48015-1. Washington, DC: National Academy Press.

T34 Hunter, T.O. 1979. "Technical Issues of Nuclear Waste Isolation in the Waste Isolation Pilot Plant (WIPP)," *Proceedings, 87th National Meeting of American Institute of Chemical Engineers, Boston, MA, August 19-22, 1979*. SAND79-1117C. New York, NY: American Institute of Chemical Engineers. (AIChE preprint available from the Linda Hall Library, Kansas City, MO, 1-800-662-1545. SAND79-1117C is on file in the SWCF as WPO#26711.)

T35 Sattler, A.R., and C.L. Christensen. 1980. *Measurements of Very Large Deformations in "Potash Salt" in Conjunction With an Ongoing Mining Operation*. SAND79-2254. Albuquerque, NM: Sandia National Laboratories.

T36 McVey, D.F. 1981. *Analysis of Data from Line Source Thermal Conductivity Measurements Taken In Situ in Dome Salt at the Avery Island Mine*. SAND81-1232. Albuquerque, NM: Sandia National Laboratories.

T37 Ewing, R.I. 1981. *WIPP Test of a Radiant Heater in the Avery Island Salt Mine*. SAND81-1305. Albuquerque, NM: Sandia National Laboratories.

T38 Christensen, C.L., R.D. Statler, and E.W. Peterson. 1980. *Downhole Television (DHTV) Applications in Borehole Plugging*. SAND80-0459. Albuquerque, NM: Sandia National Laboratories.

T39 Popielak, R.S., R.L. Beauheim, S.R. Black, W.E. Coons, C.T. Ellingson, and R.L. Olsen. 1983. *Brine Reservoirs in the Castile Formation, Waste Isolation Pilot Plant (WIPP) Project, Southeastern New Mexico*. TME 3153. Albuquerque, NM: U.S. Department of Energy, Waste Isolation Pilot Plant. (Copy on file in the SWCF as WPO#42085.)

T40 Lambert, S.J. 1983. *Dissolution of Evaporites In and Around the Delaware Basin, Southeastern New Mexico and West Texas*. SAND82-0461. Albuquerque, NM: Sandia National Laboratories.

T41 Snyder, R.P., and L.M. Gard, Jr. 1982. *Evaluation of Breccia Pipes in Southeastern New Mexico and Their Relation to the Waste Isolation Pilot Plant (WIPP) Site, with a Section on Drill-Stem Tests, WIPP 31*, by J.W. Mercer. Open-File Report 82-968. Denver, CO: Prepared by the U.S. Geological Survey for the Albuquerque Operations Office, U.S. Department of Energy.

T42 Earth Technology Corporation. 1988. *Final Report for Time Domain Electromagnetic (TDEM) Surveys at the WIPP Site*. H. Cline and M. Blohm. SAND87-7144. Albuquerque, NM: Sandia National Laboratories.

T43 Matalucci, R.V., C.L. Christensen, T.O. Hunter, M.A. Molecke, and D.E. Munson. 1982. *Waste Isolation Pilot Plant (WIPP) Research and Development Program: In Situ Testing Plan, March 1982*. SAND81-2628. Albuquerque, NM: Sandia National Laboratories.

T44 Lynch, R.W., R.L. Hunter, D.R. Anderson, F.W. Bingham, J.M. Covan, G.F. Hohnstrieter, T.O. Hunter, R.D. Klett, E.E. Ryder, T.L. Sanders, and W.D. Weart. 1991. *Deep Geologic Disposal in the United States: The Waste Isolation Pilot Plant and Yucca Mountain Projects*. SAND90-1656. Albuquerque, NM: Sandia National Laboratories.

T45 Tyler, L.D., R.V. Matalucci, M.A. Molecke, D.E. Munson, E.J. Nowak, and J.C. Stormont. 1988. *Summary Report for the WIPP Technology Development Program for Isolation of Radioactive Waste*. SAND88-0844. Albuquerque, NM: Sandia National Laboratories.

T46 NRC (Nuclear Regulatory Commission). 1994. "Part 71—Packaging and Transportation of Radioactive Material," *Code of Federal Regulations 10, Part 71*. Washington, DC: Superintendent of Documents, U.S. Government Printing Office.

T47 Morgan, H.S., C.M. Stone, and R.D. Krieg. 1985. "The Use of Field Data to Evaluate and Improve Drift Response Models for the Waste Isolation Pilot Plant (WIPP)," *Research and Engineering Applications in Rock Masses, Proceedings of the 26th U.S. Symposium on Rock Mechanics, Rapid City, SD, June 26-28, 1985*. Ed. E. Ashworth. Boston, MA: A.A. Balkema. Vol. 2, 769-776.

T48 Morgan, H.S., C.M. Stone, and R.D. Krieg. 1986. *An Evaluation of WIPP Structural Modeling Capabilities Based on Comparisons with South Drift Data*. SAND85-0323. Albuquerque, NM: Sandia National Laboratories.

T49 Romesberg, L.E., and M.L. Hudson. 1986. "Impact, Puncture and Thermal Testing of TRUPACT-I," *Proceedings of an International Symposium on the Packaging and Transportation of Radioactive Materials (PATRAM '86), Davos, Switzerland, June 16-20, 1986*. SAND84-2067C, IAEA-SM-286/107. Vienna, Austria: International Atomic Energy Agency. Vol. 2, 511-519.

T50 Romesberg, L.E., R.S. Longenbaugh, and B.J. Joseph. 1989. *Fire Testing and Analysis of TRUPACT-I Thermal Test Article*. SAND86-2710, TTC-0704. Albuquerque, NM: Sandia National Laboratories.

T51 Lappin, A.R. 1988. *Summary of Site-Characterization Studies Conducted From 1983 Through 1987 at the Waste Isolation Pilot Plant (WIPP) Site, Southeastern New Mexico*. SAND88-0157. Albuquerque, NM: Sandia National Laboratories.

T52 Sandoval, R.P., and L.C. Sanchez. 1987. "TRUPACT Containment Issues," *Proceedings of an International Symposium on the Packaging and Transportation of Radioactive Materials (PATRAM '86), Davos, Switzerland, June 16-20, 1986*. SAND85-2203C. Vienna, Austria: International Atomic Energy Agency. Vol. 2, 719-727.

T53 Warrant, M.M., J.M. Nelsen, and S.W. Woolfolk. 1987. "Containment Analysis of TRUPACT-I," *Proceedings of an International Symposium on the Packaging and Transportation of Radioactive Materials (PATRAM '86), Davos, Switzerland, June 16-20, 1986*. SAND85-2188C, IAEA-SM-286-111P. Vienna, Austria: International Atomic Energy Agency. Vol. 2, 529-536.

T54 Begley, S., and M. Miller. 1987. "A Nuclear Dump Springs a Leak," *Newsweek*. Vol. 100, no. 26, 65.

T55 Nowak, E.J., D.F. McTigue, and R. Beraún. 1988. *Brine Inflow to WIPP Disposal Rooms: Data, Modeling, and Assessment*. SAND88-0112. Albuquerque, NM: Sandia National Laboratories.

T56 Beauheim, R.L. 1989. *Interpretation of the H-11b4 Hydraulic Tests and the H-11 Multipad Pumping Test of the Culebra Dolomite at the Waste Isolation Pilot Plant (WIPP) Site*. SAND89-0536. Albuquerque, NM: Sandia National Laboratories.

T57 LaVenue, A.M., T.L. Cauffman, and J.F. Pickens. 1990. *Ground-Water Modeling of the Culebra Dolomite. Volume I: Model Calibration*. SAND89-7068/1. Albuquerque, NM: Sandia National Laboratories.

T58 Nuclear Packaging, Inc. 1989. *Safety Analysis Report for the TRUPACT-II Shipping Package, Rev. 4*. SR00045. Washington, DC: Nuclear Packaging, Inc. Vols. 1-5. (Copy on file in the U.S. Nuclear Regulatory Commission Reading Room, Washington, DC, 1-800-397-4209.)

T59 Lappin, A.R., R.L. Hunter, D.P. Garber, and P.B. Davies, eds. 1989. *Systems Analysis, Long-Term Radionuclide Transport, and Dose Assessments, Waste Isolation Pilot Plant (WIPP), Southeastern New Mexico; March 1989*. SAND89-0462. Albuquerque, NM: Sandia National Laboratories.

T60 Jensen, A.L., C.L. Howard, R.L. Jones, and T.P. Peterson. 1993. *Room Q Data Report: Test Borehole Data From April 1989 Through November 1991*. SAND92-1172. Albuquerque, NM: Sandia National Laboratories.

T61 Munson, D.E., A.F. Fossum, and P.E. Senseny. 1989. *Advances in Resolution of Discrepancies Between Predicted and Measured In Situ WIPP Room Closures*. SAND88-2948. Albuquerque, NM: Sandia National Laboratories.

T62 DOE (U.S. Department of Energy). 1989. *Waste Isolation Pilot Plant No-Migration Variance Petition*. DOE/WIPP 89-003, Rev. 0. Carlsbad, NM: Westinghouse Electric Corporation, Waste Isolation Division.

T63 Marietta, M.G., S.G. Bertram-Howery, D.R. Anderson, K.F. Brinster, R.V. Guzowski, H. Iuzzolino, and R.P. Rechard. 1989. *Performance Assessment Methodology Demonstration: Methodology Development for Evaluating Compliance With EPA 40 CFR 191, Subpart B, for the Waste Isolation Pilot Plant*. SAND89-2027. Albuquerque, NM: Sandia National Laboratories.

T64 Bertram-Howery, S.G., M.G. Marietta, D.R. Anderson, K.F. Brinster, L.S. Gomez, R.V. Guzowski, and R.P. Rechard. 1989. *Draft Forecast of the Final Report for the Comparison to 40 CFR Part 191, Subpart B, for the Waste Isolation Pilot Plant*. SAND88-1452. Albuquerque, NM: Sandia National Laboratories.

T65 DOE (U.S. Department of Energy). 1990a. *WIPP Test Phase Plan: Performance Assessment*. DOE/WIPP 89-011, Revision 0. Carlsbad, NM: United States Department of Energy, Waste Isolation Pilot Plant.

T66 DOE (U.S. Department of Energy). 1990b. *Final Safety Analysis Report, Waste Isolation Pilot Plant, Carlsbad, New Mexico*. WP 02-9, Rev. 0. Carlsbad, NM: Westinghouse Electric Corporation. Vols. 1-8. (Copy on file in the SWCF as WPO#43327.)

T67 Rechard, R.P., H.J. Iuzzolino, J.S. Rath, A.P. Gilkey, R.D. McCurley, and D.K. Rudeen. 1989. *User's Manual for CAMCON: Compliance Assessment Methodology Controller*. SAND88-1496. Albuquerque, NM: Sandia National Laboratories.

T68 Bertram-Howery, S.G., M.G. Marietta, R.P. Rechard, P.N. Swift, D.R. Anderson, B.L. Baker, J.E. Bean, Jr., W. Beyeler, K.F. Brinster, R.V. Guzowski, J.C. Helton, R.D. McCurley, D.K. Rudeen, J.D. Schreiber, and P. Vaughn. 1990. *Preliminary Comparison with 40 CFR Part 191, Subpart B for the Waste Isolation Pilot Plant, December 1990*. SAND90-2347. Albuquerque, NM: Sandia National Laboratories.

T69 Rechard, R.P., W. Beyeler, R.D. McCurley, D.K. Rudeen, J.E. Bean, and J.D. Schreiber. 1990. *Parameter Sensitivity Studies of Selected Components of the Waste Isolation Pilot Plant Repository/Shaft System*. SAND89-2030. Albuquerque, NM: Sandia National Laboratories.

T70 DOE (U.S. Department of Energy). 1992a. "Waste Isolation Pilot Plant RCRA Part A Permit Application," *Resource Conservation and Recovery Act Part B Permit Application*. DOE/WIPP 91-005, Revision 1.0. Carlsbad, NM: Waste Isolation Pilot Plant. Vol. I, Chapter A. (Part A Permit Application dated July 10, 1991.)

T71 DOE (U.S. Department of Energy). 1992b. *Resource Conservation and Recovery Act Part B Permit Application*. DOE/WIPP 91-005, Revision 1.0. Carlsbad, NM: Waste Isolation Pilot Plant. Vols. I-VII.

T72 WIPP PA (Performance Assessment) Division. 1991. *Preliminary Comparison with 40 CFR Part 191, Subpart B for the Waste Isolation Pilot Plant, December 1991*. SAND91-0893/1/2/3. Albuquerque, NM: Sandia National Laboratories. Vols. 1-3.

T73 DOE (U.S. Department of Energy). 1991. *Report of the Geotechnical Panel on the Effective Life of Rooms in Panel 1*. DOE/WIPP 91-023. Carlsbad, NM: Westinghouse Electrical Corporation, Waste Isolation Division.

T74 DOE (U.S. Department of Energy). 1992. *WIPP Supplementary Roof Support System Room 1, Panel 1 Geotechnical Field Data Analysis Bi-Annual Report*. DOE/WIPP 92-024. Carlsbad, NM: Westinghouse Electrical Corporation, Waste Isolation Division.

T75 DOE (U.S. Department of Energy). 1993a. *Test Phase Plan for the Waste Isolation Pilot Plant*. DOE/WIPP 89-011, Revision 1. Albuquerque, NM: U.S. Department of Energy, WIPP Project Integration Office.

T76 DOE (U.S. Department of Energy). 1993b. *Waste Retrieval Plan for the Waste Isolation Pilot Plant*. DOE/WIPP-89-022, Rev. 1. Washington, DC: U.S. Department of Energy.

T77 NRC (National Research Council). 1992. *A Letter Report by the Panel on the Waste Isolation Pilot Plant, Board on Radioactive Waste Management*. Washington, DC: Commission on Geosciences, Environment, and Resources, National Research Council. (Copy on file in the SWCF as WPO#35203-35204.)

T78 WIPP PA (Performance Assessment) Department. 1992/1993. *Preliminary Performance Assessment for the Waste Isolation Pilot Plant, December 1992*. SAND92-0700/1/2/3/4/5. Albuquerque, NM: Sandia National Laboratories. Vols. 1-5.

T79 DOE (U.S. Department of Energy). 1995a. *Engineered Alternatives Cost/Benefit Study Final Report*. DOE/WIPP 95-2135 Revision 0. Albuquerque, NM: IT Corporation; Carlsbad, NM: United States Department of Energy, Waste Isolation Pilot Plant, Carlsbad Area Office.

T80 DOE (U.S. Department of Energy). 1995b. *Transuranic Waste Baseline Inventory Report (Revision 2)*. DOE/CAO-95-1121. Carlsbad, NM: U.S. Department of Energy, Carlsbad Area Office.

T81 Meigs, L.C., and J.T. McCord. 1996. "Physical Transport in the Culebra Dolomite." Unpublished Memorandum to File, July 11, 1996. Albuquerque, NM: Sandia National Laboratories. (Copy on file in the SWCF as WPO#39167.)

T82 Meigs, L.C., R.L. Beauheim, J.T. McCord, Y.W. Tsang, and R. Haggerty. 1997. "Design, Modeling, and Current Interpretations of the H-19 and H-11 Tracer Tests at the WIPP Site," *Field Transport Experiments, Role in the Prediction of Radionuclide Migration: Synthesis and Proceeding of an NEA/EC GEOTRAP*

Workshop, Cologne, Germany, August 28-30, 1996. SAND96-2796C. Paris: Nuclear Energy Agency, Organisation for Economic Co-Operation and Development. 157-169.

T83 EPA (U.S. Environmental Protection Agency). 1996. "40 CFR Part 194: Decision to Certify Whether the Waste Isolation Pilot Plant Complies with the 40 CFR Part 191 Disposal Regulations and the 40 CFR Part 194 Compliance Criteria; Advance Notice of Proposed Rulemaking (ANPR)," *Federal Register*. Vol. 61, no. 222, 58499-58500.

T84 Taucher, M. 1996. "Key WIPP Document Exceeds 400 Lbs," *Albuquerque Journal*. November 21, 1996. Section D, page 3.

T85 NAS/NRC (National Academy of Sciences/National Research Council). 1996. *The Waste Isolation Pilot Plant: A Potential Solution for the Disposal of Transuranic Waste*. Committee on the Waste Isolation Pilot Plant, Board on Radioactive Waste Management, Commission on Geosciences, Environment, and Resources, National Research Council. Washington, DC: National Academy Press. 6, 79-80.

T86 Taucher, M. 1996. "Scientists: WIPP Not A Threat," *Albuquerque Journal*. October 24, 1996. Section A, pages 1, 10.

T87 Hansen, F.D., M.K. Knowles, T.W. Thompson, M. Gross, J.D. McLennan, and J.F. Schatz. 1997. *Description and Evaluation of a Mechanistically Based Conceptual Model for Spall*. SAND97-1369. Albuquerque, NM: Sandia National Laboratories.

T88 Anonymous. 1997. "Independent Experts: WIPP Conceptual Models Adequate," *Carlsbad Current-Argus*. May 11, 1997. Section A, page 3.

T89 Weart, W.D. 1983. *Summary Evaluation of the Waste Isolation Pilot Plant (WIPP) Site Suitability*, SAND83-0450. Albuquerque, NM: Sandia National Laboratories.

T90 Rechard, R.P., ed. 1992. *User's Reference Manual for CAMCON: Compliance Assessment Methodology Controller, Version 3.0*. SAND90-1983. Albuquerque, NM: Sandia National Laboratories.

T91 Rechard, R.P. 1991. "CAMCON: Computer System for Assessing Regulatory Compliance of the Waste Isolation Pilot Plant," *Proceedings of the International Conference on Probabilistic Safety Assessment and Management (PSAM)*, Beverly Hills, CA, February 4-7, 1991. Ed. G. Apostolakis. SAND90-2094C. New York, NY: Elsevier Science Publishers. Vol. 2, 899-904.

T92 Rechard, R.P. 1989. *Review and Discussion of Code Linkage and Data Flow in Nuclear Waste Compliance Assessments*. SAND87-2833. Albuquerque, NM: Sandia National Laboratories.

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