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THE 1999 OPENING OF THE WASTE ISOLATION PILOT PLANT TRANSURANIC WASTE REPOSITORY: A GLANCE IN THE REARVIEW MIRRORS ON SUCCESSFUL AND UNSUCCESSFUL STRATEGIES

Prepared by:

Leif G. Eriksson, Director, Nuclear Waste Management
GRAM, Inc.
8500 Menaul Boulevard NE, Suite B-335,
Albuquerque, New Mexico 87112
USA
Phone: +(505) 299-1282; Fax: +(505) 296-3289; E-mail: leif@nmia.com

For:

The European Nuclear Society's 1999 Topical Meeting on
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Steve,

Read the highlighted paragraph on p. 3.

Mr. Eriksson is a DOE/~~AAO~~ Contractor

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ABSTRACT

The world's first deep geological repository for safe disposal of transuranic radioactive waste (TRUW)[a] opened at the Waste Isolation Pilot Plant (WIPP) site (Figure 1) on the 26th of March 1999. Before it could open, the U.S. Department of Energy (DOE) had to carefully characterize and select the final site; design and construct the required surface and subsurface facilities; demonstrate compliance with two different legal and regulatory frameworks; and overcome a legal challenge. In the 24-year effort leading to the 1998 certification and draft permitting and the 1999 opening of the WIPP TRUW repository, the DOE overcame a broad range of challenges, many of which, and in particular those experienced during the past six years when the aforementioned milestones were advanced more than two years, will be faced by similar programs/projects in the USA and abroad. Key DOE strategies for accomplishing these global milestones included the 1993 establishment of an authoritative office in Carlsbad, New Mexico; the 1994 development and implementation of an integrated management plan for the nation's TRUW; and the 1995 development and implementation of a focused, regulatory-based scientific program.

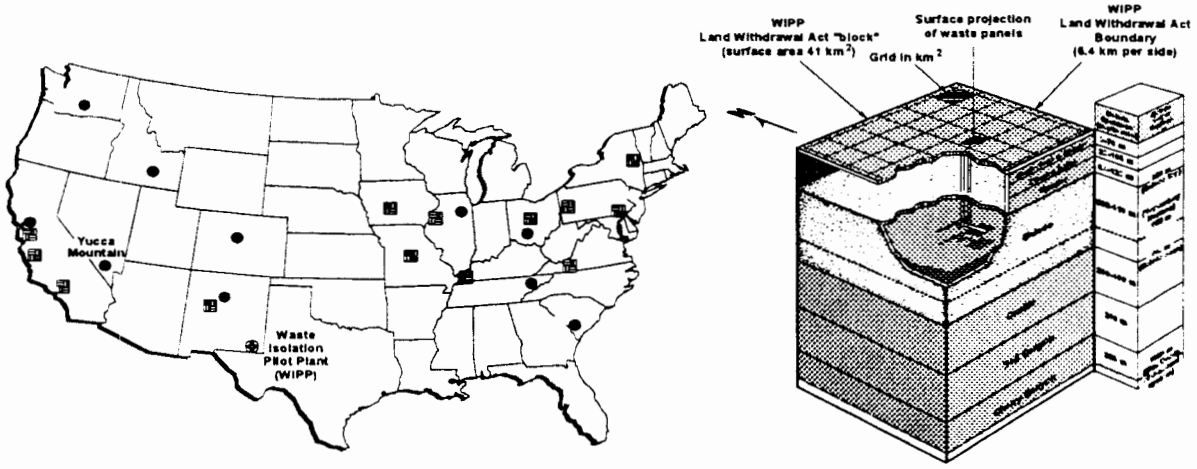

Fig 1. Locations of the WIPP, 10 large- (circles), and 13 small-quantity (squares) TRUW generator/storage sites (left figure), and a schematic illustration of the main stratigraphic units within the 41.6 square kilometer horizontal by 1,970 meters deep "controlled area" at the WIPP site (right figure).

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[a] TRUW is a man-made, mainly alpha-emitting radioactive waste category containing isotopes with atomic weights/numbers greater than uranium having more than 3,700 becquerels per gram of waste, with half-lives greater than 20 years, and having a maximum surface dose rate of 10 sieverts per hour (Sv/h). Up to 175,584 cubic meters (m^3) of TRUW may be disposed of in the WIPP repository, of which at least 168,504 m^3 will have a surface dose rate below 0.002 milliSv/h (mSv/h) and up to 7,080 m^3 will have a surface dose rate between 0.002 and 10 Sv/h. However, only up to 354 m^3 may be above 1 Sv/h.

1. Introduction

In the United States of America (USA), by law, the DOE is responsible for the safe disposal of all long-lived radioactive wastes in deep geological repositories in compliance with all applicable regulations. The two main categories of long-lived radioactive waste are: (1) spent nuclear fuel and other high-level radioactive wastes (HLW); and (2) TRUW. Each of these radioactive waste categories is governed by distinctly different laws and regulations, and is managed by two essentially autonomous DOE organizations. The DOE's Office of Civilian Radioactive Waste Management (OCRWM) is responsible for the safe disposal of the nation's commercial and a portion of its defense-generated HLW, whereas the DOE's Carlsbad Area Office (CAO) is responsible for the safe disposal of the nation's defense-generated TRUW.

This text addresses the CAO mission only and focuses on a few select key strategies and measures employed during the past six years by the CAO to accomplish the May 1998 certification and draft permitting, and the March 1999 opening of the WIPP TRUW repository. A concise background summary of the history of and future plans for the WIPP project, basic TRUW repository safety requirements and concepts, and the WIPP disposal system's performance relative to these safety requirements precedes the description and discussion of the select key DOE strategies and measures. Key terms and concepts used in the text are highlighted in *Italics*.

2. Background

Site characterization activities at the WIPP site commenced in 1975. A portion of the proposed repository and a test facility were constructed in the candidate rock salt formation between 1981 and 1988 and subjected to in-situ tests. All surface and subsurface facilities required to operate the WIPP TRUW repository were in place in 1988. However, a combination of evolving laws, regulations, DOE policies, and legal challenges required another ten years of DOE efforts before the WIPP TRUW repository was certified by the EPA in May 1998 and opened in March 1999. Whereas the DOE's policies and the legal challenges continue to evolve, the legal and regulatory frameworks summarized below have remained consistent since 1996, providing the stable bases required for measuring and demonstrating safety and conveying regulatory and project credibility to the public.

The WIPP Land Withdrawal Act of 1992 (LWA) [1], as amended in 1996, is the current legal cornerstone for safe disposal of *defense-generated TRUW*. It directs the DOE to develop and operate a deep geological repository for the safe disposal of defense-generated TRUW at the WIPP site (Figure 1) in compliance with the *site-specific disposal regulations* to be developed by the U.S. Environmental Protection Agency (EPA). The EPA promulgated the final disposal regulations in December 1993 [2] and the related compliance criteria in February 1996 [3]. The DOE submitted the WIPP compliance *certification* application (CCA) [4] to the EPA in October 1996, and the EPA conditionally approved it on the 13th of May 1998 [5]. Three conditions of the EPA's certification of the WIPP TRUW repository are that the DOE must (1) recertify the WIPP TRUW repository at least every fifth year, (2) advise the EPA of any significant change or departure from the information provided by the DOE in the CCA [4] or defined by the EPA in the certification [5], and (3) obtain the EPA's concurrence that the quality assurance (QA) and waste characterization procedures used by the TRUW generator/storage sites are acceptable to the EPA before TRUW shipments may commence.

About 60 percent of the existing TRUW is mixed with regulated hazardous constituents and, pursuant to the Resource Conservation and Recovery Act of 1976 [6], the DOE also needs a *permit* from the New Mexico Environment Department (NMED) that the proposed surface and subsurface facilities comply with all applicable hazardous waste disposal regulations [7-9] before this *mixed TRUW* may be disposed of at the WIPP site. The DOE submitted the WIPP permit application to the NMED in May 1995, and the NMED issued a conditional draft permit on the 15th of May 1998, which was amended on the 13th of November 1998. The amended draft permit was then scrutinized in public hearings in Santa Fe and Carlsbad, New Mexico, during February and March 1999. The NMED also announced on the 13th of November 1998 that the final permit would be issued in July, August, or September 1999.

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The WIPP TRUW repository opened on the 26th of March 1999 and, by mid May 1999, *non-mixed TRUW* from two large-quantity TRUW generator/storage sites had been disposed of at the WIPP site. However, before the WIPP TRUW repository could receive any non-mixed TRUW, the DOE had to overcome a legal challenge, which was accomplished on the 22nd of March 1999, when a federal court declared that the WIPP TRUW repository (a) could open for non-mixed TRUW prior to receiving the permit, and (b) had interim status as a hazardous waste disposal facility. It should be noted that although the DOE is legally entitled to also dispose of mixed TRUW at the WIPP site pending the NMED's final ruling on the permit, the DOE has not yet done so.

Because long-term (post-closure) safety was one of the basic prerequisites for regulatory, oversight group, peer, and public acceptance of the WIPP TRUW repository, and a "commitment for the future environment" is the main theme of the Topseal'99 conference, summarized below are: (1) the main currently applicable long-term TRUW disposal safety criteria in the USA, and (2) how the WIPP TRUW repository performs relative to these criteria. In the opinion of this author, the EPA's regulatory framework for TRUW disposal [2,3] is (a) one of the most stringent and prescriptive in the world, and (b) contains several unique safety/performance concepts. These safety requirements and concepts need to be understood in order to convey (1) the scientific and engineering challenges imposed by the disposal regulations, (2) the inherent safety of the WIPP TRUW repository, and (3) the potential excellent containment and isolation characteristics vested in rock salt. A priori, the safety basis for the disposal regulations [2] is 1,000 cancer deaths over the 10,000-year regulatory period among 10 billion people, which means that if the WIPP TRUW repository barely meets the safety criteria defined in the disposal regulations, the probability that it would cause one cancer death is one in 100 billion, i.e., 10^{-11}. Pro secundo, the two basic safety criteria defined in the disposal regulations are: (1) the *maximum annual committed effective dose* (CED) to a person located at the boundary between the *controlled area* (Figure 1) and the *accessible environment* when the repository is only affected by natural features, events, and processes (FEPs), also referred to as "undisturbed conditions"; and (2) the normalized cumulative amount of radionuclides released to the accessible environment during the 10,000-year regulatory period when the repository is affected by both natural and hypothetical human-induced FEPs, also referred to as "disturbed conditions". It should be noted (a) that several FEPs may be (and were) combined in scenarios, and (b) that all FEPs with a probability of occurrence greater than 10^{-8} needed to be (and were) addressed in the CCA.

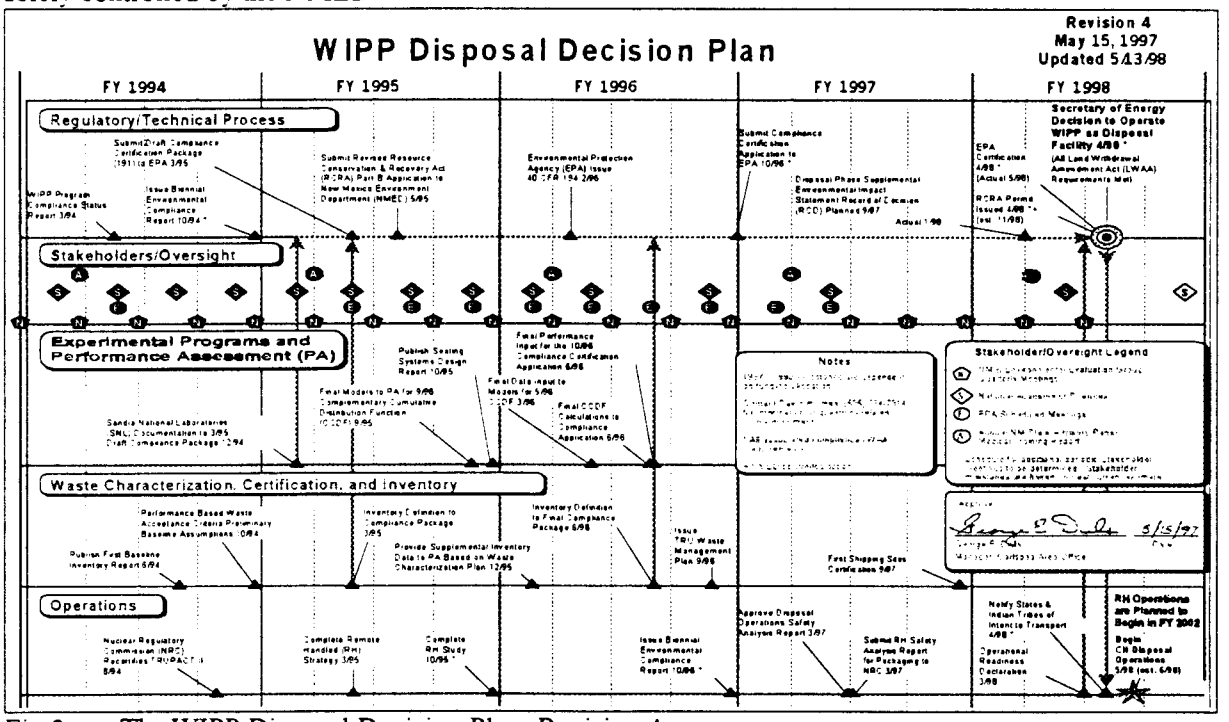
The regulatory limit for the maximum annual CED is 0.15 mSv [2], which is about 1/24th of the natural average background radiation in the USA. The conservatively calculated CED value for the WIPP TRUW repository is 0.0047 mSv [4]. As follows, *the WIPP TRUW repository safety factors relative to the regulatory CED limit and the natural average background radiation in the USA are 32 and 768, respectively*. The two regulatory limits for the maximum cumulative amount of radionuclide releases to the accessible environment during the 10,000-year regulatory period are based upon the type and amount of radionuclides emplaced in the repository. In other words, they are not quantitatively defined. *The maximum cumulative amount of radionuclide releases from the WIPP TRUW repository to the accessible environment reported in the CCA [4] shows a safety factor of at least 20, and a "worst-case" bounding performance assessment verification test subsequently requested by the EPA shows a safety factor of at least 10 relative to the applicable regulatory limits.*

It should be noted that a low-probability, multiple-drill-hole-based, human-induced FEP scenario causes almost all of the potential post-closure radionuclide releases to the accessible environment reported in the CCA. Furthermore, to fully appreciate the inherent safety of the WIPP TRUW repository and the excellent radionuclide containment and isolation characteristics of rock salt, it should be recognized that (a) the *controlled area* at the WIPP site (Figure 1) within which the radionuclides may move freely, is less than half of that permissible under the disposal regulations [2], and (b) the aforementioned calculations of the maximum annual CED and cumulative amount of radionuclide releases to the accessible environment involve very conservative assumptions and models. Indeed, the very high safety of the WIPP TRUW repository strongly indicates that deep geological disposal is a very safe and viable concept, posing the question, *why pursue other geologic media for disposal of long-lived wastes if a reasonably stable and large body of rock salt is available?*

3. Description and discussion of select DOE key strategies and measures

In response to the mandates of the LWA [1], the DOE established the CAO in Carlsbad, New Mexico, in December 1993 with a mission to: (1) integrate the safe management and shipment preparation of the nation's TRUW, and (2) develop, open, and operate a deep geological repository for safe disposal of TRUW at a depth of 650 meters (m) below the surface in a 250-million year old, 600-m thick, virtually impermeable bedded salt formation at the WIPP site in New Mexico (Figure 1) in compliance with all applicable regulations. The establishment of the CAO 42 kilometers (km) northeast of the WIPP site in the largest city in the region reinforced the DOE's partnership with and commitment to local communities. However, the real key to the enhanced local and public credibility and acceptance of the CAO was that it was more than a DOE "puppet" office. Two key DOE measures instrumental to the programmatic success, acceptance, and credibility of the CAO were (1) appointing a competent and resourceful CAO manager, and (2) having the CAO manager reporting directly to the Under Secretary of Energy rather than to and/or through several "competing" DOE offices and departments. However, the first CAO manager left the DOE in June 1998, leaving the CAO without a permanent manager until May 1999. In the mean time, new CAO strategies were devised and implemented at the direction of the new Secretary of Energy and reemerging DOE Headquarter (DOE HQ) managers. These new strategies include (a) overwhelming the NMED with marginal information and requests diverting its scarce resources and attention from the permitting process and further delaying the NMED's final ruling on the permit application, (b) inserting new, non-CAO participants in the permitting process, and (c) removing much of the decision making authority and more than 10 percent (more than 20 million dollars) of the 1998 budget from the CAO to DOE HQ. These new strategies have adversely affected the DOE's partnership and credibility with local communities adjacent to the WIPP site, the DOE's relationships with the NMED and other state officials and organizations, and compromised the CAO's credibility, effectiveness, and ability to successfully continue its mission.

In April 1994, the CAO issued an integrated plan and schedule, the WIPP Disposal Decision Plan (DDP) advancing the certification and opening of the WIPP TRUW repository about three years relative to the schedule milestones in effect prior to the establishment of the CAO. The 1996 amendment to the LWA and EPA's 1996 promulgation of compliance criteria [3] required modifications to the DDP (Figure 2). By mid May 1999, all revised DDP milestones within the CAO's control have been met. The only remaining DDP milestone to be met is the NMED's issuance of the final permit, which is a milestone solely controlled by the NMED.



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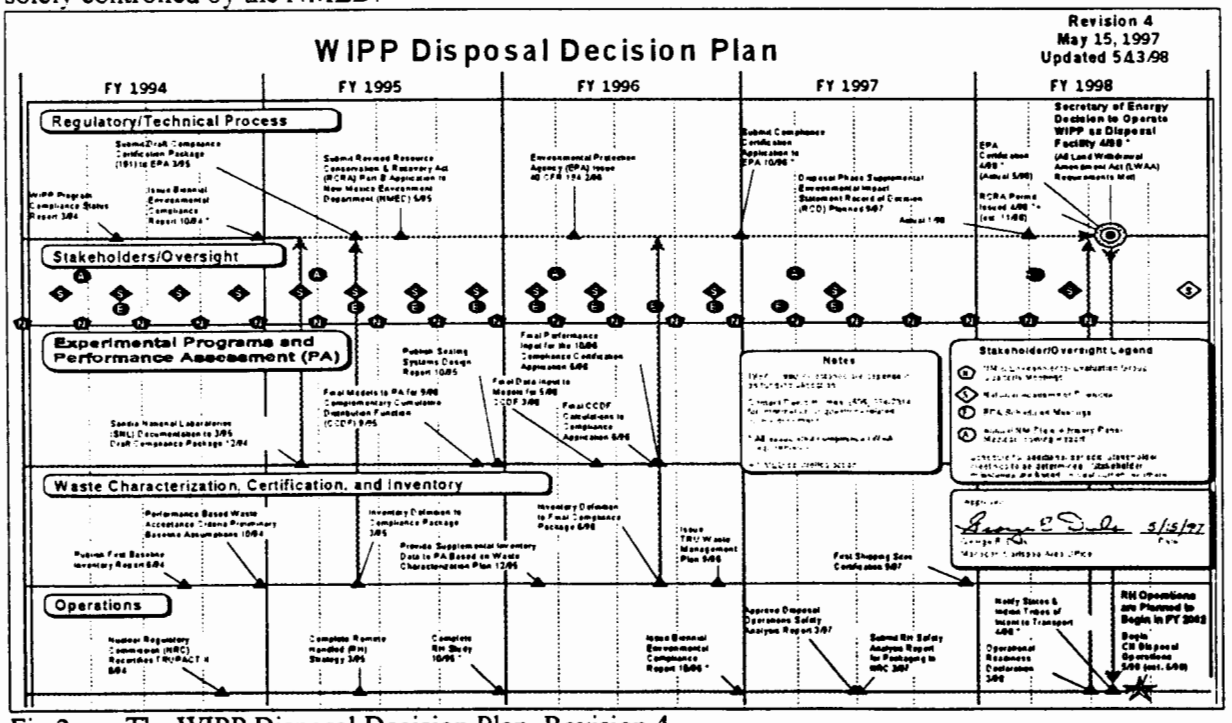

Fig 2. The WIPP Disposal Decision Plan, Revision 4.

The five main integrated activities in the DDP are (1) Regulatory and technical processes; (2) Stakeholder and oversight group interactions; (3) Experimental programs and performance/safety assessment; (4) Waste characterization, certification, and inventory; and (5) Operations. Three integrated keys to the more than two-year advancement of the certification and opening of the WIPP TRUW repository were (1) capable and credible DOE and CAO leadership; (2) system-wide TRUW-management planning preceding the issuance of the DDP; and (3) vigorous implementation of the DDP. Additional strategies and measures used by the CAO and the essential components contributing to the CAO's success or lack thereof in each of these five DDP activities are summarized below.

The *regulatory and technical processes* activities involve numerous successfully accomplished milestones, of which the EPA's 13th of May 1998 certification and the DOE's 26th of March 1999 opening of the WIPP TRUW repository are the most prominent. The only remaining DDP milestone is the NMED's issuance of the final permit. The initial April 1994 DDP target date for the NMED's issuance of the final permit was December 1997. In August 1995, the NMED depicted that the final permit would be issued in June 1997. In November 1998, the NMED announced that the final permit would not be issued until July 1999 at the very earliest. Following the EPA's May 1998 certification of the WIPP TRUW repository and recognizing that it had grossly underestimated the time required by the NMED to issue the final permit, the CAO embarked on the strategy to open the WIPP repository for non-mixed TRUW pending the NMED's issuance of the final permit. Some of the main reasons for this new strategy were: (1) the EPA had certified that it was safe to dispose of the radioactive TRUW constituents at the WIPP site; (2) the public health and environmental risks resulting from the hazardous TRUW constituents were significantly less than those of the radioactive TRUW constituents; (3) the NMED's repeated schedule delays provided very low confidence that it would be able or willing to meet any schedule; (4) the extended storage of the non-mixed TRUW imposed an unwarranted and unnecessary risk on the 53 million residents living within an 80-km radius of the 23 TRUW generator/storage sites (Figure 1); and (5) the daily cost of maintaining the WIPP TRUW repository and transportation system in active status was on the order of 500,000 dollars per calendar day. The new strategy was crowned with success on the 26th of March 1999, when the first shipment of non-mixed TRUW arrived at the WIPP site. By mid May 1999, three generator/storage sites have shipped non-mixed TRUW to the WIPP site, negating the anti-nuclear movements' global strategy for opposing and trying to close down all nuclear-related applications by claiming that the resulting long-lived radioactive waste cannot be safely discarded. However, this successful and socio-economically justified strategy has further strained the DOE's relationship with the NMED.

Two particularly successful, paradigmatic strategies employed by the CAO in support of the *stakeholder and oversight group interactions* activities were: (1) early and iterative interactions with the regulators, oversight groups, and other affected or interested parties (stakeholders); and (2) open and readily understood communication of information and the basis for CAO decisions. The initial DDP defined 47 scheduled public meetings with federal and state regulators, oversight groups, and other affected and interested parties (stakeholders) during a five-year period. Additional public meetings were held by the CAO as required to obtain periodic input on programmatic documents and on scientific/technical and socioeconomic issues. These frequent public meetings provided a focused forum for stakeholder involvement and input. They also provided the CAO an opportunity to maintain a real-time, credible dialogue on programmatic issues and to convey the inherent safety of the WIPP TRUW repository, which greatly contributed to the enhancement of regulator, peer, and stakeholder acceptance of the CAO, the WIPP TRUW repository, and the deep geological disposal concept.

Tempering scientific curiosity and integrating several "proud and peerless" disciplines are two of the major challenges to any large multidisciplinary earth sciences/geoengineering program. Following the EPA's December 1993 promulgation of the disposal regulations [2], the CAO and its Science Advisor, Sandia National Laboratories (SNL), promptly devised and implemented one of the CAO's most significant and successful *experimental programs and performance/safety assessment* strategies, the System Prioritization Method (SPM). Prior to the establishment of the CAO, 116 scientific activities were considered needed to collect the information required to certify the WIPP TRUW repository. The SPM process evaluated all of these scientific activities in more than 46,000 combinations by some

1,300,000 safety/performance assessment calculations in terms of their individual and supplementary contribution to demonstrating compliance with the disposal regulations. The SPM process/report [10] identified eight scientific activity combinations/sets that, if performed as designed and with results within the projected ranges, would provide a 0.96 probability that compliance with the disposal regulations would be demonstrated. The EPA's May 1998 certification of the WIPP TRUW repository clearly demonstrates the success of the SPM strategy.

Two key measures enhancing the acceptance and credibility of the SPM process/results and the CAO were: (1) the CAO's solicitation of periodic input on the format and interactive communications on the progress of the SPM in eight public meetings, including 11 topical white papers; and (2) the resulting transparency of the August 1995 decision by the CAO manager to focus the experimental program on the eight scientific activity sets identified by the SPM. It should also be acknowledged that the SPM process and results greatly contributed to the almost three-year advancement of the EPA's certification of the WIPP TRUW repository, which (a) represents a cost saving on the order of 500 million dollars and (b) clearly evidences the value of a focused, regulatory-driven, scientific program.

Although the DOE historically has been self-regulating its TRUW generator/storage-site activities, including the documentation of the TRUW it generated and/or stored, the CAO's initial strategy for the *waste characterization, certification, and inventory* activity was to (1) issue WIPP-specific (a) QA plans and procedures, and (b) Waste Acceptance Criteria that had to be met by the TRUW generator/storage sites before they could send any TRUW to the WIPP site, and (2) to check the existing national database on TRUW by involving the nation's TRUW generator/storage sites in an inventory of their respective TRUW stockpile. This database inventory was documented and periodically updated in several reports that provided important input to the safety/performance assessments presented in the CCA and contributed to the identification of TRUW acceptable for disposal at the WIPP site. The foresight of this strategy became apparent with the EPA's certification of the WIPP TRUW repository, which included a condition that the EPA would audit and approve the DOE's certification of any generator/storage site before it could send TRUW to the WIPP site. By mid May 1999, the EPA has concurred with the DOE's certification of three large-quantity TRUW generator/storage sites and two of these sites are shipping non-mixed TRUW to the WIPP site.

Furthermore, TRUW characterization and preparation for shipping involves about half of the projected 12 billion dollar life cycle cost for the WIPP TRUW repository and were perceived to be encumbered with unnecessary requirements. The CAO, therefore, also promoted the development of initiatives, procedures, and processes for more cost-effective characterization of existing and pending TRUW. One such initiative was the development and privatization of mobile waste characterization units to serve small-quantity TRUW generator and storage sites and thereby negating the need for stationary, more expensive, on-site waste characterization units. Another such initiative was the March 1998 establishment of a TRUW Characterization Task Force, chartered to assess and comment on (a) the TRUW characterization required under current statutes and regulations and (b) the efficacy of currently used TRUW characterization methods and techniques. However, recent cuts in the CAO's budget have depleted the number of members on the Task Force and delayed the final Task Force report, initially scheduled for March 1999.

The *operations* activities integrated in the DDP (Figure 2) included all TRUW generator/storage sites (Figure 1), the WIPP site (Figure 1), and the system required for transporting TRUW. One main activity established the timing and equipment requirements for TRUW shipments. Again, by mid May 1999, two sites are shipping non-mixed TRUW to WIPP, a third site is scheduled to commence shipments in June, and the DOE plans is to remove all TRUW from 17 of the 23 current generator/storage sites by 2006, to operate the WIPP site through 2034, to decontaminate and close the WIPP site by 2044, and to maintain active institutional controls (safeguards) at the WIPP site through 2143. Another main activity was the privatization of the transportation system to enable cost-savings to the taxpayers. However, the privatizations of both the mobile characterization units and the transportation system have experienced repeated delays and modifications at considerable expense to the involved bidders.

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Two key measures enhancing the acceptance and credibility of the SPM process/results and the CAO were: (1) the CAO's solicitation of periodic input on the format and interactive communications on the progress of the SPM in eight public meetings, including 11 topical white papers; and (2) the resulting transparency of the August 1995 decision by the CAO manager to focus the experimental program on the eight scientific activity sets identified by the SPM. It should also be acknowledged that the SPM process and results greatly contributed to the almost three-year advancement of the EPA's certification of the WIPP TRUW repository, which (a) represents a cost saving on the order of 500 million dollars and (b) clearly evidences the value of a focused, regulatory-driven, scientific program.

Although the DOE historically has been self-regulating its TRUW generator/storage-site activities, including the documentation of the TRUW it generated and/or stored, the CAO's initial strategy for the *waste characterization, certification, and inventory* activity was to (1) issue WIPP-specific (a) QA plans and procedures, and (b) Waste Acceptance Criteria that had to be met by the TRUW generator/storage sites before they could send any TRUW to the WIPP site, and (2) to check the existing national database on TRUW by involving the nation's TRUW generator/storage sites in an inventory of their respective TRUW stockpile. This database inventory was documented and periodically updated in several reports that provided important input to the safety/performance assessments presented in the CCA and contributed to the identification of TRUW acceptable for disposal at the WIPP site. The foresight of this strategy became apparent with the EPA's certification of the WIPP TRUW repository, which included a condition that the EPA would audit and approve the DOE's certification of any generator/storage site before it could send TRUW to the WIPP site. By mid May 1999, the EPA has concurred with the DOE's certification of three large-quantity TRUW generator/storage sites and two of these sites are shipping non-mixed TRUW to the WIPP site.

Furthermore, TRUW characterization and preparation for shipping involves about half of the projected 12 billion dollar life cycle cost for the WIPP TRUW repository and were perceived to be encumbered with unnecessary requirements. The CAO, therefore, also promoted the development of initiatives, procedures, and processes for more cost-effective characterization of existing and pending TRUW. One such initiative was the development and privatization of mobile waste characterization units to serve small-quantity TRUW generator and storage sites and thereby negating the need for stationary, more expensive, on-site waste characterization units. Another such initiative was the March 1998 establishment of a TRUW Characterization Task Force, chartered to assess and comment on (a) the TRUW characterization required under current statutes and regulations and (b) the efficacy of currently used TRUW characterization methods and techniques. However, recent cuts in the CAO's budget have depleted the number of members on the Task Force and delayed the final Task Force report, initially scheduled for March 1999.

The *operations* activities integrated in the DDP (Figure 2) included all TRUW generator/storage sites (Figure 1), the WIPP site (Figure 1), and the system required for transporting TRUW. One main activity established the timing and equipment requirements for TRUW shipments. Again, by mid May 1999, two sites are shipping non-mixed TRUW to WIPP, a third site is scheduled to commence shipments in June, and the DOE plans is to remove all TRUW from 17 of the 23 current generator/storage sites by 2006, to operate the WIPP site through 2034, to decontaminate and close the WIPP site by 2044, and to maintain active institutional controls (safeguards) at the WIPP site through 2143. Another main activity was the privatization of the transportation system to enable cost-savings to the taxpayers. However, the privatizations of both the mobile characterization units and the transportation system have experienced repeated delays and modifications at considerable expense to the involved bidders.

4. Summary and Conclusions

During the past six years, the CAO has very successfully integrated and implemented a politically complex, nation-wide, multi-disciplinary radioactive waste management program. The most visible and profound achievements are the EPA's May 1998 certification and the DOE's March 1999 opening of the world's first specially designed and constructed deep geological repository for safe disposal of long-lived radioactive waste at the WIPP site more than two years ahead of the DOE's pre-CAO schedule. These advancements were accomplished by a successful combination of: (a) a streamlined organizational structure (including local decision-making authority); (b) a skilled and committed CAO management team (including contractor staff); (c) an independent regulator (the EPA) promulgating and overseeing the DOE's compliance with a well defined regulatory framework for safe disposal of TRUW at the WIPP site [2,3]; (d) the development and successful implementation of a detailed plan for the cost-effective and credible integration of the nation's management and commencement of disposal of defense-generated TRUW at the WIPP site (the DDP); (e) the development and successful implementation of a focused, regulatory-based scientific program (the SPM), and last but not least (f) a firm partnership with and long-standing project support by the local communities.

Figuratively speaking, the 1992 LWA [1], as amended in 1996, defines the playing field and the key players, the EPA's 1993 disposal regulations [2] provide the narrow goal posts, the EPA's 1996 compliance criteria [3] provide the low cross bar, the EPA and the NMED are the referees, the stakeholders are the spectators, the NMED's permit is the cubic ball, and the ensuing (football/soccer) game is played between the DOE's players and the representatives/spokespersons for a broad range of interest groups and individuals driven by a multitude of motifs. Furthermore, whereas the DOE strategy has to be built on defense, the opposition's strategy is solely built on offence, because the playing field is tilted and, contrary to common judicial philosophy, the DOE is essentially considered wrong until proven right. As follows, the strategies and measures used by a government organization historically encumbered by inherent bureaucracy and territorial power struggles to advance the certification and opening of the WIPP TRUW repository more than two years within a period of only six years is a remarkable feat deserving recognition and serious attention both in the USA and abroad.

5. References

[1] U.S. Congress, *The WIPP Land Withdrawal Act of 1992*, Public Law 102-572.

[2] U.S. Environmental Protection Agency, *Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes; Final Rule*, Code of Federal Regulations, Title 40, Part 191, December 1993.

[3] U.S. Environmental Protection Agency, *Criteria for Certification of the Waste Isolation Pilot Plant's Compliance With the 40 CFR 191 Disposal Regulations; Final Rule*, Code of Federal Regulations, Title 40, Part 194, February 1996.

[4] U.S. Department of Energy Carlsbad Area Office, *Waste Isolation Pilot Plant Compliance Certification Application with 40 CFR 191, Subparts B and C*, October 1996.

[5] U.S. Environmental Protection Agency, *Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the Disposal Regulations: Certification Decision; Final Rule*, Federal Register, Volume 63, pp. 27354-27406, May 1998, Radiation Protection Division, Washington, D.C.

[6] U.S. Congress, *The Resource Conservation and Recovery Act of 1976*, Public Law 94-580.

[7] U.S. Environmental Protection Agency, *Identification and Listing of Hazardous Waste*, Code of Federal Regulations, Title 40, Part 261.

[8] U.S. Environmental Protection Agency, *Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities*, Code of Federal Regulations, Title 40, Part 264.

[9] U.S. Environmental Protection Agency, *Land Disposal Restrictions*, Code of Federal Regulations, Title 40, Part 268.

[10] Sandia National Laboratories, *SPM-2 Report*, prepared for Department of Energy, Waste Isolation Pilot Plant, April 1995.