A Regional Approach to HLW, Spent Fuel, and TRU Waste Disposal in New Mexico

By Christopher M. Timm

What would it take to develop a spent fuel/high-level waste storage or disposal facility in southeastern New Mexico?

In the late 1950s, the Atomic Energy Commission (AEC), the predecessor agency of the U.S. Department of Energy, requested that the National Academy of Sciences (NAS) determine the best solution for the long-term disposal of radioactive waste. The need for a national radioactive waste disposal program grew out of the NAS's deliberations, resulting in a recommendation of deep geologic disposal.[1] Although the NAS did not indicate a preference for a single national disposal site or several regional sites, its recommendation led to the U.S. government's extensive investigative efforts over the next 20-plus years to identify and site one or more deep geologic repositories for radioactive waste.

Evolution of Selected Disposal Sites

The buried salt beds of the Salina Basin beneath Michigan and Ohio were the initial deep geological disposal site locations that the AEC considered and investigated in the late 1950s and early 1960s. Perhaps an omen of what would later plague both the Waste Isolation Pilot Plant (WIPP) project in New Mexico and the Yucca Mountain project in Nevada, those studies in the Midwest were terminated because state and local officials, as well as various concerned citizens groups, objected to the possibility of having such a disposal site in their states.

In a 1974 study,[2] the NAS issued a report indicating that its primary choice for the deep geological disposal of radioactive wastes would be salt beds, based on areal availability and a number of other characteristics. Salt deposits are widespread and abundant in the United States (see Fig. 1), underlying about 500 000 square miles in portions of 24 states. Physically and geologically, salt deposits have the following attractive characteristics:

- Good structural properties, with a compressive strength and radiation-shielding properties similar to concrete.
- For bedded salt deposits, a complete lack of circulating groundwater and isolation from underground aquifers both above and below provided by essentially impermeable rock formations, usually shale.
- Location in areas of low seismicity.
- Healing of any fractures that might develop by plastic deformation and recrystallization of the salt.
- Thermal properties that are better than those of most other rock types.
- Relative inexpensiveness to mine.

In the early 1970s, the AEC announced that a salt mine in Lyons, Kan., would be developed as a high-level waste repository, and in fact conducted a number of tests and experiments related to the possible effects of heat and radioactivity on the salt.[3] That salt mine as a potential repository candidate, however, was abandoned in 1972 after Kansas state geologists discovered that the site had been penetrated by a number of abandoned oil and gas exploration boreholes that might threaten the integrity of the mine. Subsequently, the DOE began studying several other sites in various geologic media.

The histories of WIPP and Yucca Mountain diverge significantly at that point.

Waste Isolation Pilot Plant

When it was learned that that the salt mine near Lyons was no longer being considered, the local, state, and federal politicians representing the Carlsbad, N.M., area all came forward to the AEC in favor of locating the disposal site in southeastern New Mexico, initially in an abandoned potash mine. The offer was accepted. In 1979, the DOE proceeded to issue a draft environmental impact statement (EIS) proposing that WIPP be considered for

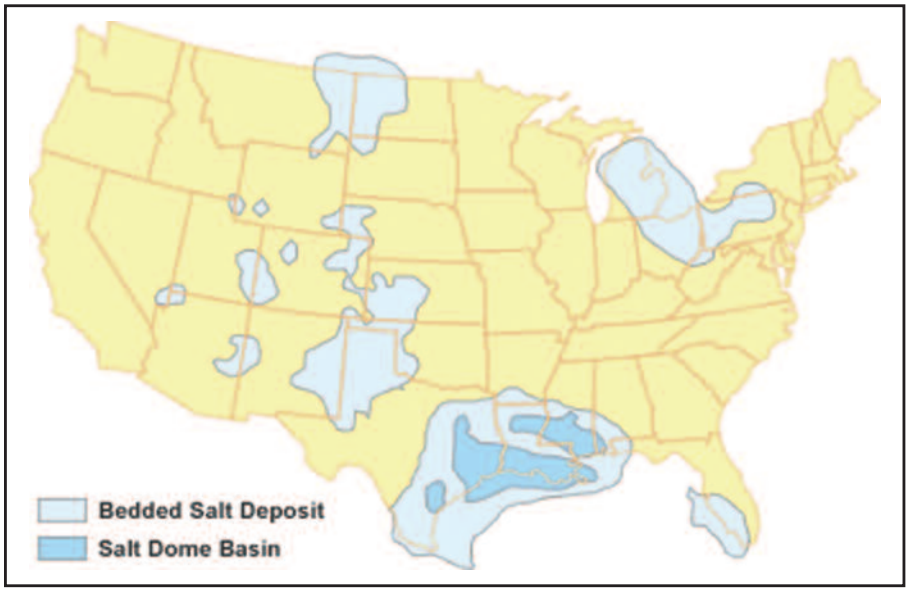

Fig. 1. Salt formations in the United States

the disposal of both defense-related and commercial HLW and the storage of spent nuclear fuel.[4]

Consequently, Congress determined in 1979 that a radioactive waste disposal facility was needed to continue nuclear weapons production, and WIPP was authorized "to demonstrate the safe disposal of radioactive waste resulting from the defense activities and programs of the United States exempted from regulation by the Nuclear Regulatory Commission." The original design concepts for this repository included the disposal of both transuranic (TRU) waste and HLW, including spent nuclear fuel rods from the nuclear navy.

As a result of objections from the state of New Mexico and assorted citizens groups, however, the mission of WIPP as authorized by Congress in 1979 was that of only a research and development facility to study the feasibility of the disposal of defense-related radioactive waste in salt beds. The Record of Decision for the EIS that the DOE issued in 1981 concentrated on the potential disposal of TRU waste. It also included, however, an intent to conduct experiments involving the disposal of defense-generated HLW, and so the construction of WIPP proceeded. In that same time frame, the resistance to WIPP by other entities in New Mexico—in particular, antinuclear groups—became very active. Somewhat surprising was that the congressman who represented the district that contained Los Alamos National Laboratory was against locating WIPP in New Mexico, as were—equally so—the state environmental department and the attorney general. As a result, several lawsuits were filed, and an agreement was reached in 1981 that effectively limited WIPP to the disposal of defense-related TRU waste only.

The construction of WIPP and the evaluation of its acceptability as a radioactive waste disposal facility continued, despite repeated attempts by various opponents to stop the project. Those attempts led to a declaration by the secretary of energy in 1989 that the opening of WIPP would be delayed indefinitely (this declaration was withdrawn a few months later), and a subsequent lawsuit in 1991 by the state of New Mexico to stop shipments to WIPP.

Nevertheless, Congress made the determination to proceed with WIPP via the Land Withdrawal Act of 1992. This led to the EPA's certification of WIPP in 1998 and the first disposal of TRU waste in March 1999. The facility has continued to safely dispose of TRU waste for more than 14 years.

Yucca Mountain

Partly as a result of the limitations placed on WIPP in 1979, Congress passed the Nuclear Waste Policy Act of 1982, which set in motion a nationwide search for a new site for the deep geologic disposal of HLW and spent nuclear fuel.[5] In 1983, the DOE named nine previously screened, potentially acceptable repository sites in six states. In 1985, the DOE nominated five of these sites from the original nine. As a result of extensive public objections by the states in the eastern United States that had candidate sites, the list was whittled down to the final three. The three sites ultimately chosen for characterization were in Deaf Smith County, in far western Texas, in salt (part of the huge Permian Basin that was the site of the 1970s effort in Kansas and that today is home to WIPP); in Richland, Wash., in a basalt ridge on the Hanford Reservation; and in a volcanic tuff mountain formation at Yucca Mountain, on the edge of the Nevada Test Site, in Nye County, Nev.

Because of concerns about the cost of investigating three sites, Congress narrowed down the characterization to just the Yucca Mountain site in 1987, a decision that was based more on politics than on science. Investigation work began that year and culminated in 2002 in the issuance of the required EIS and Record of Decision; the initiation of supplemental EISs in 2006 and 2008; and the submission of the license application to the NRC in 2008. During that period of time, the residents and government of Nye County became proponents of the project, recognizing that it was safe and was also an economic boon for the county. Unfortunately, the state of Nevada and antinuclear groups, based primarily in Clark County, have been able to suspend, if not end, the Yucca Mountain Project, again through political means rather than based on any scientific or engineering reasons.

To provide some perspective, it took 27 years from the time that the proposal was made to locate WIPP in southeastern New Mexico until the facility opened. The development of Yucca Mountain has been under way for 25 years, and it might have actually opened in 2020 if it had not been put on hold by the Obama administration, primarily in response to resistance from the state of Nevada.

Eddy-Lea Energy Alliance

In August 2006, the city of Carlsbad and Eddy County and the city of Hobbs and Lea County teamed up to

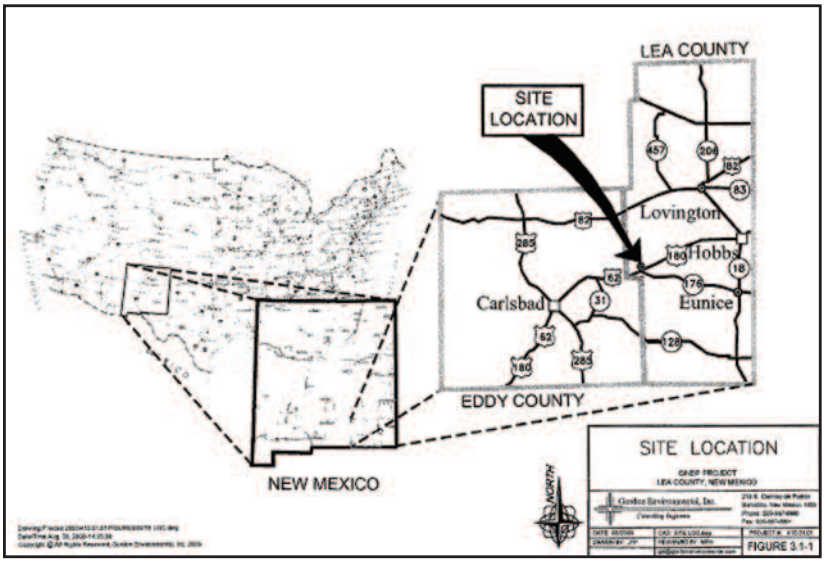

Fig. 2. Location of the proposed Eddy-Lea Alliance facility

create the Eddy-Lea Energy Alliance LLC. Initially, the alliance was created to secure federal funding from the DOE to site the Nuclear Fuel Recycling Center and an Advanced Recycling Reactor in southeastern New Mexico under the Global Nuclear Energy Partnership (GNEP). As shown in Fig. 2, the alliance's site comprises 960 acres of land and is located in Lea County, approximately 34 miles east of Carlsbad and 37 miles west of Hobbs, just north of State Highway 62/180. As a part of the application process for the GNEP initiatives, a detailed site characterization study was conducted and a detailed site report was prepared and submitted to the DOE in 2007. The site study reviewed the extensive geologic, environmental, socioeconomic, and historical data available for the region that resulted from the WIPP development studies and additional studies that were conducted for the National Enrichment Facility (now URENCO USA). Table I summarizes the results of the site characterization study.[6]

The conclusion of the site study stated that there were no features, characteristics, or existing conditions on or in the immediate vicinity of the site that would result in any licensing or permitting issues.

Subsequent to the current administration's decision to abandon Yucca Mountain, in 2011 the alliance decided to push for an aboveground interim storage facility for spent nuclear fuel at the same location in southeastern New Mexico. Effectively, the alliance would build and operate an independent spent fuel storage installation (ISFSI), along with the infrastructure to support it. The alliance believes that the dry, remote southeastern corner of New Mexico is ideal for such temporary storage and would build on the local and regional communities' acceptance of WIPP to set the stage for the approval of an interim storage facility in close

Table I
Summary of Physical, Geological, and Environmental Site Conditions

Characterization Topic	Summary of Site Conditions
Aquatic and Riparian Ecological Communities	No aquatic or riparian habitats are located within the site.
Water Resources	No important surface or groundwater resources are located within or adjacent to the site.
Critical and Important Plant and Animal Habitats	No important plant or animal habitats are situated on the site.
Threatened, Endangered, or Special Concern Species	Neither any threatened, endangered or special concern species nor their habitats were identified on the site.
Regional Demography	The area is sparsely populated and of minimal agricultural value.
Historical, Archeological, and Cultural Resources	The few locations covered by this topic are identified in the report and are of neither the size nor significance to prevent development of the proposed facilities.
Future Projects/Cumulative Environmental Impacts	There are no known future projects proposed in the vicinity of this site.
Geology/Seismology	Comparable to that of the WIPP site and the URENCO USA site—very stable.
Weather/Climatology	Hot and dry. Comparable to WIPP and URENCO USA sites.
Hydrology/Flooding	No perennial streams near the site. Subject to occasional intense rainstorms.
Impact of Existing Contamination	Oil-field brine and solids disposal sites located on the property but not within the area designated for the construction and operation of the new facilities.
Visual Resources	No significant or unusable visual resources are in the area.
Noise	The area is isolated and remote; no noise constraints are anticipated.

proximity to WIPP. Among the attributes are the preexisting scientific and nuclear operations workforce that exists in the area and a community that is open-minded about possible nuclear expansion. Further, two major DOE national laboratories, Sandia and Los Alamos, maintain active research operations in the area. Recycling or disposal sites could also eventually be selected in the vicinity.

An interim storage facility would temporarily store spent fuel inside robust containers placed on concrete pads and would likely also include a security component, canister and cask manufacturing, and cask movement equipment. Spent fuel research also might be conducted at the site.

Issues Regarding the Establishment of an Interim Storage Facility

If the site in southeastern New Mexico proposed by the alliance for the interim storage of HLW (and spent fuel, if reprocessing continues to be blocked in the United States), the following issues would have to be addressed: compliance with applicable environmental requirements; licensing; recovery of spent nuclear fuel; operational health and safety; security; and transportation.

Compliance with Applicable Environmental Requirements

The environmental requirements for the alliance's proposed facility are as established in 10 CFR Part 51, Section 51.20(b)9, which specifies that an EIS will be required. The EPA sets generally applicable radiation protection standards for the safe management of radioactive waste. Federal, state, and other organizations implement the EPA's standards in waste management regulations, which may or may not apply to the alliance's proposed facility, depending on the characteristics of the waste streams to be placed in interim storage. Additional NRC regulations establish the allowable dosages and other environmental requirements that must be addressed in the EIS.

Because the spent fuel would be stored in dry casks cooled by natural airflow, one potential environmental issue would be possible releases of radioactivity to the air should the casks rupture for any reason. Another environmental issue would be the general contaminant discharges associated with facility operations. The detailed site study that has already been conducted would serve as a good baseline for the both the EIS and environmental report required by the NRC.

Licensing

Unlike either WIPP or Yucca Mountain, the proposed alliance facility would be for interim storage, and so the sole responsibility for licensing of a facility for the storage of spent nuclear fuel rests with the NRC. The NRC authorizes an ISFSI by issuing either a site-specific license or a general license. The proposed alliance facility would be considered site-specific, meaning that the NRC would review the safety, environmental, physical security, and financial aspects of the licensee and proposed ISFSI. If the conclusion were that the facility could operate safely, the NRC would issue a license. This license would contain requirements on topics such as leak testing and monitoring, and would specify the quantity and type of material the alliance would be authorized to store at the site. License applicants must show the NRC that it is safe to store spent fuel in dry casks at their sites, including analysis of earthquake intensity and tornado missiles. Programs—such as security and emergency planning—designed to prevent exposure of the stored radioactive materials to the environment or public also must be developed and presented. Assuming that this would be a privately operated facility with no intent for long-term disposal, there should be no requirement to meet the EPA standards established in 40 CFR Part 191.

If or until the country should opt for a closed fuel cycle that would include reprocessing, then the storage of spent fuel in an interim storage facility such as that proposed by the alliance would be the most cost-effective option because storage would be at or near ground surface.

The other EPA standards that may be at issue relate to the Resource Conservation and Recovery Act. If any of the waste streams to be stored in the proposed alliance facility are mixed wastes, then it is very probable that a Hazardous Waste Facility Permit (HWFP) issued by the New Mexico Environment Department would be required. It appears that obtaining an HWFP under the current New Mexico state administration would be easier than it was to obtain the HWFP for WIPP. In addition, it is anticipated that permits for wastewater treatment and disposal, and for a storm water control plan, would be required.

Recovery of Spent Nuclear Fuel

The United States currently does not have a spent fuel recycling program, and the Blue Ribbon Commission that was established by President Obama to recommend upgrades and redirections to this country's nuclear energy strategy chose to defer any recommendations to reverse the current federal recycling policy. If or until the country should opt for a closed fuel cycle that would include reprocessing, then the storage of spent fuel in an interim

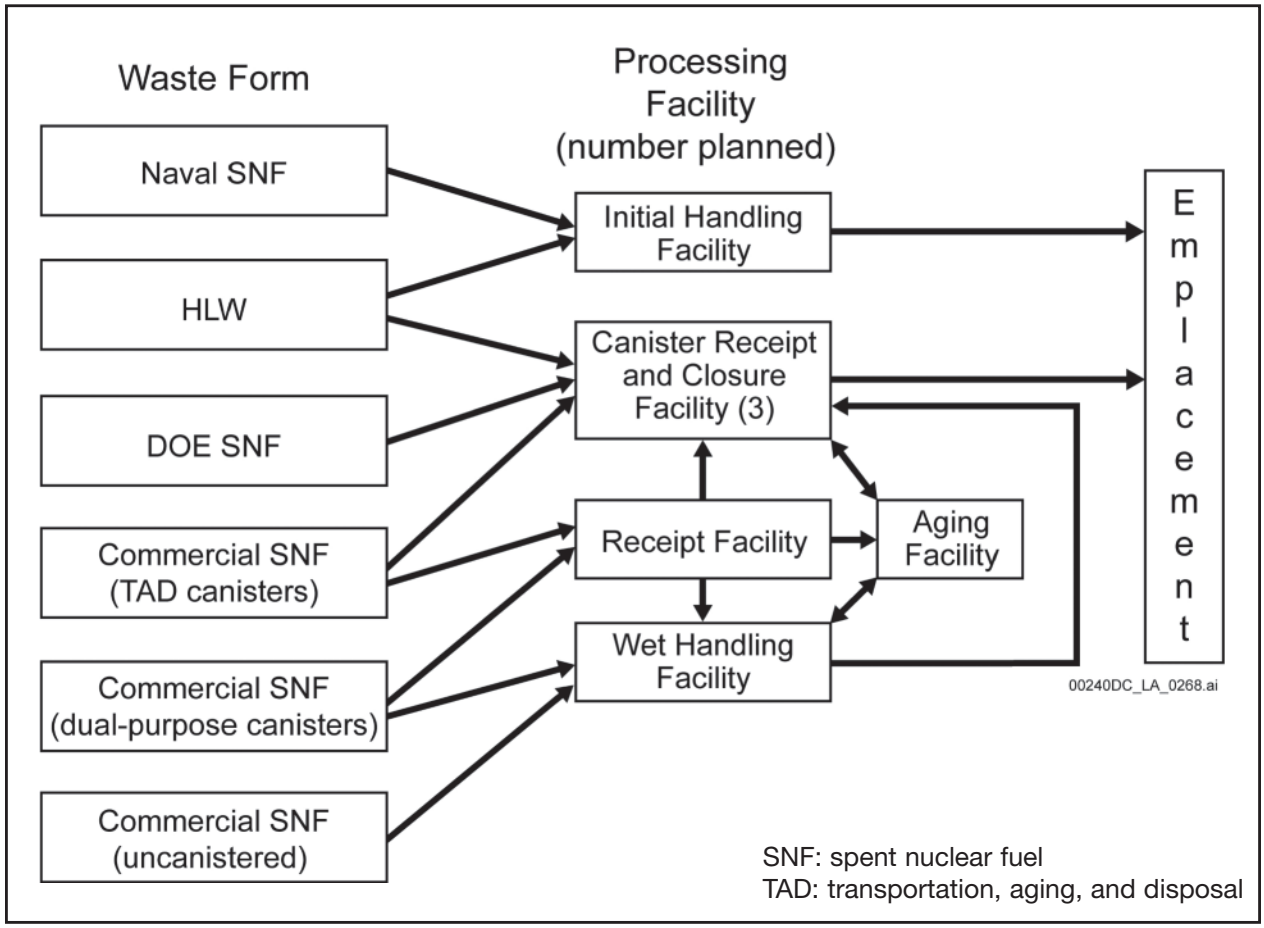

Fig. 3. Potential waste streams for storage at the alliance's proposed facility

storage facility such as that proposed by the alliance would be the most cost-effective option because storage would be at or near ground surface.

A major reason the NAS recommended disposal in a salt formation as the first choice in its 1957 report and in subsequent reports is that salt deforms—or creeps—with time under very low differential stresses. Unfortunately, that very fact would make retrieval for reprocessing much more difficult, dangerous, and expensive than retrieval from a surface interim storage facility. Comparably, whereas retrieval from a hard-rock deep geologic repository such as Yucca Mountain would be feasible, the costs of both building and maintaining such a deep storage repository in salt to facilitate retrieval for reprocessing would greatly exceed the capital, operations, and maintenance costs for the proposed alliance facility, which focuses on surface storage. Along with the benefits associated with the retrieval of spent fuel, the alliance's site would offer sufficient area for the addition of research, development, and demonstration facilities, as well as a recycling facility.

Operational Health and Safety

Substantial radiological health and safety expertise is available in southeastern New Mexico associated with WIPP and the URENCO USA uranium enrichment plant. That expertise could be drawn upon to develop the required health and safety plans for the interim storage of spent fuel and HLW. In addition, the research done and experience acquired during the development of the Yucca Mountain site would facilitate the identification, understanding, and appropriate programs to ensure full operational health and safety associated with the larger diversity of the radioactive waste types expected to be managed at the alliance's proposed facility.

The facility could be designed to receive six waste streams in different forms of canisters that were planned for disposal in Yucca Mountain, which are shown in Fig. 3. Preparing those waste streams for disposal in the appropriate containers (the transportation, aging, and disposal canisters) will require eight separate facilities—in effect, large hot cells—most of which are planned for remote handling of the waste. The HLW and spent fuel will be transferred into waste packages (essentially cylinders 5–6 ft in diameter ranging from 10 to 20 ft long and weighing up to 50 tons) for final emplacement. The surface temperature of the waste packages will range from 60 °C to 200 °C. The surface dose rate of the waste packages, however, will be at or below the contact-handled limit.

Security

The security issues related to the proposed alliance facility are comparable to those faced by any ISFSI in this country and include such things as deliberate attacks, severe weather events, and earthquakes. Concerns about deliberate penetration attempts would be higher than if the

Fig. 4. Waste Isolation Pilot Plant truck transportation routes (Figure: Nuclear Waste Partnerships LLC)

HLW/spent fuel were stored in a deep geologic repository, but not substantially. Impacts of severe weather events such as tornadoes could be mitigated by the design of the ISFSI. The proposed alliance facility might require a larger security force, but that operating cost would be offset by the lower capital cost.

Transportation

The major transportation routes to WIPP have already been established, as shown in Fig. 4. To support the HLW/spent fuel repository proposed by the alliance, additional truck transportation routes would be required to serve the commercial nuclear facilities located in southern Texas, Florida, the upper Midwest, and along the eastern seaboard. These potential routes had already been identified in the Yucca Mountain National Environmental Policy Act documents. Transport by rail to the WIPP site would use much of the basic rail network proposed for Yucca Mountain via the Texas-Pacific and Burlington Northern-Santa Fe (BNSF) railroads, with the addition of BNSF routes from the Midwest and Union Pacific routes through Texas to that network. Also, the environmental impacts associated with the transportation to the proposed site would actually be less than those associated with disposal at Yucca Mountain, since there are more nuclear power generation and federal HLW generator sites located in the East, South, and Midwest than in the Far West.

References

1. *The Disposal of Radioactive Waste on Land*, A Report of the Committee on Waste Disposal, Division of Earth Sciences, National Academy of Sciences–National Research Council, Publication 519, Washington, D.C. (1957).
2. F. H. Pittman, "High-Level Radioactive Waste Management Alternatives," WASH-1297, U.S. Atomic Energy Commission, Washington, D.C. (1974).
3. F. M. Empson, R. L. Bradshaw, W. C. McClain, and B. L. Houser, "Results of the Operation of Project Salt Vault: A Demonstration of Disposal of High-Level Radioactive Solids in Salt," Oak Ridge National Laboratory, Oak Ridge, Tenn. (1968).
4. G. J. Barnes and M. E. Whatley, "The WIPP Journey to Waste Receipt," DOE/WIPP 97-2091, Westinghouse Electric Corporation, Waste Isolation Division, Carlsbad, N.M. (April 1997).
5. U.S. Congress, Public Law 97-425 "Nuclear Waste Policy Act of 1982," as amended, Washington, D.C. (Jan. 7, 1983).
6. Eddy-Lea Energy Alliance LLC, *Detailed Site Report for the Consolidated Fuel Treatment Center and Advanced Recycling Reactor*, (April 30, 2007).

Christopher M. Timm is vice president and senior project manager for PECOS Management Services Inc. in Albuquerque, N.M. For additional information, he can be contacted at ctimm@pecosmanagement.com.

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