

Technical Working Group Report for the SunZia Transmission Line Project

Executive Summary

The Arizona and New Mexico state offices of the Bureau of Land Management (BLM) conducted an environmental analysis and on June 14, 2013, published a Final Environmental Impact Statement (FEIS) for the SunZia Southwest Transmission Project. Using the conclusions from the FEIS, the BLM will decide whether to grant, grant with modifications, or deny the proposed action. The action under consideration would construct and operate up to two 500-kilovolt (kV) above-ground transmission lines and associated substations stretching for a distance of approximately 515 miles from Lincoln County, New Mexico to the Pinal Central Substation, Coolidge, Arizona.

The FEIS analyzed the environmental consequences of installing bulk power transmission lines to connect New Mexico wind generation resources to load centers in Arizona. Additionally, the Project is designed to transport conventional energy generation that might connect to the transmission line. A primary consideration in the development of the FEIS was a Right-of-Way (ROW) agreement between BLM and the developer to allow the routing of the transmission lines across Federal lands.

The proposed routing of the transmission lines has been an issue from the onset of the Project's scoping discussion in 2008. From a Department of Defense (DOD) point of view, routing remains an issue unless a portion of the Project is placed underground or a more northern route is considered, such as the DOD preferred alternative, which does not require transmission line burial. The FEIS studied burial of the entire Project, as well as burial of a short segment of the Project under a river crossing (unrelated to DOD's mission compatibility concerns), and concluded that both of those alternatives were technically and economically infeasible.

In order to resolve these important routing issues, DOD and the Department of the Interior (DOI) agreed to form a Technical Working Group (TWG) to address the technical feasibility of burying a portion of the Project where it is proposed to cross the White Sands Missile Range (WSMR) Northern Extension Area (NEA). This report summarizes the evaluation conducted, and concludes that burying a 35 mile segment of the Project would be technically feasible. While the cost to bury 35 miles would be expensive, that cost must be compared to the loss of critical testing capability important to national security. The TWG analysis concludes that the cost to bury the transmission lines is less than the cost to the nation to replace or replicate critical testing activities available at WSMR.

The TWG, composed of subject matter experts from the DOD, and the Department of Energy's Idaho and Pacific Northwest National Laboratories, consisted of four teams, each of which was assigned a specific focus area: 1) technical feasibility of burying the transmission line, 2) mission compatibility, 3) hold harmless and indemnification considerations, and 4) procedures and operational considerations.

The 60-day study, conducted in May and June 2013, analyzed issues and documented their results. This report provides the results of the team efforts, and proposes Hold Harmless and Construction Memorandum of Agreement (MOA) documents. In summary, the conclusions of the TWG are:

1. It is technically feasible to bury a segment of two single-circuit 500 kV transmission lines. Existing underground 500 kV cables are in operation in several locations worldwide. 500 kV cables can be constructed, installed, and operated to ensure reliability, minimize operational risks and, when the construction is combined with micro-siting, lessen environmental impacts. The TWG concludes that worldwide manufacturing capability exists to produce the segment of the transmission line envisioned. DOD believes this new information calls into question the conclusions regarding transmission line burial reported in the FEIS
2. The distance required for line burial is 35 miles. This is the minimum distance necessary to prevent impairment of the Nation's unique capabilities to test DOD weapon systems in this location.
3. A *Hold Harmless Agreement* is required to indemnify DOD for any claims related to damage to the line. This clause should apply to government, state trust, and private land, and should be included in the ROW agreement.
4. An *Operations and Scheduling Agreement* is required to enable continued testing during line construction and operation. This agreement would also include provision for access to the line in the event of an emergency.

Section A of the report provides an introduction to the Project, and Section B provides the findings regarding the feasibility of transmission line burial. Section C identifies the portion of the line that must be buried in order to safely conduct military testing in the NEA. Section D provides draft language for a hold harmless and indemnification clause and associated draft operating procedures to ensure compatible power line operations and military testing in the NEA. Section E examines the economics of the DOD stipulations. The final Section F provides conclusions.

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A. Introduction

The Bureau of Land Management (BLM) conducted an environmental and economic analysis, resulting in publication of a Final Environmental Impact Statement (FEIS) for the SunZia Southwest transmission project connecting Central New Mexico wind resources to the Pinal Central Substation near Tucson, Arizona. The study area for the EIS included an area that is a recognized “call-up” area for the White Sands Missile Range (WSMR), also known as the Northern Extension Area (NEA). WSMR officials have consistently stated since 2008 that vertical towers for the overhead high-voltage transmission lines, and the conductors themselves, will have a significant impact on their test missions if located in the northern portion of WSMR or the NEA.

The NEA is a 1,600-square-mile area of mixed BLM public land, state of New Mexico trust lands, and privately owned land. The Army has longstanding agreements with BLM, the state, and private land owners within the NEA to vacate people from some or all of the NEA during potentially hazardous military testing activities. Additionally, the US Army has agreements with the Federal Aviation Administration (FAA) to grant temporary flight restrictions to commercial and general aviation transiting the NEA, as needed. The NEA has been evacuated for hazardous operations 86 times over the past six years in support of 12 different Service programs. DOD’s use of this area for testing has increased by 20 percent since 2010 (approximately 40 missions per year), and is scheduled to increase as DOD conducts additional integrated tests of military weapons utilizing joint force capabilities.

Discussions to date between DOD and DOI on alternative SunZia routes have not reached a consensus on the Preferred Alternative Route (PAR) contained in the FEIS.

A Technical Working Group (TWG) was established during an April 22, 2013 meeting between the DOD and DOI to examine the issues impacting DOD by the SunZia project. Four TWG teams were established to examine specific areas:

- Team #1: Determine the overall technical feasibility of installing the transmission line underground for the distance identified by Team #2.
- Team #2: Validate the portion of the transmission line that must be installed underground to enable WSMR to support current and future test mission requirements.
- Team #3: Draft a “hold harmless and indemnification” clause for the EIS Record of Decision, and a Right-of-Way Agreement.
- Team #4: Draft procedures to allow for unimpeded testing to occur during construction and maintenance of the line.

This TWG report provides evidence that an underground transmission line across a segment of the NEA is technically and economically feasible. Further the report concludes that the Project, if constructed as an overhead transmission line project, will negatively affect WSMR mission activities and, therefore, national security.

B. SunZia Transmission Line Underground Installation Technical Feasibility

1. Objective

Section B reports the results of the Team #1 evaluation of the technical feasibility of installing a section of the proposed transmission line along the PAR underground.

2. What the FEIS Says about Installing a Transmission Line Underground

The BLM considered two underground alternatives in the FEIS. The first alternative addressed installing and operating the entire Project underground across the 515 miles between the Sun Zia East substation northeast of WSMR to the Pinal Central Substation near Tucson, Arizona. The EIS states that:

“Burial of the entire Project or portions of the Project is considered technically infeasible due to potential reliability concerns, operational risks, environmental impacts, and high construction cost.”¹

The FEIS also notes factors of limited material supply and limited manufacturing capability to produce sufficient quantities of 500 kilovolt (kV) buried cable systems.² The FEIS states that this line burial would be 20 times longer than the longest known underground 500 kV transmission line project. For these reasons, the FEIS authors eliminated underground burial of the entire transmission line from further consideration. For purposes of this report, generally all references to 500 kV systems refer to High Voltage Alternating Current (HVAC) systems.

The second alternative evaluated in the FEIS, based on public concerns about the risk of migratory birds colliding with overhead transmission lines crossing the Rio Grande, was undergrounding a short section of the transmission line. Chapter 4.16 of the FEIS summarizes a detailed analysis of this alternative provided in a separate report and concludes that, although it is technically feasible to place a short 12,000-foot segment of the transmission line underground, installing the underground segment would cost approximately 16–21 times the cost of overhead transmission lines. These conclusions were based on the administrative record, which includes a detailed report on the technical

¹ SunZia Southwest Transmission Project Final Environmental Impact Statement, 14 June 2013, Chapter 2, 2–37 to 2–40.

² Ibid.

and economic feasibility of burying a segment of the transmission line under the Rio Grande.³ Based on this report, the EIS determined that an underground installation was technically and economically infeasible.

The TWG requested further documentation available in the administrative record associated with studying underground applications. BLM provided the following additional reports and analysis (Table 1).

Table 1. Electrical Engineering References Prepared for the Administrative Record, SunZia Southwest Transmission Project

| Author | Date | Title |
|---|-------------------|--|
| The Western Electricity Coordinating Council (WECC) Peer Review Group | February 22, 2011 | SunZia Southwest Transmission Project WECC Accepted Path Rating Phase 2 Study Report Volume 1 – Main Report |
| Southwestern Power Group | March 7, 2013 | WECC 2013 Annual Progress Report |
| Jim Hsu, P.E., PDS Consulting | April 22, 2009 | SunZia Southwest Transmission Project Comprehensive Progress Report Submittal for Phase 1 of WECC Three-Phase Accepted Rating Review Process |
| WECC Planning Coordination Committee Operating Committee Technical Studies Subcommittee | March 25, 2011 | Ltr, Subject: SunZia Southwest Transmission Project Achieve Phase 3 Status |

When the FEIS authors forwarded these technical studies to the TWG, they noted that SunZia Transmission, LLC (the Applicant) would be required to file amended studies that could take up to two years to complete should the decision be made to change the design of this proposed 500 kV overhead-constructed power system to include a segment that is placed underground.

The FEIS states that it is considered technically feasible to bury an extruded alternating current (ac) cable with cross-linked polyethylene (XLPE) insulation (a solid dielectric insulating system) for short distances.⁴ During a TWG meeting with the Applicant, the Applicant stated that the short distances envisioned were associated with burial under the Rio Grande.⁵ FEIS Chapter 4.16 cites this length as approximately 12,000 feet, or about 2.5 miles.

³ SunZia Transmission POWER Engineers, SunZia Southwest Transmission Project Underground Technology and Cost Analysis, February 2011.

⁴ EIS Ch 2, § 2.3.3.2, 2–39, line 13–14.

⁵ Teleconference between BLM, SunZia, and DOD, 28 June, 2013.

The FEIS also states that the only 500 kV underground transmission lines in the United States are at the Grand Coulee Dam; however, due to concerns regarding underground transmission line failures, the Bonneville Power Administration and the Bureau of Reclamation are considering upgrading the 2.1 miles of underground lines at Grand Coulee Dam with overhead transmission lines.⁶ Discussions with the Bonneville Power Administration project lead for the Grand Coulee Dam confirmed that the underground installation was being replaced due to the age of the installation (built in the 1970s). During the 1980s, there was a hard-to-extinguish fire in the tunnel, which damaged the power line (the cause of the fire was never determined). The repair took several months and, during that time, emergency overhead lines had to be installed. Recently, when the decision to replace the aging lines was made, the Bureau of Reclamation decided to replace the oil-filled cable in the tunnel with overhead lines primarily based on the costs, the availability of overland routing, and the fear of a repeat fire. The existing oil-filled cable will remain in place as a backup.

BLM's NEPA Handbook⁷ frames the rationale used by the FEIS authors not to carry forward the two underground alternatives considered. Specifically, Section 6.6.3 states that an action alternative may be eliminated from detailed analysis if it is:

- Ineffective (it would not respond to the purpose and need).
- Technically or economically infeasible (consider whether implementation of the alternative is likely given past and current practice and technology; this does not require cost-benefit analysis or speculation about an Applicant's costs and profits)
- Speculative regarding an Applicant's costs and profits.
- Inconsistent with the basic policy objectives for the management of the area (such as, not in conformance with the Land Use Plan (LUP)).

While installing the entire 500-mile length of the transmission line underground or undergrounding a portion under the Rio Grande crossing were considered in the FEIS, these alternatives were not carried forward because they were determined to be technically and economically infeasible.

3. What the TWG Discovered

Team #1, composed of subject matter experts from the DOD and the Department of Energy's Idaho and Pacific Northwest National Laboratories evaluated the following hypothesis: "a 500 kV underground transmission line (cable, splice units, link boxes, terminations, compensation, etc.) across a portion of WSMR is technically feasible."

⁶ EIS Ch 2, § 2.3.3.2, 2-37, line 34-3.7.

⁷ BLM NEPA Handbook H-1790-1, dated January 2008.

In order to test the hypothesis, Team #1 examined whether:

- 3,000 megawatts (MW) (4,500 MW if a second transmission line is added within the utility corridor) of electrical power transported through underground cables for a distance of 35 miles across the NEA is feasible. This is the distance identified by Team #2 as required for underground transmission line installation (see Section C).
- The worldwide capacity to manufacture sufficient quantities of cable and splice units is feasible.
- Transportation of cables and installation equipment to the NEA is feasible.
- The worldwide expertise to field test and install up to 35 miles of 500 kV underground transmission line exists.

Additional areas that were examined but not considered deterministic of the technical feasibility included:

- General metrics on the cost of installing transmission lines underground cables versus cost of overhead transmission lines.
- Exact transmission line route and associated geological characteristics.
- Available experience on reliability and maintenance for 500 kV underground transmission cables.
- Future additional transmission line routes across the NEA, and evaluation of potential additional mission impacts from cumulative transmission lines.
- Transmission line electromagnetic interference (EMI) effects and EMI impact on WSMR's range infrastructure and equipment.

a. Technical Feasibility

In order to assess the technical feasibility, production capability, and installation expertise, eight companies were contacted: six cable manufacturers/installers (General Cable, Tele-Fonika, Taihan Cable, VISCAS, Nexans, and NKT) and two high-voltage transmission line installation companies (Siemens and General Electric).

Three operational HVAC cable systems were examined:

- The Shinkeiyo Toyosu 500 kV Transmission Line, installed in 2000, is a 20 kilometer (km) underground solid dielectric XLPE transmission line. This project connects the Tokyo Electric Power Company's Shin-Keiyo substation and the Shin-Toyosu substation with two circuits. This transmission line includes 240 splices. Discussions with the operators in Tokyo confirm that no failures of the cable or splices have occurred since its installation.

- The Shanghai Shibo 500 kV Transmission Line, installed in 2010, is a 17 km underground solid dielectric XLPE transmission line. This project incorporates 147 splices, and the tunnel for underground routing starts from the 500 kV World Expo Station at West Beijing Road, crosses downtown Shanghai above the Huangpu River, and connects the cable tunnel of the San-lin station. Discussions with the operators in Shanghai confirm that no failures of the cable or splices have occurred since its installation.
- The underwater transmission line from mainland Canada to Vancouver Island includes both a 9 km and a 30 km 525 kV line segment. An oil filled cable was placed in service in 1984. The operating experience has been reported as being excellent. Results of recent studies and monitoring of cable performance led BC Hydro, the owners of the cable, to increase the rating of the cable to 1320 MW in 2008.

Although none of these examples report on cable lengths equal to, or exceeding what is proposed for a segment across the WSMR's NEA, they represent significant lengths of cables and many hundreds of cable splice units per installation.

Additionally, two feasibility studies were also examined that looked at underground installations of 500 kV transmission lines. Due to cost concerns raised by those studies, neither of these projects was installed underground. These two studies are:

- Cable Consulting International (CCI) conducted a feasibility study to install either 10 km or 20 km (two alternative routes) of a 500 kV transmission line in the Edmonton, Canada area. Although costly, it was determined that it was technically feasible to install a 500 kV transmission line underground for either the 10 km or the 20 km route. A major concern of this study was the extreme low temperatures that would be experienced.
- Patrick Engineering, examined a potential 10 km 500 kV transmission line to be installed in a duct bank across the Everglades in Florida. Again, this study concluded that it would be technically feasible to install a 10 km 500 kV transmission line underground; however, the decision was made to install the transmission line on overhead towers due to the cost of an underground installation.

All of the cable manufacturers and the high voltage transmission line installation companies contacted were asked if a 3,000 MW transmission line operated at 500 kV could be installed underground for a distance of at least 35 miles without the need to construct intermediate above ground substations to house reactive compensation units (large transformer-like devices). Reactive compensation is required to optimize the power transfer in the cables. Each of the eight vendors contacted stated that, for a line equal to or less than 35 miles, mid-point reactive compensation would not be required.

Siemens indicated that a transmission line could go 50–70 miles underground with a 500 kV solid dielectric XLPE cable. General Electric (GE) indicated that a 3,000-MW, 500 kV system could be constructed up to 40 miles in length. GE noted that it would be more cost effective to install a high voltage direct current (HVDC) transmission line once the distance to be covered reached approximately 40 miles, even though there would be an added expense of installing voltage source converter stations at each end of the line. HVDC transmission lines don't have line length restrictions as do HVAC transmission lines.

It was also noted during the discussion with the cable manufacturers, that each manufacture 500 kV solid dielectric XLPE-type cable.

The TWG did not complete a specific project design for the underground installation of a 500 kV transmission line across the NEA. There are several construction methods for installing a 500 kV transmission line underground. The TWG did not attempt to assess each contractor's cable specification or capability against each specific construction technique as this was beyond the scope of this assessment. Each of the contractors has experience installing 500 kV transmission lines. Each of the contractors also has experience in field splicing. The specifics of installation (forced-air ventilated tunnel installation with racked splice groupings; concrete-encased conduit banks with surface-mounted clean-room splice housing, etc.), along with which contractor should perform the work, should be decided by the Applicant.

b. Cost of Installation

The TWG confirmed the FEIS observation that there has been limited experience with long-distance 500 kV underground transmission lines in operation around the world. A comprehensive literature search was conducted to determine current and projected costs and experience with solid dielectric cables rated for 500 kV (see Appendix A). The projects examined were selected because they were recently studied, were configured as 500 kV or greater transmission lines, span significant distances, and involved complex geographical obstacles that had to be crossed. (The exception was the Grand Coulee Dam project addressed below.) Analysis of these projects concluded that installing underground transmission lines is more costly than installing an overhead system.

As noted in Table 2, a significant range of cost factor multipliers was identified for underground cable installation due to the variety of complex geographical obstacles that had to be considered.

Table 2. Underground 500 kV Installations

| Project | Authors | Date | Length (Miles) | Cost Multiplier for Underground Alternative | Remarks |
|--|---|--------|----------------|---|--|
| CCI Feasibility Study for 500 kV Underground Cables, Edmonton Canada | Heartland Project (Cable Consultants International) | Feb-10 | 12.5 | 6.5-8.7 | Crossings (pipeline, river, road, wetlands increase cost) |
| Everglades National Park 500 kV Underground Feasibility Study | National Park Service (Patrick Engineering) | Mar-10 | 6.5 | 7-10 | Cost of going through Everglades Nat'l Park drives costs upward |
| Grand Coulee's Third Powerplant 500 kV Transmission Line Replacement Project | Bonneville Power Administration | May-11 | 2.1 | | BOR – Decision to go overhead based on cost to replace old oil filled line |
| I-5 Transmission Corridor Project | Bonneville Power Administration Power Engineers | Jan-11 | 68-76 | 14-15 | A number of major waterways, railroads, and wetlands would be crossed using horizontal directional drilling, reactor stations every 25 miles |
| SunZia Rio Grande Crossing | Bureau of Land Management (SunZia Transmission Power Engineers) | Feb-11 | 2.27 | 16-20 | Includes horizontal drilling under Rio Grande |

Based on information provided by reputable cable manufacturers and, even with the lack of complex obstacles to be crossed in the WSMR call-up area, the cost for undergrounding a 500 kV line would be expected to range from 6 to 10 times the cost of installing the cables overhead on towers.

c. Reliability

To investigate reliability of underground transmission lines, the four existing projects listed above and two feasibility studies mentioned below were analyzed. All of the projects considered involved transmission lines of at least 500 kV.

As discussed above, both the 9 km and 30 km segments of the 525 kV underwater power lines from mainland Canada to Vancouver Island,⁸ as well as the Shinkeiyo

⁸ Sudhakar Cherukupalli, Allen MacPhail, and Ross Nelson, BC Hydro Engineering, and Joseph Jue and Jim Gurney, BC Transmission Corp., "Monitoring Produces Higher Cable Ratings," *TD World*, Dec. 1, 2008.

Toyosu⁹ 500 kV Transmission Line and the Shanghai Shibo¹⁰ 500 kV Transmission Line, have proven reliable, experiencing no failures of cable or splices since their installation.

The Grand Coulee Dam has a 500 kV transmission line through a tunnel in the dam approximately 3 km long. See discussion in Section B.2 regarding the replacement of this line.

The Heartland Project and the Everglades National Park feasibility studies also discussed the reliability of 500 kV underground transmission lines. The Heartland Project quoted data from a Conseil International des Grands Réseaux Électriques (CIGRE) Study projecting that for every 100 km there would be .066 internal faults per year, and for each 100 splices there would be .026 internal faults per year.

As mentioned earlier, SunZia conducted a study to examine the feasibility of installing a transmission line underground to cross the Rio Grande. This report, written in February 2011, states “Historically, extruded (or Solid Dielectric) cables lack the experience when compared to HPFF [high-pressure fluid-filled] and SCFF [self-contained fluid-filled], but are gaining in experience and usage. This cable technology has the benefits of a simplified installation method, in turn reducing operations and maintenance costs compared to other cable systems, while maintaining a high level of reliability. Today, XLPE is the preferred insulation in the United States for voltages over 69 kV. XLPE cable designs and construction are excellent and experience with accessories has improved. An XLPE cable system would be the best application for an underground crossing of the Rio Grande by the SunZia Project.”

A 2009 CIGRE report cited earlier indicated that, of nearly 5,000 splices installed between 2000 and 2005, only six have been reported with faults.¹¹ While there are not many long-distance underground 500 kV power lines in existence, reliability history to date has been acceptable to the operating utilities.

Repair times for underground cables are significantly longer than repair times for overhead cables. The CIGRE report cited an average repair time for underground cable of 25 days. In order to increase the reliability of a transmission line, a spare underground

⁹ Norihiro Yonemoto, Yasuhiro Muneta, Hiroshi Yamanouchi, Sukebumi Seo, Yoshinori Kumada, Mashiko Itoh, Satoshi Kunimura, Shoichiro Nakamura, Yoshiyuki Fujii and Tomomi Ishii, “Construction of the World’s First Long-Distance 500 kV XLPE Cable Line,” Tokyo Electric Power Company, Inc., and VISCAS Corporation, December 2002.

¹⁰ Yun JIANG1 , Shanghai Municipal Electric Power Company, (China), malan@sh163.net, Xiaojuan JIANG2, Zhigang WANG2, Inspection & Maintenance Company, Shanghai Municipal Electric Power Company, (China), jiang-xiaojuan@163.com, shiboxmb@sina.com, “500 KV FEED CABLE PROJECT FOR EXPO SUBSTATION,” 8th International Conference on Insulated Power Cables, June 2011.

¹¹ Working Group B1.10 CIGRE, “Update of Service Experience of HV Underground and Submarine cable systems,” April 2009.

cable is often installed, or the existing cables are designed to accept higher loads temporarily. Installation and operation of a robust cable and splice unit health monitoring system along with spare cable stored nearby will further reduce any potential reliability issues and enhance line maintainability.

d. Operational Risks

The primary threat to buried cable systems is referred to as a “dig-in;” that is, construction crews accidentally hitting buried cable. This threat can be minimized through robust route marking and routine line route inspections. In the event of a failure, an underground line would take longer to repair than an overhead line, although ensuring that maintenance roads are properly maintained and access agreements are in place would expedite the ability to make necessary repairs. Securing standing maintenance contracts that include defined mobilization times with qualified cable repair technicians, along with routinely exercising mutual aid agreements, will minimize the time required to accomplish a repair once on-site. Maintaining sufficient spare cables, splice units, and other appropriate materials needed for emergency repairs in an appropriate location to facilitate rapid deployment to the repair site will also minimize down time in the event of a failure or damage to the line. In short, there are prudent and reasonable mitigations that can minimize the operational risks.

e. Future Modifications and Access to the Transmission Line

There is concern that, if the SunZia transmission line were installed across the NEA, additional transmission lines also will be allowed to transit the NEA to access it based on the concept of “Open Access.” Historically, electric utilities owned generation, transmission, and distribution facilities, and sold these three services as part of a “bundled” package. But as transmission technologies improved and alternative power suppliers emerged, a wholesale energy market developed, giving wholesale energy consumers new sources for competitively priced power. Utility ownership and control of transmission lines, however, remained a barrier to the development of this market. Recognizing that utilities that owned and controlled transmission lines had a profit-maximizing motive to restrict access to their transmission lines, the Federal Energy Regulatory Commission (FERC) promulgated regulations aimed at “unbundling” transmission services from the other services that a utility offered and opening access to the transmission lines on equal terms.

FERC issued Order No. 888¹² to “require all public utilities owning and/or controlling transmission facilities to offer non-discriminatory open access transmission

¹² FERC Order 888: Promoting Wholesale Competition Through Open Access Non-Discriminatory Transmission Services by Public Utilities; Recovery of Stranded Costs by Public Utilities and Transmitting Utilities, 61 Fed. Reg. 21540 (May 10, 1996).

service” to any interested stakeholder. This includes requirements set forth by local public utility commissions.

Applying the “non-discriminatory open access” order typically means that third party entities can obtain access to transmission lines, and that the costs to connect to the lines must be paid for by the requesting entity. Once connected, the third party agency is charged equal and fair tariffs for the use of the transmission line. It is important to note that the FERC order does not dilute the authority of or regulatory requirements imposed by local public utility commissions, environmental regulations, and regional power authorities.

Open Access orders have been upheld in Federal courts, with one of the most recent cases, NRG Power vs. Federal Energy Regulatory Commission, 14 June 2013,¹³ supporting open access to a requesting third party entity.

The implication of FERC Order 888 is that the Project may be directed to accept other renewable energy generators and their associated overhead transmission lines onto the NEA. It is less likely that the state would compel the Project operator to accept additional generation if it is an underground line.

f. Environmental Impacts

The TWG acknowledged the comments of the FEIS authors and the Applicant that adding an underground segment to the proposed design will require additional environmental analysis, which could take significant time to complete.

Additionally, installing an underground cable will involve a greater disturbance of the environment during the construction period than installation of above-ground transmission lines and, given the proposed route under consideration, there is a risk of uncovering cultural and archaeological artifacts during construction. However, once installed, underground cable poses a much lower risk to the environment. For example, although the area in the NEA has not been identified as a migratory route, with underground cables, the risk of avian strikes is eliminated. Maintenance roads will be required for any type of line installed. For underground installation, inspection access points will continue to be visible; however, once construction is completed, since there is nothing above ground to be seen, there would be a reduced visual impact. Prudent and reasonable mitigations employed during construction could minimize any environmental impacts.

¹³ Transmission Access Policy Study Group v. FERC, 225 F.3d 667, 681 (D.C. Cir. 2000) NRG Power vs Federal Energy Regulatory Commission, U.S. Court of Appeals for District of Columbia, No. 11-1201; Decided June 14, 2013.

g. Production Base

The FEIS notes that the worldwide suppliers of underground cable components may not have the manufacturing capability to supply long lengths of 500 kV buried cable systems.¹⁴ In order to validate that supply is sufficient to support an underground project across the NEA, and to obtain information on installation, Team #1 contacted six cable manufacturers and two companies that specialize in underground installation. These are listed in Table 3.

Table 3. Summary of Telephone Conversations with HVAC Cable Manufacturers

| Company | Manufacturing Location(s) | Manufacture 500 kV Cable? | 35 Mile Length Feasible? | Manufacturing timeline (weeks) | Remarks |
|------------------|---------------------------|---------------------------|--------------------------|--------------------------------|---|
| General (Silec) | France & Spain | Yes | Yes | 20-24 | US based Splice teams |
| Tele-Fonika | Poland | Yes | Yes | 10-12 | EU and Latin America Based |
| Taihan Cable | So Korea | Yes | Yes | Keep up w/construction | Korea & US Splice teams |
| Viscas | Japan | Yes | Yes | 52 | Installed 20Km Tokyo 500kVAC Line |
| Siemens | NA | No | Yes | NA | 50-60 miles possible. Siemens provides Installation services. |
| Nexans | France, US (2014) | Yes | Yes | 26 | Installation Services Provided |
| NKT | Germany | Yes | 32* | 52 | |
| General Electric | NA | No | Yes (DC) | NA | At 40km, DC more cost effective |

Based on these telephone conversations with manufacturers and installers, Team #1 concluded:

- Two of the manufacturers currently have a one-year backlog; however, based on the total capacity, sufficient cable could be provided in a timely manner to support construction.

¹⁴ EIS Ch 2, § 2.3.3.2, 2–37, line 22–25.

- Several of the overseas cable companies have US-based splicing teams. However, some would use foreign splicing teams, which may lead to security considerations.
- Nexans is proposing to build a US cable production plant in South Carolina in 2014. (At the time of this report, ABB, another cable manufacturing company that was not contacted also announced their intent to build a US-based cable manufacturing facility.)
- Siemens and GE install underground power lines, but do not produce the cables themselves. GE estimated that the cost break-even point for using DC instead of AC for underground cabling was about 40 miles (this included the costs for the voltage source converters at either end).
- All of the companies contacted that do manufacture cable produce 500 kV cable on reels capable of transport by common carrier.

h. Electric and Magnetic Fields

WSMR tests sensitive electronic equipment and also uses telemetry and radar to conduct test measurements. Assessing how military electronic equipment may be impacted by EMI from high-voltage transmission lines is an ongoing challenge. Several studies have been conducted over the past few years, mainly by the Army Electronic Proving Ground and the Headquarters, Army Test and Evaluation Command. Results have not been entirely conclusive; however, it has been shown that under some conditions overhead transmission lines can contaminate the electronic environment. Burying the high-voltage transmission line eliminates these electric fields and significantly reduces the magnetic fields from these lines. Table 4 is an excerpt from Appendix B of a 1994 Argonne National Laboratory report on electric power high-voltage transmission line design options, cost, and electric and magnetic fields.¹⁵ As can be seen, with the underground installation of a 500 kV transmission line, calculated strengths for the electric fields are zero, and the magnetic fields are significantly reduced.

¹⁵ J. B. Stoffel, E. D. Pentecost, R. D. Roman, and P. A. Traczyk, “Electric Power High-Voltage Transmissions Lines: Design Options, Cost, and Electric and Magnetic Field Levels” (Argonne, IL: Argonne National Laboratory, November 1994).

Table 4. Design Options for High-Voltage Transmission Lines

| Description | Construction Cost per Mile (\$1000s) | Magnetic Field (mG) | | | Electric Field (kV/M) | | |
|--|---|----------------------------|--------------|---------------|------------------------------|--------------|---------------|
| | | Under | 40 ft | 200 ft | Under | 40 ft | 200 ft |
| Wooden H-Frame (base case) | 230–260 | 59.6 | 29.7 | 1.6 | 2.6 | 1.9 | 0.04 |
| 230 kV | | | | | | | |
| 300 A | | | | | | | |
| 125 MW | | | | | | | |
| 19-ft Spacing | | | | | | | |
| Vertical Delta | 220–250 | 27 | 11 | 0.6 | 1.9 | 0.7 | 0.04 |
| Horizontal Delta | 220–250 | 28.9 | 9.8 | 0.5 | 1.6 | 0.7 | 0.03 |
| Increased voltage | 400–500 | 24.4 | 16.9 | 1.2 | 5.5 | 5.8 | 0.1 |
| 500 kV | | | | | | | |
| 138 A | | | | | | | |
| 30-ft spacing | | | | | | | |
| Steel lattice tower | | | | | | | |
| Underground line: fluid-filled steel pipe | 1,500–2,000 | 4.9 | 0.2 | 0.01 | 0 | 0 | 0 |
| Underground line: dry type cable nonmagnetic pipe | 1,500–2,000 | 14.7 | 0.6 | 0.03 | 0 | 0 | 0 |

i. Method of Burial

Several methods of installing high voltage cable of this type underground have been used. Direct burial, duct banks, and conduit are all options available. The TWG did not investigate alternative underground installations.

j. Why Not Consider a HVDC System?

The FEIS analyzed a second, future circuit within the transmission line corridor that could be either HVAC or HVDC. In some situations, such as underground installation, HVDC has both technical and economic advantages. There are many examples of 500 kVdc lines being buried for long distances. Of note in the United States is the 105 km 500 kVdc cable connecting Sayreville, New Jersey and Hicksville, New York; 80 km of the line is installed underwater and 20 km is installed underground in the shoulder of the Wantagh Expressway, Long Island, New York. Other examples exist where HVDC cables are buried for 100 miles or more.

Underground construction costs for direct current would be lower since only two cables per circuit are required. For direct current, converter stations are required at both ends of the underground conduit; for ac, reactive compensators are required at either end of the conduit. The cost of converters for dc lines has been declining, making dc a more attractive option than in the past. With HVDC there will also be less electric field stress

on the cable and the splice units than for HVAC. This gives HVDC an advantage for reliability. Since dc does not require reactive compensation, the distance required for underground installation is not an issue.

An option may be to run HVDC overhead lines from the beginning of the SunZia East station to WSMR, install the segment proposed to cross the northern call-up area underground, and then continue overhead to the SunZia midpoint station where dc to ac converters could be installed. An engineering study would be required to determine if this is an economical solution; however, this would meet the criteria of transmitting 3,000–4,500 MW of electricity from the SunZia East substation to the SunZia midpoint substation and still allow the interconnection of any additional substations between the SunZia midpoint substation and the Pinal Central Substation near Tucson, Arizona.

4. Conclusions

This section did not attempt to define all of the engineering trade-offs and designs required to install a segment of the Project underground across the NEA. However, Team #1 concludes:

- Manufacturing capability and a trained workforce exist to provide sufficient quantity of cable and splice units to install underground transmission lines across the NEA.
- A 500 kV underground system across a portion of the NEA is technically feasible without mid-point above-ground reactive compensation. (See Section C for a discussion on the length of the line that would be required to be buried.)
- The cost of installing an underground transmission line of this capacity is higher than the equivalent overhead high-voltage transmission line. (See Section D for further cost analysis.)
- While few long distance 500 kV lines are in operation, modeling and experience to date demonstrate cable reliability is not a significant issue. The most prevalent reliability and technical issues will be in the splice joints; however, splice joints have demonstrated high reliability in the data published to date.
- It is unlikely that the New Mexico Public Regulation Commission will require the power line operator to accept new energy generation from an underground transmission line; however, FERC regulations do mandate open access to transmission capability for new energy producers at the expense of the producer. Nonetheless, the cost of interrupting a buried line would be substantial; therefore, further impact on WSMR missions is unlikely.

Finally, EMI from a high-voltage transmission line of this magnitude, if installed above ground, will require further study. Established EMI specifications for WSMR have

not been identified. However, EMI from a buried high-voltage transmission line is greatly reduced and deemed not significant.

C. Mission Compatibility Assessment: Validate the Portion of the Transmission Line that must be buried to enable WSMR to Support Test Mission Requirements

1. Objective

This section documents DOD test requirements for WSMR and the NEA, along with where the line would need to be buried to allow continued test operations.

The BLM PAR identified in the FEIS traverses the NEA and WSMR's restricted airspace. DOD controls the restricted air space from surface to infinity as shown in Figure 1. The TWG notes that DOD has consistently said that placing overhead high-voltage transmission lines and towers in the NEA will preclude the ability to conduct critical test missions. WSMR provides a unique combination of characteristics for conducting tests that cannot be duplicated anywhere else in the United States. Without the ability to conduct these tests, DOD cannot ensure that weapon systems delivered to our warfighters will function as intended in an operationally realistic environment.

The placement of an above-ground transmission line anywhere within the NEA will significantly and adversely affect military test missions, including the Joint Air and Missile Defense (JAMD) Architecture. In some mission scenarios, the transmission line will act as a barrier to low altitude flights. In others, the line itself would be at risk based on the statistically expected potential for debris from target intercepts or missile detonations and strikes to the line. These potential risks would force DOD to compromise its operational testing parameters in order to avoid the line. The intent of this section is to document DOD's test requirement, specifically in the NEA PAR vicinity; why WSMR is the only viable location to conduct this testing; recently conducted test missions and near-term scheduled and planned test missions; the required PAR burial distance to allow continued critical test operations; an assessment of alternatives for mitigation such as DOD's alternative; and a general discussion of cost impact. This report concludes that the Project should install 35 miles of transmission line underground within WMSR's NEA or relocate the transmission line so that it follows the DOD-identified preferred alternative route.

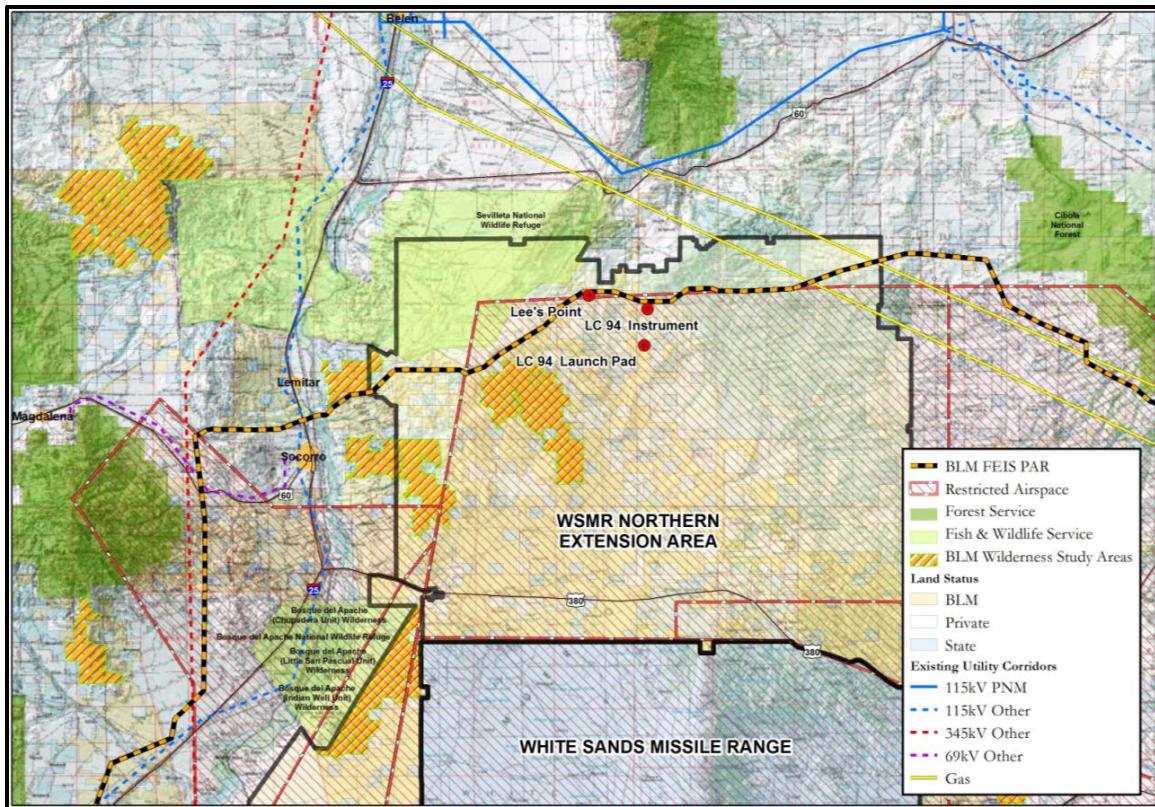


Figure 1. The NEA showing the BLM PAR, WSMR Test Resources, and the DOD PAR

2. Background

The Northern and Western extension/evacuation areas surrounding WSMR were established in 1972 with BLM, the State land office, and the affected ranchers with their private land holdings. This initially provided safety buffer zones for Pershing missile system (P2) launches out of Green River, Utah and Fort Wingate, New Mexico into WSMR. These extension areas have evolved to support test missions and have been incorporated in the WSMR range-wide programmatic EIS and other documents, including BLM Resource Management Plans (RMPs). Referring to Figure 1, the NEA is approximately 40 miles by 40 miles along with WSMR's restricted airspace (FAA designation R-5107 series—surface to infinity). The NEA is outlined in black and includes a portion of the Sevilleta National Wildlife Refuge on the northwest corner. Restricted airspace is outlined in red and is the red hatched area. The BLM FEIS PAR traverses into WSMR's NEA and restricted airspace as shown by the orange/black line. WSMR fixed test resources are located adjacent to, or just south of, the PAR.

The NEA underlies restricted airspace from surface to infinity that is controlled by WSMR. The NEA and its associated airspace are routinely used to satisfy multiple military weapons test requirements from precision guided munitions to air and missile

defense systems. The restricted airspace is scheduled on a daily basis for test operations. The NEA has been evacuated for hazardous operations 86 times over the past six years in support of tests associated with 12 different Service programs, some of which are Patriot, Terminal High Altitude Area Defense System (THAAD), Missile Defense Agency (MDA), Army Tactical Missile System (ATACM), Standard Missile, Joint Air-to-Surface Standoff Missile (JAASM), and Naval Integrated Fire Control-Counter Air (NIFC-CA). DOD's use of this area for testing has increased by 20 percent since 2010 (approximately 40 missions per year), and is scheduled to increase as DOD conducts additional integrated tests of Service weapons utilizing joint force capabilities.

3. The DOD Test Requirement

This report focuses primarily on the JAMD Architecture test requirements, because they are most significantly affected by the BLM PAR. The JAMD test requirements are visually represented by the operational view (OV1) shown by Figure 2 and discussed below. This OV1 is not intended to be all-inclusive of the Service capabilities or of the threat set but provides a portrayal of the operational environment that must be maintained at WSMR to support specific test requirements. The various threats depicted in Figure 2 include Land Attack Cruise Missile (LACM), Anti-Ship Cruise Missile (ASCM), Tactical Ballistic Missile (TBM), and manned and unmanned aircraft. These threats exist today in locations where US forces operate. Systems to defeat these threats are employed by the Army, Navy, and Air Force.

In layman's terms, much of the testing at WSMR relates to detecting and destroying replica enemy missiles. The types of target missiles being employed at WSMR generally approach US and allied assets at a low altitude across sea and land surfaces. Thus, the accurate testing of the Nation's defense systems relies on the ability of the target (enemy) missile to fly at the same low altitude in a ground clutter environment that would be encountered in a real threat situation. In some cases, the test targets are launched from WSMR proper, fly out to a specified distance, and drop to the appropriate low altitude as they re-enter the NEA. The test scenario involves the use of multiple airborne sensors to detect the location, speed, and other parameters of the target vehicle, and then communicate their information to the central fire control position that is located near the inceptor missile launch site, which is a significant distance from the potential engagement location. The purpose of the test is to be able to detect the test vehicle to demonstrate a "engage on remote" capability to intercept and destroy the missile target. Other tests involve dropping the target missile from an aircraft and conducting a similar engagement. It is critical that the low-altitude flights of the target missiles not be interrupted by the need to "pop up" over an obstacle, as this negates the goal of the sensor test and systems of systems integration associated with the "engage on remote" scenario. Additionally, the

extra distance provided by the NEA is critical, as enemy weapon systems continue to evolve in terms of capability.

In some instances, the target is launched from Launch Complex 94 (LC-94), located within the NEA. While the launch parameters are carefully calculated, there is always a potential for an unpredicted malfunction. In such a case, the missile is detonated in order to prevent safety hazards outside the NEA or WSMR. The debris fields for such malfunction events have been modeled extensively, focusing on the areas for which safety hazards are considered unacceptable. The current PAR in the FEIS traverses the area modeled as an unacceptable risk from debris that would result from a malfunction detonation. Each of these scenarios is discussed in more detail below.

Each Service is working to integrate sensors, Command and Control (C2), and hard and soft kill capabilities into a robust system of systems to defeat the threat set. The Army has incorporated its systems into the Army Integrated Air and Missile Defense (AIAMD) program. The Navy has incorporated its systems into the NIFC-CA program consisting of multiple programs of record. Each of these programs has interoperability requirements.

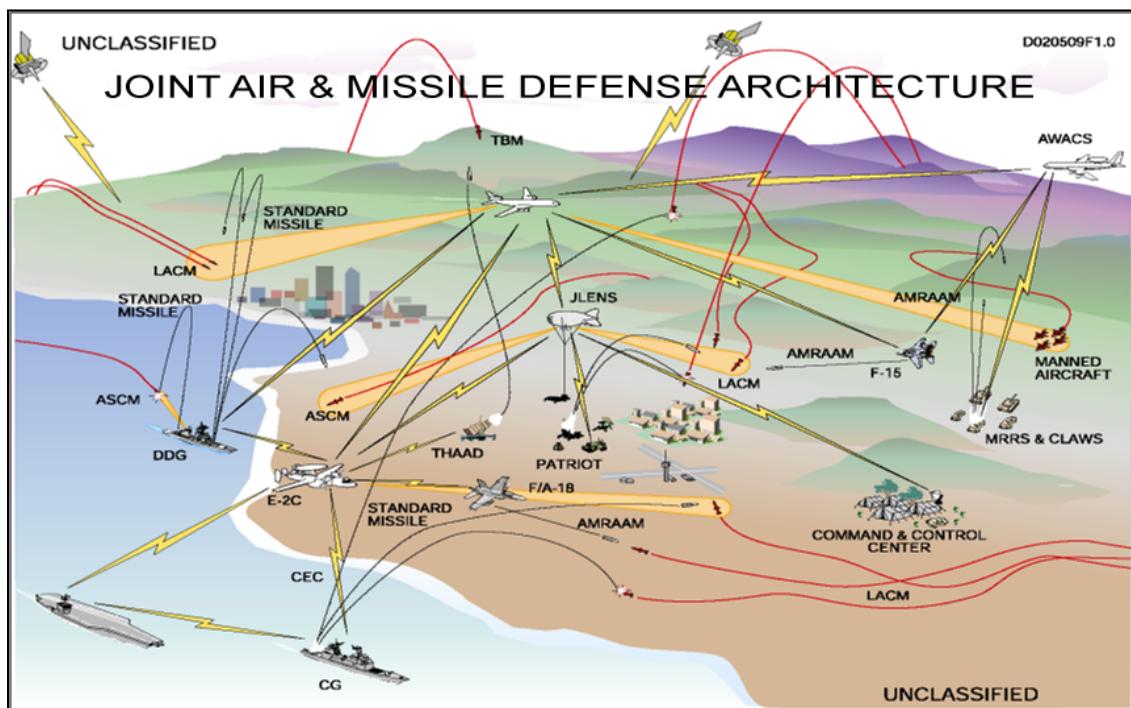


Figure 2. Joint Air and Missile Defense (JAMD) Architecture

The characteristics of the systems comprising the air and missile defense architectures dictate the distances and altitudes necessary for WSMR, the NEA and associated Restricted Airspace. For example, a system of systems program like the

AIAMD has a large defended area that must be protected against threats. These ranges are based on the initial detect, track, C2, and engagement capabilities of the systems comprising the air and missile defense architectures. There is an engagement sequence, shown in Figure 3, associated with these systems, that follows a specific set of steps to counter air threats. Steps in the engagement sequence are time dependent.

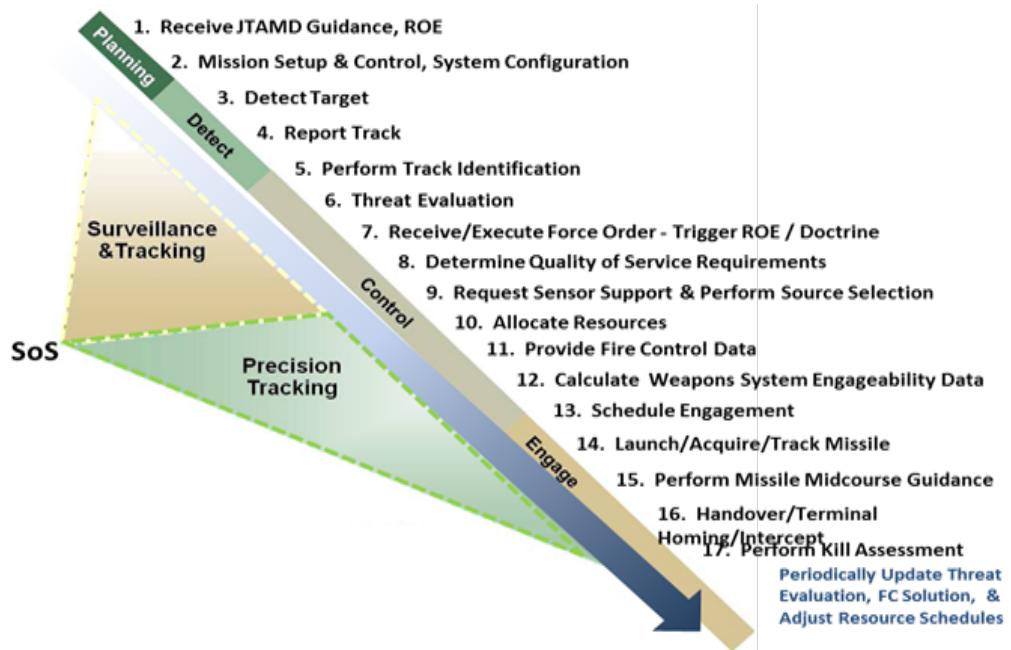


Figure 3. Engagement Sequence

Throughout the engagement sequence, a target must fly an operationally realistic profile to test system hardware and software logic paths. Each step in the sequence has a specific duration in time and track quality, among other performance parameters, before transition to the succeeding step in the engagement. For low-altitude scenarios, it is imperative that the threat target remain in a high ground clutter environment to stress the capabilities of defensive systems to ensure that test adequacy is attained. Each system (e.g., Patriot or AEGIS) that supports these integrated programs (e.g., NIFC-CA or AIAMD) also has unique capabilities and engagement sequences. They must test their initial detect, C2, engagement capabilities under a variety of conditions. In some deployment scenarios they may be required to operate independently. These systems have specific requirements to fully test their hardware and software capabilities. These requirements are tested at various distances and altitudes to collect data on hardware components (uplink/downlink, fuse, digital signal processors, etc.) and software modules (missile type selection logic, radar surveillance logic, launcher selection logic, etc.). This testing is needed for each capability of the system. Missile firings and search track missions are scripted to collect the required data for evaluation of these capabilities.

The system will perform differently depending on the target type, altitude, distance, speed, and other parameters. The missile flight path will change depending on target performance. The test matrix to collect these data points is different for each system. The majority of these performance parameters of system functionality can be obtained through comprehensive modeling and simulations. However, actual data from live tests will be required at specific points in the performance envelope to validate the models and simulations. Another compelling reason for conducting live tests that are as realistic as circumstances permit is that the interoperation of systems of systems in a scenario such as “engage on remote” has so many potential variables that simulation may not provide results that are sufficiently predictive of real world system performance.

The most stressing tests include multiple simultaneous engagements (MSEs) at the system level and at the integrated program (or system of system) level. Many of the systems have MSE requirements of two, three, or more missiles versus two, three, or more targets of various types. These types of missions are usually complex and require specific distances and altitudes to collect the required data. At the system level, test conditions (e.g., target altitude, speed, and range) must be strictly controlled to ensure the correct missile from the correct launcher engages the correct target. From just a radar perspective, the targets must come from different angles to stress various aspects of the surveillance code (e.g., range gates, waveforms, or resource scheduling logic). Changes in target conditions will not test the hardware/software functionality in the expected/required path. If the target conditions are not flown as scripted, the required data will not be collected to validate system performance and associated models and simulations. At the program (or system of system) level the complexity becomes more challenging. The target conditions have to be strictly controlled to ensure the correct platform engages the correct target at the right time. These test conditions provide data for a whole different set of logic paths to confirm system functionality. Again, models and simulations will provide valuable information, but a minimal set of open air testing will always be required for validation of these models and simulations. Low-level flight tests, as described above, at the system and program level are among the types of tests that necessitate ensuring the NEA is available to meet critical Defense testing requirements.

4. WSMR is the Only Location to Meet These DOD Requirements

Of the 23 Major Range and Test Facility Base (MRTFB) installations within the United States, WSMR is the only one with the combination of characteristics to support the types of testing described thus far. Figure 4 provides a comparison of WSMR to the other large DOD land range complexes. WSMR controls 5,731 square miles for the specific purpose of conducting the hazardous missile operations described above. The Nevada Test and Training Range (NTTR) land area comes closest with 4,658 square

miles, but lacks the necessary combination of distance (depth) and terrain to meet test requirements.

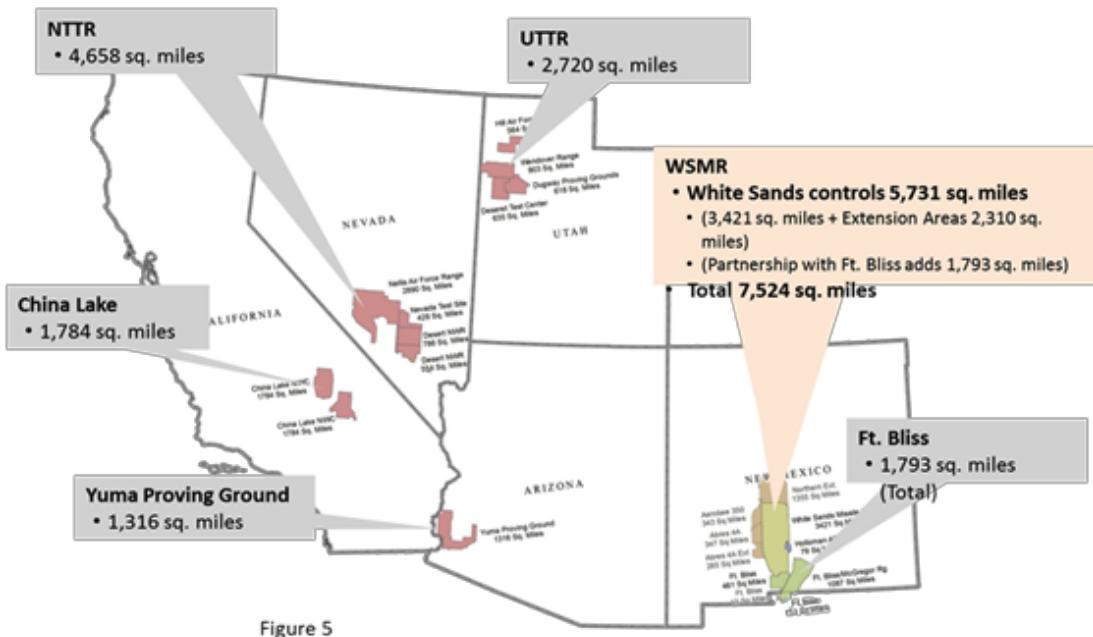
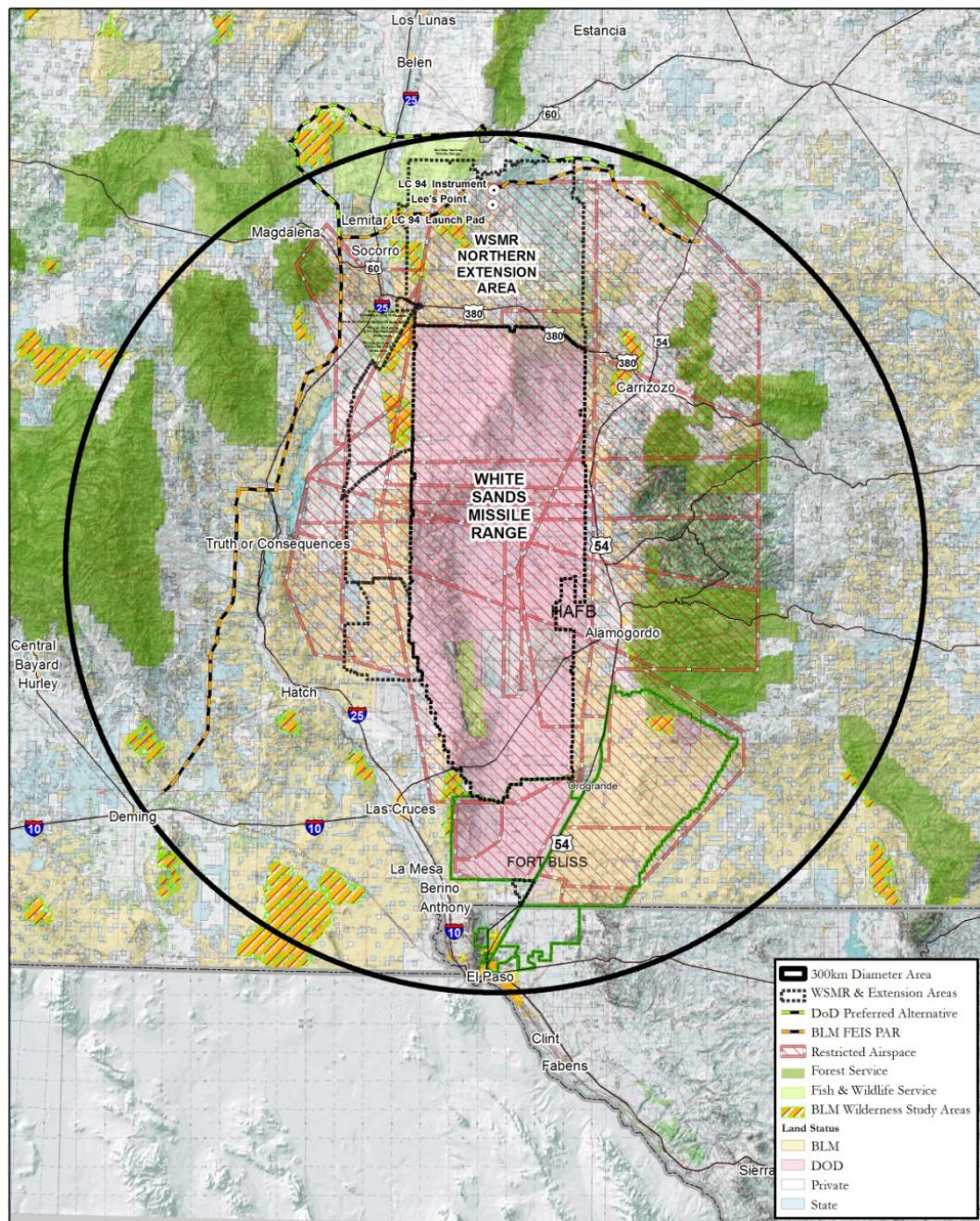


Figure 4. Relative Sizes of DOD Land Range Complexes

WSMR has the required terrain features (mountains, valleys, and plateaus) that provide a wide spectrum of threat conditions identified in the various system and program Test and Evaluation Master Plans (TEMPs). WSMR controls the airspace from surface to infinity over the NEA to accommodate hazardous operations required by DOD. In addition, the NEA is surrounded by Military Training Routes (MTRs) that have a floor of 100 feet above ground level (AGL). As Figure 4 clearly demonstrates, it is not just the size of the land space in terms of square miles, but also the long configuration of the range and call-up area that is critical to the ability of WSMR to accommodate test requirements. The additional airspace available in the NEA is routinely used to provide longer flight profiles when required to meet test requirements. Airspace and a low electromagnetic noise environment allow DOD to test weapon systems in development. No other location exists in the United States that can even minimally meet the JAMD Architecture test requirements identified earlier. Figure 5 provides an illustration of AIAMD's 300 km diameter requirement and illustrates how WSMR's airspace, land size, and surrounding MTRs are able to support air defense test requirements.



WHITE SANDS MISSILE RANGE

Sun Zia Routes - Northern Extension Area
July 2013

0 5 10 20
Miles
0 5 10 30
Kilometers



Produced by Team ASD for the Department of Defense
White Sands Missile Range, NM.
No warranty is made by the White Sands Missile Range as to the
accuracy, reliability, or completeness of these data for individual
use or for use with other data, or for purposes not intended
by WSMR. Specific information may be found in the map's
Map Accuracy Standards. This information may be updated without notice.

Figure 5. White Sands Missile Range

5. Mission Impact from the BLM FEIS PAR

In the NEA, the BLM PAR would result in numerous unacceptable mission impacts described below.

a. Low-Level Flyers

This category of test missions is characterized by the requirement to fly at low altitudes through NEA airspace. WSMR conducts tests with various manned and unmanned aerial targets. The main purpose of these tests is to present targets in realistic flight profiles for evaluation against developmental systems and programs. One objective of such test missions is for airborne and/or ground sensors to detect the threat targets and pass targeting information to the interceptor system to permit calculation of the remainder of the kill chain for engagement of the target. WSMR along with its NEA provides the required terrain and distances to support these test scenarios (engage on remote or, in some cases, line of sight engagement scenarios). In many test scenarios the kinematic performance of the missile requires the extra distance provided by the NEA to successfully complete the engagement sequence. The target detection through launch decision (Steps 3–13 of Figure 3) must be accomplished with the target in an operationally realistic threat profile (i.e., low-level flight profile) before the missile is committed. If a target has to fly up and over transmission lines, the test would be invalid because the target would not be operating in representative ground clutter. Another class of low-level flight tests in the NEA contains those used for airborne sensor development. It is critical to know the airborne radar's performance envelope, particularly the maximum detection range of targets at low altitude, also in a ground clutter environment. Figure 6 provides examples of continuing test activity in the NEA. This 35-mile distance extends from the western edge of WSMR's restricted airspace to the eastern boundary of the NEA (point A to point B).

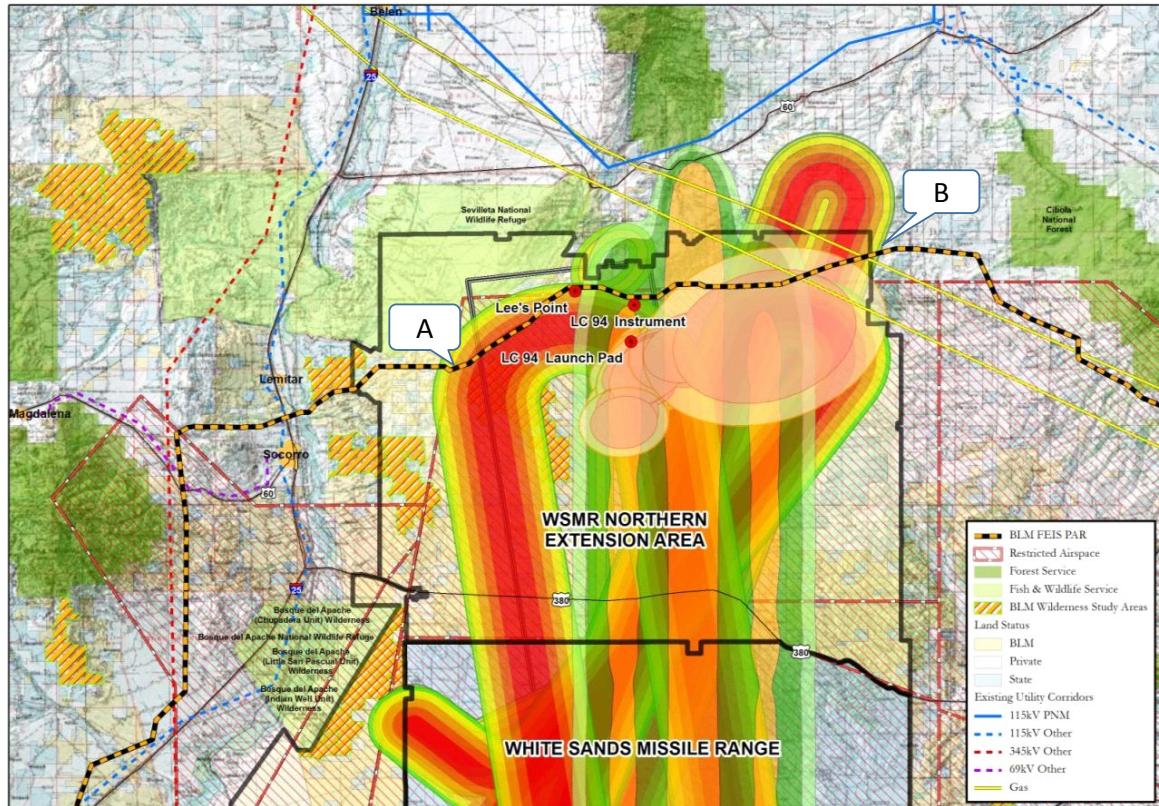


Figure 6. WSMR Missions and Debris Fields in the NEA

The most stressing and complex test missions involve multiple simultaneous engagement (MSE) of aerial targets in a single presentation. The low-level flight scenarios to support MSEs are shown in Figure 7. Flight profiles shown are near-term projected missions based on existing requirements. These types of profiles will demonstrate MSEs for the Joint Air Missile Defense architecture. This requirement alone mandates the 35-mile underground installation of the transmission line to ensure that incoming targets are in the proper alignment to the background clutter for a realistic presentation.

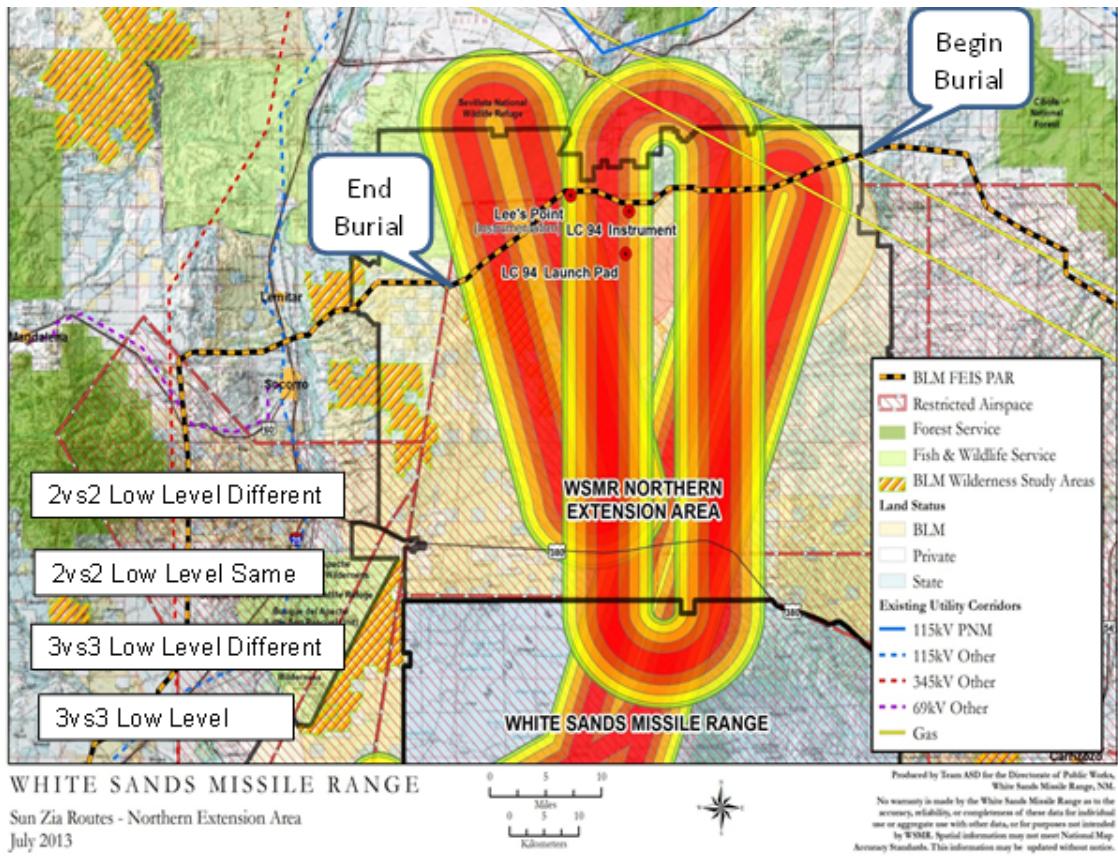


Figure 7. Projected MSE Scenarios in the NEA

b. Risk of Exposure Due to Debris Fields

There are two major considerations with overland ranges and containment of debris fields. The first is the requirement to protect people and property; the second is the requirement to retrieve test components so that test or failure data can be analyzed. The requirement to protect people and property is defined in WSMR Regulation WSMRR 385-17 derived from DOD Military Standard (MIL-STD-882D). For test events involving long weapon system trajectories and explosive warheads, safety envelopes are required to protect people and property from test debris. Determination of these safety envelopes is based on calculations of potential flight test vehicle impact points, as well as corresponding calculations for debris in event of inflight destruct. The NEA is used to launch missiles from Launch Complex 94 (see LC-94 on Figure 1 for location). These missiles are developmental, and launch and flight characteristics can be unpredictable. To protect public safety, risk is predicted using established DOD-wide range standards, and test events will only be conducted if risk can be mitigated through evacuation of people from within the NEA, or missile in-flight destruction, should unplanned flight path issues occur. In all cases, tests will not be conducted if there is a risk to people or property. The

NEA and western extension areas of WSMR are critical for the added buffer zones to conduct complex and hazardous tests. In addition, WSMR is permitted intermittent use of property at the Lee Ranch within the NEA for missile impacts, under the terms of an evacuation agreement dated January 1, 1996. This agreement designates 51 acres as the Lee Impact Area. The area is used to support Army ballistic missile testing and allows for missiles to be fired into it. If the transmission line is constructed along the BLM FEIS PAR it would be exposed to these hazardous operations. Figure 6 shows the recently conducted missions that would have exposed the transmission line to a debris field.

c. Electromagnetic Interference and Compatibility (EMI/EMC)

Introduction of the 500 kV overhead transmission lines in the NEA would raise the background noise level and create a heat signature that would be detected during infrared (IR) sensor testing. At present, there is very limited EMI interference within the NEA. The NEA has little to no infrastructure other than Highway 380, county dirt roads, and distribution-level power lines providing 240/120 volts to about 40 ranch homes/trailers. The area has a very low radio frequency (RF) noise background level. The EMI from 500 kV transmission lines situated immediately to the north of LC-94 test could create interference with target build-up, pre-mission checks, and launch test activities. Of particular concern are Flight Termination Systems, Hazards of Electromagnetic Radiation to Ordnance (HERO) issues, C-Band/Telemetry assets, local communication (radios, etc.), and communication with range control, since it is microwaved from Lee's Point.

d. Mission Impact Summary

The above-ground construction and introduction of the SunZia transmission line along the FEIS PAR places an obstruction in the path of low-level flyers, thus jeopardizing the effective conduct of testing.

Targets flying critical low-level profiles would have to “pop up” from those flight levels to avoid transmission lines. The FAA requires a 500 foot buffer above structures for safety considerations. Such a “pop up” would prematurely provide identification and targeting and thus disrupt and invalidate the test mission profile because of the change in the observed background clutter. The NIFC-CA testing is conducted at WSMR to meet the technical requirements of detecting, tracking and engaging low-flying targets in ground clutter and to address tactical test scenarios of intercepting threat representative targets in a ground clutter environment. Targets flying as high as 650 feet, even if only to “pop up” over the proposed SunZia transmission line, are not in ground clutter and therefore cannot replicate the test environment required.

- The above-ground construction and introduction of the FEIS PAR within the NEA would require a significant change in mission profiles that may lead to test cancellation in whole or in part. In compliance with Common Risk Criteria

Standards for National Test Ranges, debris from in-flight failures of test vehicles would create a risk of damage to the proposed SunZia power line. As discussed in Section C.5.c above, introduction of the FEIS PAR route in the NEA would raise the background electronic noise level and create an artificial heat signature that would be detected and negatively affect infrared (IR) sensor testing.

e. Mitigation Alternatives

This TWG report has documented DOD test requirements and the significant impacts from the FEIS PAR location within the NEA. Of the multiple mitigation alternatives studied, only two alternatives were identified as viable. They are (1) placement of the line underground for the 35 miles from where the FEIS PAR enters the eastern boundary of the NEA to the western boundary of the restricted airspace, or (2) relocation of the transmission line farther north without burial along the DOD PAR to minimize impact to WSMR test requirements. Figure 8 depicts the location for underground installation of the FEIS PAR and also the DOD recommended route. It should be noted that on December 2, 2010 the cooperating agencies formally requested that BLM conduct a detailed analysis of the DOD PAR. The DOD PAR, within the area of influence, is approximately 41 miles longer than the FEIS PAR but travels along existing right-of-ways and maximizes the use of disturbed land. The DOD PAR would transverse only 33 miles along undisturbed terrain, whereas the FEIS PAR would transverse 63 miles of undisturbed terrain. There is a strong potential that the DOD PAR would have less of an impact on the environmental and cultural resources than the FEIS PAR. DOD program test requirements would not be compromised if the transmission line is located along these northern existing right-of-ways and disturbed lands.

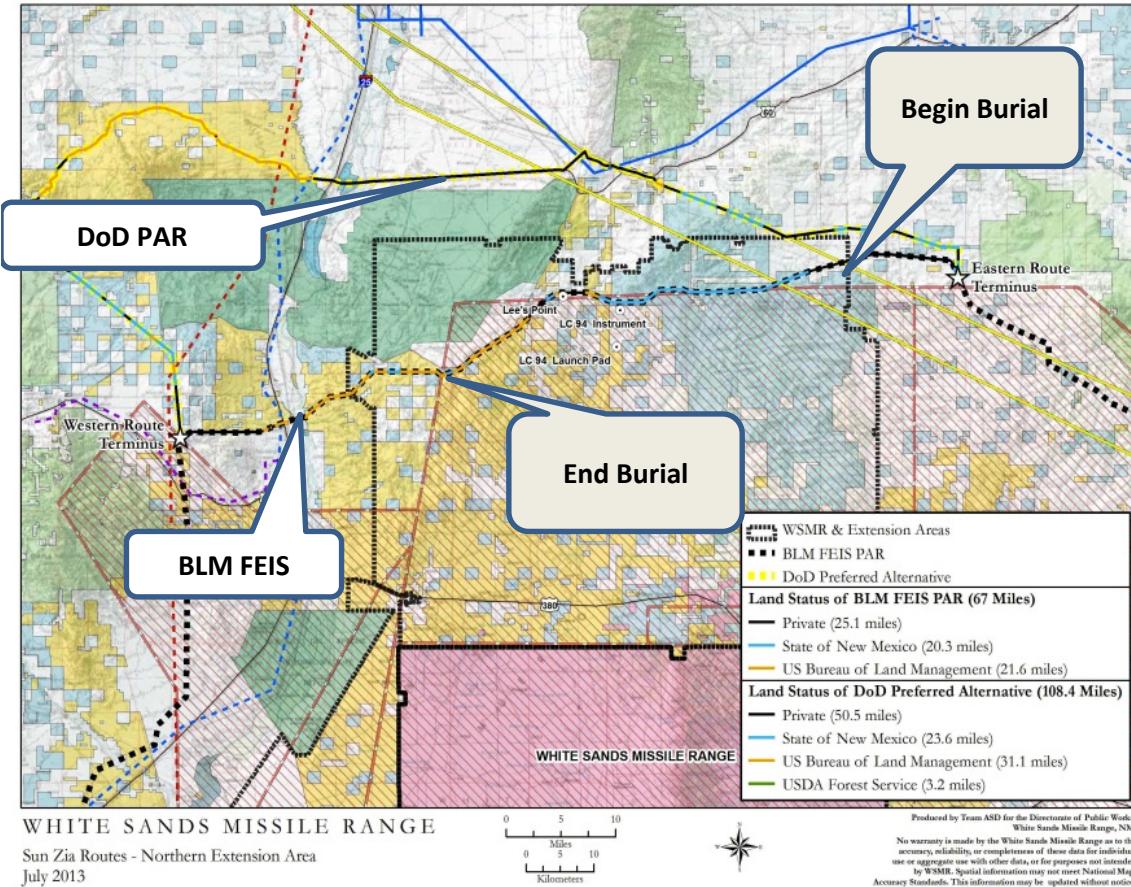


Figure 8. Area Identified for Underground Transmission Line Installation

D. Other Considerations

Two additional areas considered were (1) indemnification or hold harmless of the government for any claims for damage caused from the construction, operation or power disruption of the transmission line, and (2) factors that would be used in a Memorandum of Agreement (MOA) between DOD and the Applicant to allow for continuing DOD testing during line construction and operation.

1. “Hold Harmless and Indemnification” Clause for the Right-of-Way Agreement

a. Objective

A Hold Harmless Clause was developed for incorporation in any ROW Agreement that may be prepared in connection with the installation of bulk power electrical transmission lines by the Applicant.

b. Discussion

Development of such a Hold Harmless Clause is indicated in an amendment made to the FEIS before its release that reads as follows:

Alternative Transmission Technologies: undergrounding the entire length or portions of the Project is considered to be technically infeasible; however, the BLM, DOD, and the Applicant continue to review the feasibility of underground transmission systems and other possible measures to address potential impacts related to the construction and operation of the SunZia Project. Additional discussions relate to indemnification and operational procedures to respond to concerns identified by the WSMR. In the event that further discussions between the BLM, DOD, and the Applicant lead to additional information pertinent to the Project analysis, these issues would be addressed consistent with NEPA's requirements before the BLM issues a final decision.

Additionally, the use of a Hold Harmless Clause was cited in the Under Secretary for Acquisition, Technology and Logistics (USD(AT&L)) letter of March 19, 2013, to the Deputy Secretary of the Interior as one of four mandatory measures required to mitigate effects of the Applicant's transmission lines on DOD.

The TWG researched the existence of Hold Harmless Clauses previously originated by DOD Components. The best example found was one prepared by Vandenberg Air Force Base covering its activities and other Component uses of operating areas in Southern California and adjacent coastal waters. The Vandenberg Hold Harmless Clause was used as the starting point for development of the Hold Harmless Clause applicable to this instance.

DOD's objective in the Hold Harmless Clause is to fully protect the government in its use of WSMR and the NEA. While safety precautions will be implemented to the maximum degree possible, there is always a potential risk of unintended consequences associated with military testing. The risk should be small, but the adverse consequences if the risk materializes could be substantial. A Hold Harmless Clause is indicated where the proponent elects to place an important power transmission line in an area of known military hazards. The Clause addresses the following major points: surface and sub-surface bulk power transmission line installations; successors in interest to the Applicant; liability of the Applicant and any successor in interest for any losses due to Government operations at WSMR or in the NEA, including those lands not owned by the Government; and any consequential claims resulting from damage to the transmission lines resulting from Government operations.

c. The Hold Harmless Clause

The following Clause was developed by DOD Office of General Counsel with assistance from the Department of the Army (General Counsel).

The grantee, its successors and assigns, by accepting this right-of-way, agrees to hold the United States harmless and indemnify it, its officers, agents, representatives, and employees (in this clause “United States”) from any costs, damages both direct and indirect, claims, causes of action, penalties, fines, liabilities, and judgments of any kind or nature arising out of, or in connection with, damage to grantee’s property due to the acts or omissions of the United States in conducting training and testing activities on White Sands Missile Range and all of the Northern Call-up Area including any non-Federal lands within the Call-up Area. Without regard to whether compensation for any damages or injuries giving rise to such costs, damages both direct and indirect, claims, causes of action, penalties, fines, liabilities, and judgments of any kind or nature might be due under a theory of negligence, strict or absolute liability, or otherwise, the grantee assumes all risks of damage or injury to its property present in, on, or above White Sands Missile Range and all of the Northern Call-up Area including any non-Federal lands within the Call-up Area, if such injury or damage occurs by reason of the activities of the United States being conducted as a part of, or in connection with, the programs and activities of the White Sands Missile Range. Grantee assumes the risk whether such injury or damage is caused in whole or in part by any act or omission, regardless of negligence or fault, of the United States.

2. Procedures to Allow for Unimpeded Testing to Occur During Construction and Maintenance of the Line

Procedures consistent with other construction operations that have occurred in and around WSMR have been developed. These procedures cover pre-construction, construction, and post-construction phases of the project. Emergency access is also addressed. Factors such as the following will need to be incorporated into a Memorandum of Agreement (MOA) between DOD and the Applicant, prior to issuance of the ROW, to address scheduling of construction activities and coordination with WSMR:

- WSMR Contact Information: Contact WSMR Scheduling Office.
- Pre- and Post-Construction Phase: Notify WSMR Scheduling Office of all operations to include line configuration and mitigation techniques for unwanted frequency propagation.
- Scheduling Information Required During Construction Phase: First day of each month, for the following month, project all activities within the Northern Extension Area (aircraft, blasting cranes, and other type of construction equipment that will extend above 50 feet in the restricted airspace and above 100 feet outside of the restricted airspace in order to identify airspace needs). It should be noted that the Range Schedule is subject to change based on evolving customer requirements, weather, and other factors. This may impact access to

the area or late notification of access. In addition, the range test missions would have priority over any SunZia activities.

- WSMR Scheduling Office Actions: WSMR Scheduling Office will insert into the range schedule the construction activity. Each mission will be assigned a Mission Code for the day of the activity. The Scheduling Office will inform the proponent 14 days prior to any planned Evacuations of the Fix Area in support of missions.
- Scheduling Long Term Access to and along the transmission line Right-of-Way (ROW) and support structures (Non-Emergency): The proponent will schedule all activities with the WSMR Range Scheduling Office after the construction phase. For operational security, WSMR/DOD will require line configuration and time-stamped frequency data and potential access/monitoring of transmission lines/control system.
- Emergency Access: Emergency access to the Right-of-Way. The proponent will contact WSMR Range Control at 575-678-2221/2222 to inform them of the situation and urgency of access. Emergency entry for ambulance, fire, or police will not be delayed. Range Control will inform the proponent if hazardous operations are ongoing. Range control will coordinate with the proponent on when/where to enter.

E. Cost Considerations

The issue of cost is a significant consideration that was examined by the TWG. It is noted that the cost to bury a transmission line is greater than that of constructing and operating an equivalent overhead transmission line. Yet, this cost to the rate payers to construct and operate the transmission line underground across the NEA must be weighed against the loss of critical test capability and the adverse impact of such loss on national security.

The economic impact of the various routes on DOD should be carefully considered in future deliberations. Based on a cost factor of \$1 million per mile for above-ground and a 10 times cost factor for burial, a simple comparison of going the extra 42 miles required by DOD's preferred alternative versus burial within the extension area would be \$42 million for above-ground versus \$350 million for burial. In addition, the DOD would be required to recreate WSMR's unique capabilities at another location, the costs of acquiring the land, airspace, infrastructure, and instrumentation would be prohibitive. The land size of WSMR with its extension area is 5,731 square miles. At a conservative land acquisition cost of \$500/acre, the cost to purchase an equivalent amount of land in another location (if even available) would be \$1.83 billion.

In addition to the land acquisition cost, the cost of creating the technical test infrastructure would amount to additional hundreds of millions of dollars. For example, and as a point of reference, the program cost for comparable instrumentation at a major allied range is \$300–500 million. While test ranges exist overseas that might be considered, none of the test locations open to the United States replicates the unique geographic features available at WSMR. Further, overseas testing increases the cost to test because of the added cost of overseas transport of test vehicles and personnel. Testing sensitive US military capability at overseas locations also may not be an option for security reasons.

Therefore, when a comparison is made between the cost of burying the transmission line and the cost to replicate WSMR, primary consideration must be given to national security. This is especially true when one considers that other potential transmission line routes exist to support the transport of clean energy from central New Mexico to the West. The TWG concludes that while the cost to bury the line is expensive, it would be more expensive to the nation to lose critical weapon system testing capability at WSMR. Additionally, less costly alternatives do exist if more northerly routes are re-considered by the FEIS authors.

F. Conclusion

The test requirements identified in this report are critical for evaluating the performance characteristics of critical DOD programs and systems. These tests must be conducted to assess system performance, ensure our military operators are not needlessly put at risk, and ensure our national security is protected. In many cases, the only location to conduct these tests is at WSMR. The test profiles cannot be adjusted to accommodate the FEIS PAR and still achieve the required performance data as they require all of the NEA land and even surrounding airspace within the currently FAA-approved MTRs. Locating the proposed transmission line in the FEIS PAR location will preclude the conduct of these critical tests. The only viable mitigation alternatives are to either bury the transmission lines for 35 miles within the WSMR NEA or move the lines farther north as identified by the DOD PAR. The DOD PAR is located along existing right-of-ways that are already accounted for in long-range mission activities conducted by WSMR.

The TWG has identified irrefutable facts that the construction of a segment of the transmission line underground is technically feasible. It has shown that undergrounding the line along the FEIS PAR or rerouting it to the north are both far less costly alternative courses of action than replicating WSMR at another location to preserve critical national security test capability, even if such a replication was feasible. The TWG recognizes that additional costs and significant time will be required to complete the project.

Appendix A. **Results of Literature Search**

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Appendix B. Illustrations

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Appendix D. Abbreviations

| | |
|-------|--|
| AC | Alternating Current |
| AFB | Air Force Base |
| AGL | Above Ground Level |
| AIAMD | Army Integrated Air and Missile Defense |
| ASCM | Air-to-Surface Cruise Missile |
| ATACM | Army Tactical Missile |
| BLM | Bureau of Land Management |
| BRAC | Base Realignment and Closure |
| C2 | Command and Control |
| CCI | Cable Consulting International |
| CIGRE | Conseil International des Grands Réseaux Électriques |
| DC | Direct Current |
| DOD | Department of Defense |
| DOI | Department of the Interior |
| DOT&E | Director, Operational Test and Evaluation |
| EIS | Environmental Impact Statement |
| EMC | Electromagnetic Compatibility |
| EMI | Electromagnetic Interference |
| FAA | Federal Aviation Administration |
| FEIS | Final Environmental Impact Statement |
| FERC | Federal Energy Regulatory Commission |
| GE | General Electric |
| HERO | Hazards of Electromagnetic Radiation to Ordnance |
| HV | High-Voltage |
| HVAC | High-Voltage Alternating Current |
| HVDC | High-Voltage Direct Current |
| IAMD | Integrated Air and Missile Defense |
| IR | Infrared |
| JAMD | Joint Air and Missile Defense |
| JASSM | Joint Air-to-Surface Standoff Missile |

| | |
|-----------|--|
| JIIM | Joint, Interagency, Intergovernmental and Multinational |
| km | Kilometer |
| kV | Kilovolt |
| kVAC | Kilovolt Alternating Current |
| kVDC | Kilovolt Direct Current |
| LACM | Land Attack Cruise Missile |
| LC | Launch Complex |
| LUP | Land Use Plan |
| MDA | Missile Defense Agency |
| MOA | Memorandum of Agreement |
| MRTFB | Major Range and Test Facility Base |
| MSE | Multiple Simultaneous Engagements |
| MTR | Military Training Route |
| MW | Megawatts |
| NEA | Northern Extension Area |
| NEPA | National Environmental Policy Act |
| NIFC-CA | Naval Integrated Fire Control-Counter Air |
| NTTR | Nevada Test and Training Range |
| OV | Operational View |
| P2 | Pershing Missile System |
| PAR | Preferred Alternative Route |
| RF | Radio Frequency |
| RMP | Resource Management Plan |
| ROW | Right-of-Way |
| SA | Situational Awareness |
| SoS | System of Systems |
| T&E | Test and Evaluation |
| TBM | Tactical Ballistic Missile |
| TEMP | Test and Evaluation Master Plan |
| THAAD | Terminal High Altitude Area Defense |
| TM | Telemetry |
| TWG | Technical Working Group |
| USD(AT&L) | Under Secretary of Defense for Acquisition, Technology and Logistics |
| WSMR | White Sands Missile Range |
| XLPE | Cross-linked Polyethylene |

