Feasibility Study for Paragon-Bisti Solar Ranch
on the Navajo Nation in New Mexico
DE-FOA-0000424, CFDA Number: 81.087
Feasibility Study

for Paragon-Bisti Solar Ranch

U.S. Department of Energy

Tribal Energy Program, Golden, Colorado

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June 2015
EXECUTIVE SUMMARY

DESCRIPTION OF PROPOSED PROJECT AND ORGANIZATION OF FEASIBILITY STUDY

The Navajo Hopi Land Commission Office (NHLCO) and Navajo Nation (NN) plan to develop renewable energy (RE) projects on the Paragon-Bisti Ranch (PBR) lands, set aside under the Navajo Hopi Land Settlement Act (NHLSA) for the benefit of Relocatees. This feasibility study (FS), which was funded under a grant from DOE’s Tribal Energy Program (TEP), was prepared in order to explore the development of the 22,000-acre PBR in northwestern New Mexico for solar energy facilities. Topics covered include:

- Site Selection
- Analysis of RE, and a Preliminary Design
- Transmission, Interconnection Concerns and Export Markets
- Financial and Economic Analysis
- Environmental Study
- Socioeconomic and Cultural Factors
- Next Steps.

SITE SELECTION AND RENEWABLE ENERGY TECHNOLOGIES

Site-specific Renewable Resource Assessment. The area assessed consisted principally of lands controlled by the NHLCO as well as a few sections controlled by the Eastern Land Commission, all inside the boundary or vicinity of the PBR. The PBR enjoys ample sunshine, over 7 thermal kilowatt-hours (kWh). In addition, a deep hot geothermal zone underlays the entire PBR and there are surface manifestations of some shallower hydrothermal resource. The groundwater aquifer under the PBR is said to be capable of producing up to 25,000 acre-feet of warm brine per year. The PBR has little reliable wind energy, and virtually no biomass. In this Feasibility Study, four basic forms of RE (solar, geothermal, wind, and biomass), in various types of each, were assessed over the entire PBR study area. After visiting the lands and screening with GIS tools, approximately 10,000 acres of the 22,000 acres were selected for development, and the selected portion of the PBR subdivided into five sites. According to the preliminary design herein, these sites could provide 2.1 billion watts (gigawatts, or GW) of peak power.

Technology Analysis. Solar and geothermal power generating technologies were then screened for five sites. Only photovoltaic (PV) is technically and economically viable for a utility-scale project on the PBR. Fixed flat-plate PV tilted to summertime bias was selected for all five sites.

Preliminary System Design(s). Preliminary designs for five solar ranches have been created. See Figure ES-2 for one example. Each ranch is built up from self-sufficient 1.4-MW & 2.8-MW power blocks.

Long-term O&M Planning. A fully built-out PBR would contain about 9 million PV panels occupying 200 million square feet of glass. Monitoring the performance of solar arrays and making system repairs are operations and maintenance (O&M) functions, critical for assuring peak performance and power output. These activities can last from 25-40 years. Depending on the size of the plant, monitoring may be performed by onsite staff or may be performed with automation, summoning help if a fault is detected or some other problem occurs. Although the O&M charge for a utility-scale photovoltaic facility amounts to a mere 0.9¢/kWh, the sheer scale of the PBR magnifies the O&M task. 0.9¢/kWh translates to about one (1) full-time-equivalent (FTE) for every 3 to 6 MW of PV generating capacity, or about 15-30 FTEs per 100-megawatt (MW) ranch.
Figure ES-1. Topographic Map Depicting Five Sites Suitable for Solar Development

Source: Tetra Tech. Note: The Bisti substation (square red-filled icon) is in the upper left. Red fill (Site 1 only) denotes non-Settlement Act, but still Navajo Trust land. Green fill denotes developable land remaining after initial screening.

Figure ES-2. Preliminary Design for a Site 1 Solar Ranch Adjoining the Bisti Substation.

Source: Tetra Tech
TRANSMISSION & INTER-CONNECTION

Export Markets and Transmission, and Inter-connection Considerations. Potential export markets were evaluated, and 15 utilities and possible off-takers with an RE component in their portfolio were interviewed. The dominant utility in this market is Public Service Company of New Mexico (PNM), whom the team met in September 2014. In order to sell power, three conditions must exist: (1) available transmission capacity, (2) a utility with an RE need, and (3) an agreement from an off-taker to buy that electricity through a Power Purchase Agreement (PPA). PNM controls the five major power transmission lines around the PBR and follows a formal process for interconnection. PNM also has goals for using RE and often conducts competitive calls for RE. Potential offtakers expressed price sensitivity as a major concern. In this market, solar energy must compete with cheap hydropower, coal, and natural gas. Assuming a PPA is signed, one positive aspect is that it would be for a very long term, 25 years plus. Possible agencies with a RE need that may be open to a PPA include: PNM, Farmington Electric Utility System, Navajo Tribal Utility Authority (NTUA), and Tri-State Generation & Transmission Association. One significant challenge is that several utilities (including PNM) satisfy their obligations under New Mexico’s Renewable Portfolio Standard (RPS) exclusively with customer-owned rooftop PV. One possible approach for the NN RE program is to start modestly at Site 1, develop a solar offering in the 50- to 100-MW range that can be absorbed by the existing transmission system yet generate revenue, then let success breed success.

ECONOMIC ANALYSIS

Tetra Tech developed an economic model to evaluate a nominal 100-MW solar ranch on the PBR from the viewpoint of an owner/investor. Bottom Line Up Front: If a PV ranch was constructed for no more than $1.60 per DC-watt, was financed via a 20-year loan (debt) @ 5% with 20% down (investor equity), took full advantage of every federal incentive that now exists, and sold electricity under a long-term PPA for about $75 per megawatt-hour (MWh) pegged to the Producer Price Index (PPI), then this plant would earn for its owners a decent after-tax return of 6% or so. Income for the NN from both land lease fees and normal royalties on production is allowed for in this scenario. Not having to pay income taxes would either increase the return considerably (by +33%) or allow room for cost growth. Based on interviews with major RE developers, sensitivity analysis showed the four most dominant parameters are: (1) price for electricity, (2) cost of money, (3) capital expense (CapEx) in dollars per DC-watt, not AC, and (4) debt-to-equity (D:E) ratio. A $2.50 per watt PV project cannot work today, since that requires a wholesale price of $100/MWh, which has not been seen on the West Coast for several years. The $45-55/MWh PPAs that have been mooted to the NN are not acceptable either, since a dollar-per-watt CapEx is not credible yet.

ENVIRONMENTAL STUDY

An environmental study was conducted for the 22,000-acre PBR, evaluating its potential as a solar ranch. The study was conducted at a “desktop” level using relevant literature, previous studies, databases, aerial imagery, and other resources already in print or published on the internet. Personal observations of ground conditions and general characteristics of the PBR during site reconnaissance were also gathered, together with interviews of staff from the NNEPA and other agencies to refine and enhance the environmental study. Select topics are explored with more focus, zeroing in on critical issue areas and highlighting their main elements along with important items pertaining to permitting of the project and recommended actions. The topics are: biological resources; historic and cultural resources; geology and soils/mineral resources; water resources; land use/planning; and visual, scenic, or aesthetic resources. No major areas of concern were identified in the investigation to date. Field work is required, based on the specific site boundaries, for Cultural Resources/Archaeological/Paleontological/Historical, in order to ensure avoidance of sensitive tribal lands (e.g., grave sites/sacred sites); and biological resources - vegetation and wildlife, to reduce potential impacts. Results of the cultural and biological resources field work will be considered in the design phase, along with hydrology and flood potential; high susceptibility of PBR soils to erosion; suitability of available onsite water supply for solar panel washing; visibility and effect on visual resources;
and land use, ensuring compatibility of RE facilities with the traditional Navajo lifestyle and future. A detailed matrix identifying six major permits for the project has been prepared. The timeline to obtain environmental permits and approvals/decisions for the first solar ranch is estimated to span 9-12 months.

**Preliminary Projection of Reduction in Fossil Fuel Usage.** New Mexico’s electricity sector is one of the most coal-intensive in the country, with a signature over 1.2 kg of greenhouse gas (GHG) per kWh delivered. Site 1 by itself (290 MW, see Figure ES-2) which should produce 12-20 million MWh over its 25- to 40-year life, would avoid 7 to 24 megatons of GHG emission. If fully built out, the entire Paragon Project (2,100 MW) should generate 90 to 144 million MWh over its working life, which should avoid the emission of 52 to 176 megatons of GHGs. This in turn would displace the mining and burning of 14 to 48 million metric tonnes of fossil fuel (oil or coal), which would fill a train about 3,000-10,000 miles long.

**SOCIAL ECONOMIC FACTORS**

Ramifications of a commercial scale project of this magnitude are vast and extend beyond the Relocatees to include the entire Navajo Nation. RE development of the PBR would provide many positive impacts and could serve as a model for all tribal nations. The two most significant benefits from this program are the potential for many new jobs in diverse disciplines and technical skill areas, and the income derived from the sale of green power from this inexhaustible energy source. Short term jobs during the 1- to 3-year construction phase could employ 1,000 workers for each 100-MW photovoltaic power plant. Long-term jobs during the O&M phase could employ 15-30 personnel for 25 years, or more. Annual wages could well exceed $1 million for each 100-MW plant. Technical training to compete for these new jobs will be essential. Fortunately, at least four colleges and technical schools in the vicinity of the PBR offer related technical training and are available to fill this need. Many local colleges are also willing to work with a developer to help craft an academic program to meet their specific needs in the areas of planning, management, short-term construction, and long-term O&M of a solar ranch. The program has been presented to, and gained the support of, the highest level of the Navajo Nation, including the past president, committees, chapters and councils. However, the recent change in leadership at many levels of the NN government such as the President of the NN, as well as the executive director of the NHLCO in May of 2015, requires that this education and outreach be repeated.

**STEPS FOR DEVELOPING A RENEWABLE ENERGY PROGRAM**

Three phases of six-phase PBR RE program have been completed. The first three phases provide a roadmap and next steps leading to project execution and power generation. This FS provides a substantial foundation for launching the project into those next phases including: preconstruction, construction and long term operation & maintenance of the solar facility. Several potential barriers must be addressed. One of the most critical is regaining the tribal momentum necessary to move ahead. Key to this is a tribal decision to either (1) engage a developer and offer the land under a leasing agreement, or (2) own the project and develop the site. Given there are five sites, a combination of land lease and tribal ownership could work.

Assuming a developer is selected, a successful large scale solar project such as this must seek to reduce the risk for the development team, while at the same time providing the Navajo Nation with assurance that the project will be completed and produce at expected levels of power. Thorough planning and management must be applied to ensure this outcome. It is suggested that the NHLCO establish a formal organization to accomplish these management and planning tasks in an efficient manner.

Several sources of funding exist to sponsor the program moving into the next phase, including grants from: DOE, US Department of the Interior (DOI) and from a private developer. At this point, the federal sources of funding can require cost matching between the Navajo Nation and federal agency. The NHLCO has also opened discussion with several developers, who have provided positive feedback, demonstrating a recognition of the project’s potential profile, value, and anticipated support in the solar community.
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