Navajo Hopi Land Commission Office of the Navajo Nation Navajo Hopi Land Commission Renewable Energy Development Project (NREP)

Introduction

This report summarizes the primary activities undertaken by the Navajo Hopi Land Commission Office ("NHLCO") with respect to Navajo Hopi Land Commission Renewable Energy Project ("NREP"). The product of this report is the work performed within the larger scope of a grant provided by the U.S. Department of Energy to support NREP.

The consultants contracted support project and office staff capacity to conduct design, planning, outreach, communication and implementation; support management and reporting activities, as directed: assist project director, office director and consulting team coordinator conduct task and subtask as directed.

Tasks accomplished during the first year of the NREP. Each Task is subdivided into SUBTASKS.

Task 1 Initiate Development of Large-scale Renewable Project

Task 2 Conduct Education and Outreach activities and coordinate activities with Navajo stakeholders and Non-Navajo stakeholders

Task 3 Develop institutional capacity for Navajo Nation to conduct large-scale renewable Development

Task 4 Develop Navajo Nation capacity to be a renewable energy development innovator

Task 5 Project Management and Reporting

A. PROJECT OBJECTIVES

The Navajo Hopi Land Commission Office (NHLCO), a Navajo Nation executive branch agency has conducted activities to determine capacity-building, institution-building, outreach and management activities to initiate the development of large-scale renewable energy -100 megawatt (MW) or larger -generating projects on land in Northwestern New Mexico in the first year of a multi-year program.

The Navajo Hopi Land Commission Renewable Energy Development Project (NREP) is a one year program that will develop and market a strategic business plan; form multi-agency and public-private project partnerships; compile site-specific solar, wind and infrastructure data; and develop and use project communication and marketing tools to support outreach efforts targeting the public, vendors, investors and government audiences.

The project is the first phase of a 3 -5 year program to construct and operate renewable energy generating facilities, using wind, concentrating *solar* and other renewable energy technologies.

This project will be the first large-scale -100 MW or larger -renewable energy generating project in Indian Country, in New Mexico; and the Southwest and would demonstrate:

1) The viability of *large-scale* renewable energy technology to replace coal-fired power stations as energy sources in the Southwest US

2) The viability of a Native American tribe to collaborate with industry and government partners on a large-scale renewable energy project.

B. PROJECT SCOPE

The Navajo Nation recognizes that the sunny, gently-sloping mesas of the Navajo Nation's land in Northwestern New Mexico have strong potential for development of renewable energy generating facilities, as identified on National Renewable Energy Laboratory maps of the region. Recognizing this resource, The NHLCO, a Navajo Nation executive branch agency, seeks to develop large-scale renewable energy -100 megawatt (MW) or larger -generating capacity on some of that land. The NHLCO is the Navajo Nation entity responsible for development of more than 22,500+ acres in the Paragon-Bisti Ranch area located east of NM Highway 371 about half-way between Farmington and Crownpoint. The Navajo Nation is likely to acquire another 12,500 acres contiguous to those lands following resolution of mineral rights issues.

The NHLCO conducted activities to determine and perform capacity-building, institution-building, outreach and management activities to initiate the development of large-scale renewable energy - 100 megawatt (MW) or larger -generating projects on land in Northwestern New Mexico in the first year of a multi-year program.

Project tasks for the first year of this project are: Initiate Development of Large-scale Renewable Project Conduct education and outreach activities and coordinate activities with Navajo stakeholders and non-Navajo stakeholders Develop institutional capacity for Navajo Nation to conduct large-scale renewable development Develop Navajo Nation capacity to be a renewable energy development innovator Complete Project management and reporting activities

NREP is anticipating involving large scale concentrating solar facilities as well as other solar and/or wind facilities.

C. TASKS PERFORMED

The outline below identifies TASKS accomplished during the first year of the NREP.
Each TASK is subdivided into SUBTASKS.

Task 1 Initiate Development of Large-scale Renewable Project

Task 2 Conduct Education and Outreach activities and coordinate activities with Navajo stakeholders and Non-Navajo stakeholders

Task 3 Develop institutional capacity for Navajo Nation to conduct large-scale renewable development

Task 4 Develop Navajo Nation capacity to be a renewable energy development innovator

Task 5 Project Management and Reporting

TASK 1 -Initiate Development of Large-scale Renewable Project

The NREP team has begun developing and conducting a program to support and facilitate development of large scale renewable energy facilities in the Paragon-Bisti area of the Navajo Nation in New Mexico. Tasks to support the overall objective have been conducted by project staff and consultant team. These activities support the Navajo Nation capacity to plan, invest in, manage and generate income from long-term renewable energy projects.

SUBTASKS

1. a. Active communication has been maintained with solar and wind development firms interested in projects in the Paragon-Bisti area. The Navajo Nation currently maintains an active dialogue with a suite of solar and wind development companies. The Navajo Nation had signed two Memoranda of Understanding with the companies to pursue large-scale renewable energy facilities in the Paragon-Bisti area. These two MOUs were canceled or allowed to expire without renewal by the Navajo Nation. After performing due diligence on the two developers, it was decided that these two developers were not a good match for doing business with the Navajo Nation as renewable energy development partners. One developer did not have the experience in delivering a large-scale renewable energy projects and the other developer did not have experience in doing business with a tribal nation and was uncomfortable with not having complete control of the project site, as a majority partner. The scope of this dialogue has expanded significantly during the project.

1.b Develop, conduct and evaluate site investigation plan. This was done by TetraTech EC, Inc. and Blue Hawk Design and presented to the Navajo Hopi Land Commission Office in November 2010. This plan was titled "Development of 2,000 MW Solar Project on Navajo Lands – The Paragon Plan". The plan document of 33 pages and over 11,000 words with maps and tables makes for a very detailed and comprehensive plan for the Navajo Nation to follow.

Identify criteria for emergency environmental and cultural clearance to allow site investigation. The Navajo Nation Office of Natural Resources and local NEPA office are to coordinate their efforts for timely response for emergency environmental and cultural clearances for site investigation.

The Navajo Nation and their consultants are available and plan to assist the responsible agencies conducting emergency clearance-required studies, when and where applicable.

The Navajo Nation and their consultants support preparation and submittal of clearance requests.

There has been instituted the development of a strong resource database for the Bisti-Paragon area which shall improve the Navajo Nation's capacity to develop and manage the Bisti-Paragon solar resource areas.

1.c. The Navajo Nation and their consultants have identified and established management strategies for essential infrastructure rights.

Valuation of renewable resources is established by the Navajo Nation Office of Natural Resources and in consultation with the Energy Advisory Committee and the Navajo Nation Council.

Identify key infrastructure needs -Transmission, water, rights of way, etc. Western Area Power Association (WAPA) consultants did a Transmission and Distribution study on the Paragon-Bisti Ranch area in May 2010 that was helpful in developing the Paragon Plan in November 2010.

The Navajo Nation and their consultants understand the importance of coordinating development of infrastructure agreements with development partners. This coordinating of agreements with development partners will be done at the proper time by the Navajo Nation. All parties understand the importance of coordinating development of infrastructure agreements with development partners and have a procedure in place to accomplish this activity.

The determination of the value of solar resources in the region and the identification and acquisition of land use, water use, transmission and other rights are necessary for project development. This is information is defined in detail in the "Development of 2,000 MW Solar Project on Navajo Lands – The Paragon Plan".

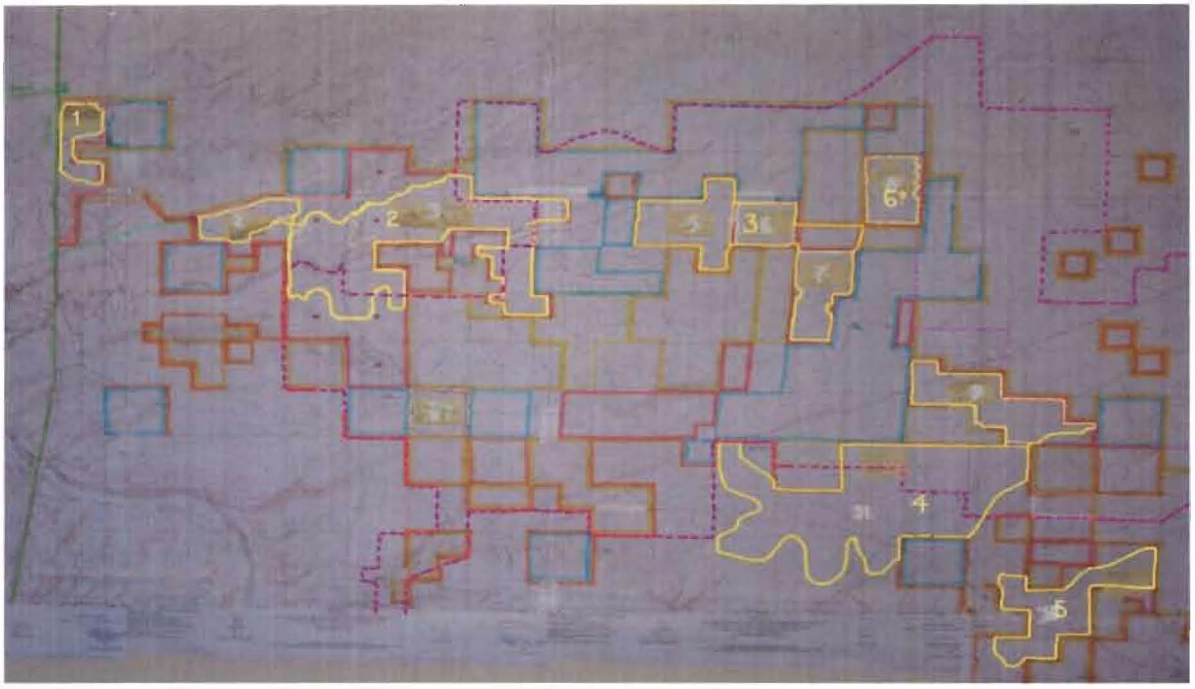
1.d. The plan called, "Development of 2,000 MW Solar Project on Navajo Lands – The Paragon Plan" accomplishes the requirement to develop and distribute working master plan for Bisti-Paragon site.

The plan called, "Development of 2,000 MW Solar Project on Navajo Lands – The Paragon Plan" accomplishes the requirement to compile available baseline information for base map/ identification of environmental setting and base map development. More information will be added to these base maps as it becomes available, and environmental clearances are completed.

The map below identifies locations of proposed renewable projects, infrastructure elements, interests of key stakeholders. The new Navajo Nation Renewable Energy Center is part of Navajo Tribal Utility Authority and at present, the NNREC is in the new NTUA LEED certified building in Window Rock, AZ. There is planning for a Navajo Nation Renewable Energy Center on site at Paragon-Bisti Ranch.

Six Sites for Development

Approximate boundaries of six tracks planned for solar development



The development of site-wide conceptual plans for the Paragon-Bisti sites, are essential to development of specific renewable energy projects. These site-wide conceptual plans communicate development plans to Navajo and Non-Navajo audiences.

1.e. Consulting team has worked with the Navajo Hopi Land Commission Office on developing economic projections for large-scale project.

Consulting team has worked with the Navajo Hopi Land Commission Office on developing operating financial projections.

Consulting team has worked with the Navajo Hopi Land Commission Office on developing transaction, financing and ownership analyses.

Financial projections are being developed to support Navajo Nation determinations regarding participation in, investment in, and management of renewable energy projects. This activity is on-going until contracts are ready for execution.

TASK 2 -Conduct education and outreach activities and coordinate activities with Navajo stakeholders and non-Navajo stakeholders

Sustained communication with Navajo Nation organizations with an interest in renewable energy development at the tribal and grass roots level are essential to development of the project. There

are five Navajo Chapters that surround the project site requiring regular information up-date session and inclusion in the project plans for employment and training opportunities.

Similarly, Non-Navajo governmental agencies and interest groups play a significant role in decision-making regarding the scope and timing of renewable development in the Paragon-Bisti area. The interest group, Sierra Club – Grand Canyon Chapter has been following this planned renewable energy project as an alternative to more coal produced energy generation in northwest New Mexico. Sierra Club favors renewable energy development in this area to improve the overall air quality by not using more coal fired energy production.

SUBTASKS

2.a. PowerPoint presentations have been prepared and presented to support education and outreach efforts at Council meetings, chapter meetings and at tribal energy review workshops.

The identified audiences and media for education and outreach materials are all Navajo Nation chapters, DoE Tribal Energy Review Workshops, tribal training / tribal education facilities, Energy Advisory Committee to the Navajo Administration and the Council, the Office of Natural Resources and the Navajo Tribal Utility Authority.

Consulting team has worked with the Navajo Hopi Land Commission Office on developing written, visual and audio materials for presentations.

Consulting team has worked with the Navajo Hopi Land Commission Office on presenting and distributing education and outreach materials.

Consulting team has worked with the Navajo Hopi Land Commission Office on developing follow-up activities after presentations and outreach efforts with stakeholders.

Consulting team has worked with the Navajo Hopi Land Commission Office on development of communication materials for local, government and technical audiences who provide tools for education and outreach efforts.

2.b. Consulting team has worked with the Navajo Hopi Land Commission Office on identifying and establishing working relationships with Navajo Stakeholders.

Consulting team has worked with the Navajo Hopi Land Commission Office on identifying the range of Eastern Agency, Navajo Nation, and Chapter contacts.

Held meetings with stakeholders and scheduled education and outreach activities with constituents. These activities will be on going as the project progresses towards completion.

Most communication efforts are focus on Navajo Nation tribal entities, especially those in the Eastern Navajo Agency where the Paragon-Bisti area is located and agencies and individuals with interest in renewable energy development.

2.c. Consulting team has worked with the Navajo Hopi Land Commission Office on identifying and establishing work relationships with non-Navajo Nation Stakeholders:

Federal – Department of Energy, Department of Agriculture, Rural Utility Service, Bureau of Indian Affairs, NREL, Sandia Lab in New Mexico

State of New Mexico – Governor's Office

Local Government- Navajo Nation Council, five chapters that surround the project site, other chapters interested in RE development, i.e. Black Mesa Chapter and Gray Mountain residents.

Non-Governmental Organizations – WAPA, NTUA (tribal utility company), Sierra Club, PNM (New Mexico utility / power authority)

Communication with non-Navajo governmental agencies and non-Navajo are necessary to build support for the project and address potential obstacles to successful development.

TASK 3 -Develop institutional capacity for Navajo Nation to conduct large-scale renewable development

Developing and applying organizational models for the Navajo Renewable Project, including a corporate framework, investment models, and Navajo National accountability, will be critical to the successful development of the project as an income producing venture for the Navajo Nation as a whole and the relocatees and other relocation-affected Navajo communities designated by law as beneficiaries of development of the Bisti-Paragon lands.

SUBTASKS

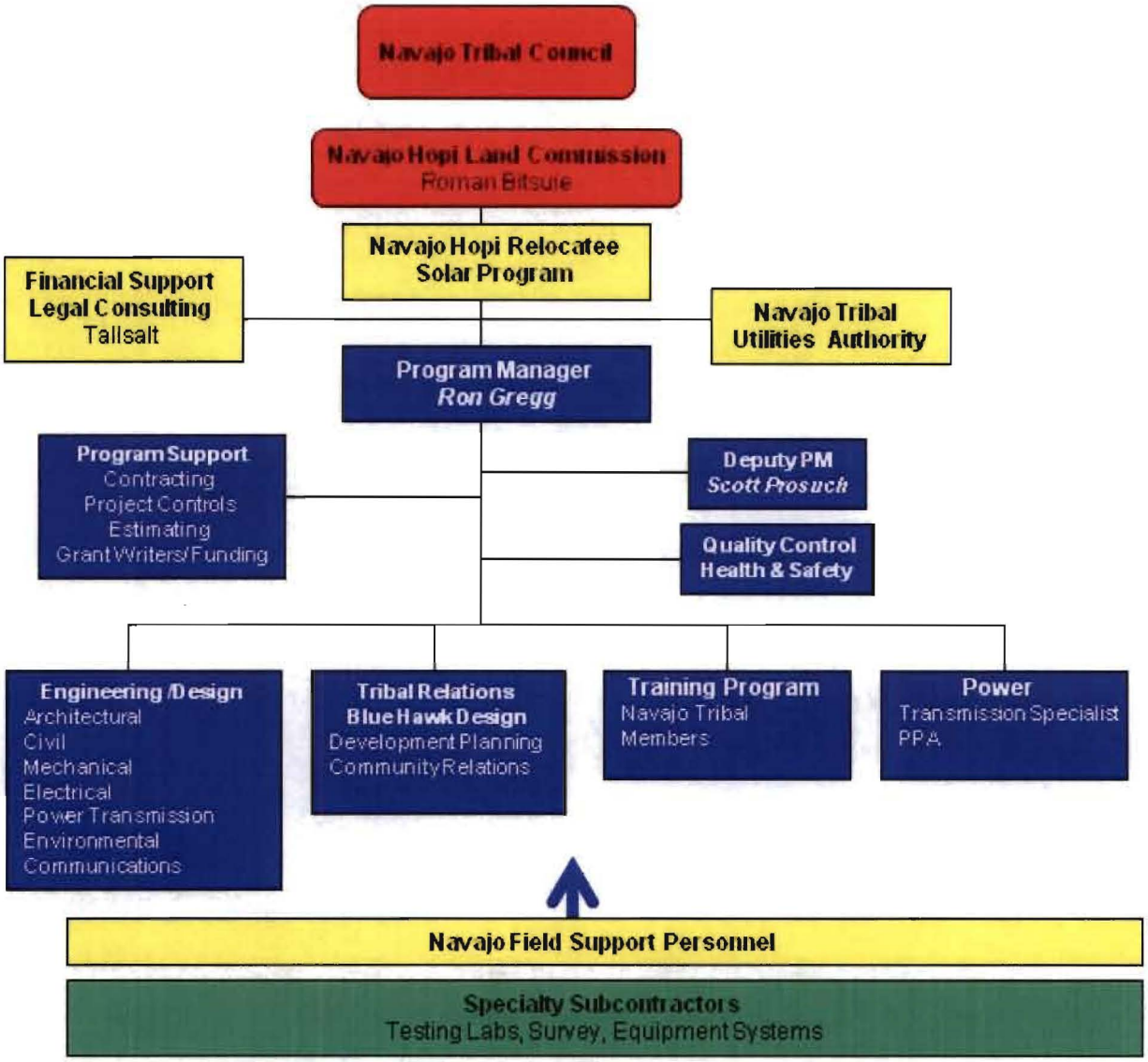
3.a. Consulting team has worked with the Navajo Hopi Land Commission Office on identifying and using appropriate institutional model. More effort will be spent in this area in the next phase of this project.

Identify institutional models (this is presently being developed with consultants and the Energy Advisory Committee to the Administration and the Council).

Evaluate institutional models (this is presently being done and on-going with consultants and the Energy Advisory Committee to the Council).

Apply appropriate institutional models (this will be done and once models are determined)

Insuring that project has a sustainable corporate structure and clearly defined accountability to Navajo Nation organizations will strengthen the project. (See the chart below.)



3.b. Consulting team has worked with the Navajo Hopi Land Commission Office on exploring opportunities for Navajo Nation to increase ownership in Project.

Consulting team has worked with the Navajo Hopi Land Commission Office to identify opportunities for Navajo Nation to increase ownership in Project.

Consulting team has worked with the Navajo Hopi Land Commission Office on evaluating opportunities for Navajo Nation to increase ownership in Project.

Consulting team has worked with the Navajo Hopi Land Commission Office on applying institutional models that allows Navajo Nation to increase ownership in Project.

Consulting team has worked with the Navajo Hopi Land Commission Office on developing a Project management model that builds wealth for the Navajo Nation and insures Navajo ownership is a strong interest of Navajo tribal leadership.

3.c. Consulting team has worked with the Navajo Hopi Land Commission Office on developing institutional model that provide benefits for Navajo relocatees per PL 96-305.

Consulting team has worked with the Navajo Hopi Land Commission Office to identify models for Relocatee Benefit Trust Fund including Navajo Rehabilitation Trust Fund.

Consulting team has worked with the Navajo Hopi Land Commission Office on evaluating models.

Consulting team has worked with the Navajo Hopi Land Commission Office on selecting and instituting structure for insuring relocatee benefits.

Consulting team has worked with the Navajo Hopi Land Commission Office on benefits for Navajo relocatees and other Navajo communities affected by relocation as required by law for developments at the Paragon- Bisti site.

TASK 4 -Develop Navajo Nation Capacity to be a renewable energy development innovator

The Navajo Hopi Land Commission Office teaming with TetraTech EC, Inc. and Blue Hawk Design shall establish broad awareness of renewable energy technologies and opportunities; apply those technologies to address Navajo needs and employ Navajo people which shall improve Navajo support for the Project. This project shall be a prime example of true economic empowerment by developing and deploying renewable energy in a large-scale project.

SUBTASKS

4.a. Design and permitting of Navajo Nation Renewable Energy Centers (These activities are to be part of the pre-construction activities and to be completed in the next phase of the project.)

Consulting team has worked with the Navajo Hopi Land Commission Office on conducting needs assessment with Navajo Renewable Energy interest groups.

Consulting team has worked with the Navajo Hopi Land Commission Office on identify program/purpose for Navajo Nation Renewable Energy Centers.

Consulting team has worked with the Navajo Hopi Land Commission Office on developing master plan for Navajo Nation Renewable Energy Centers.

Consulting team has worked with the Navajo Hopi Land Commission Office on partnering with Navajo agencies and others (i.e. NTUA, Black Mesa Chapter and Gray Mountain residents) with interest in renewable energy to develop a program for design and operation. Navajo Nation Renewable Energy Centers will build support for the Project and other renewable opportunities available to the Navajo Nation.

4.b. Consulting team has worked with the Navajo Hopi Land Commission Office on supporting Navajo Nation Renewable Task Force.

The Navajo Nation Renewable Task Force is multi-agency effort established by the President of the Navajo Nation and coordinated by the Director of the Division of Natural Resources that will be essential to timely development of the Project and other renewable energy ventures in Navajo Country

4.c. Consulting team has worked with the Navajo Hopi Land Commission Office on establishing supportive relationships with Navajo Nation entities doing renewable activities and the Navajo Tribal Utility Authority, Dine Power Authority, Dine College and Navajo Tech.

Consulting team has worked with the Navajo Hopi Land Commission Office to develop strong sustained working relationships between the Project and Navajo energy agencies and educational institutions by building support for the Navajo Nation Renewable Energy Centers and the Project as well as providing employment and training opportunities to those agencies and institutions.

TASK 5 • Project Management and Reporting

Quarterly reports and a Final Report are prepared. Quarterly and Final reports are key deliverables from the project.

EXECUTIVE SUMMARY

22,000 acres of land on the Paragon-Bisti Ranch in San Juan County, New Mexico, have been conveyed under the Navajo-Hopi Relocatee Act to the Navajo Nation. Tetra Tech has performed a preliminary study of these lands to assess their suitability for siting a solar renewable energy ranch, the results of the study conclude:

Land The aggregate area suitable for solar development is over 17,000 acres, receiving Class 7 insolation. These sites are in an around the Paragon-Bisti Ranch.

Site	Acreage	Potential Power, MW	Range of Miles to transmission line
1 Former Dineh Project Site	640	160	16
2 South of Bisti	4,000	1,030	3-14
3 South of DeNahZin	3,330	830	10-13

4 Near Fossil Forest	6,560	1,640	12-15
5 Near Ashiin Le Pai	1,960	490	12- 17
6 Closer to De Nah Zin	870	220	8- 14
17,360		4,370	

INTRODUCTION

The Paragon-Bisti Solar Ranch program has the capacity to develop up to 4,000 megawatts (MW) of solar power on Navajo lands in northwestern New Mexico. Based on Tetra Tech's extensive experience developing some of the largest solar programs in the country. All parties recognize the great potential for this program as manifested in:

Extensive inventory of suitable land receiving Class 7 insolation

Proximity to roads, transmission lines and corridors

Possible exemption from select environmental permitting actions

Availability of 25,000 acre-feet of water allocable by the Navajo Nation

Potential for ready expansion

Renewable Energy Potential. These factors could make this not just one of the largest tribal renewable energy projects, but the largest solar program in America. Additionally, development of solar energy is a national priority. Many states have landmark legislation requiring up to 33 percent of their total energy purchased be renewable. The most economical way to accomplish this is to develop large land parcels. Bringing together some of the largest major solar developers, the Navajo Nation and many federal agencies, makes this a strong partnership. The sovereignty of the Navajo Nation is also a key factor in this approach because it can assure the land will be put to solar use. The Navajo Nation's experience with large-scale energy leases demonstrates that this can be and has been accomplished in the past.

Lands. The Paragon-Bisti Ranch encompasses up to 22,000 acres of which 17,000 acres are available for solar development, suitable for solar use. Individual sites will be developed, along a staggered timeline, to develop solar ranches in capacities ranging from approximately 160 to 1,640 MW.

Concept. The concept is to develop six parcels within the Paragon-Bisti Ranch.

The program's phases and intent are:

Prepare the parcels for development – survey, permitting, environmental studies and documentation; Transmission line studies.

Solicit and engage world-class developers to partner on the program.

Prepare bid packages and competitively select developers for the sites.

Apply for access to transmission lines, transmission rights-of-way (ROW);

Obtain power purchase agreements (PPA) and approvals for construction.

Provide Engineering, Procurement and Construction (EPC) for the solar sites.

Produce power Provide long-term operations and maintenance (O&M)

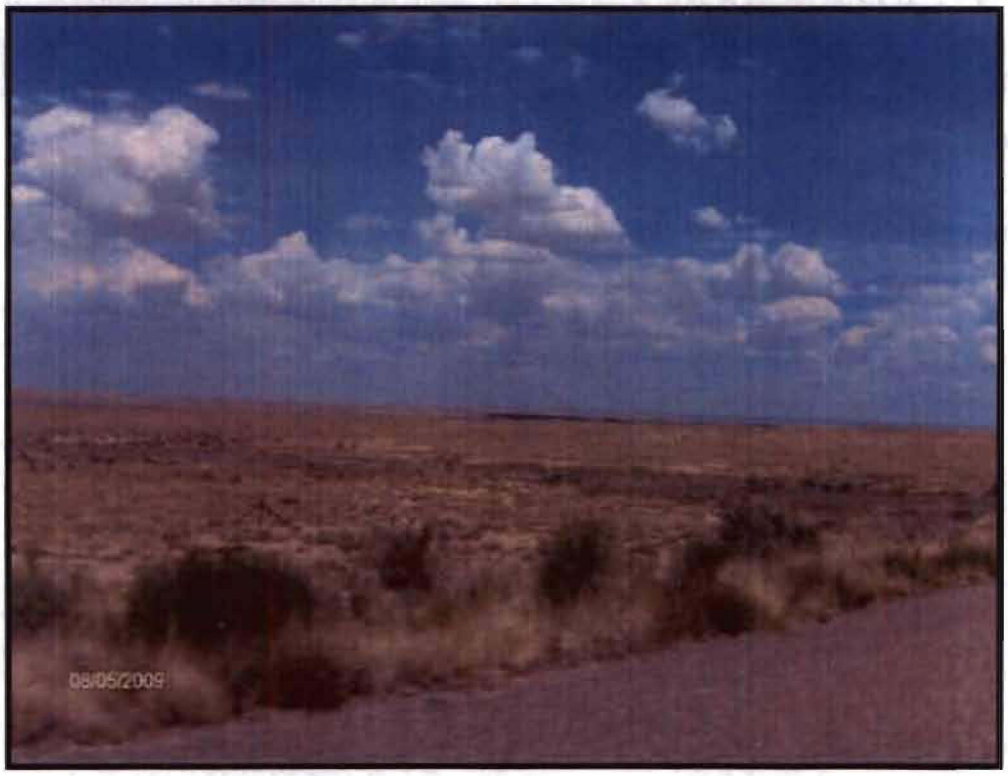
SUBTASKS

5.a. Reports and other deliverables will be provided in accordance with the Federal Assistance Reporting Checklist following the instructions included therein.

In preparing this report, the Tetra Tech, Inc. / Blue Hawk Design team participated in the annual Tribal Energy Review workshop on "Renewable Energy Development in Indian Country." These workshops (November 2009 and November 2010) served to address key issues required for development.

Development of a 4,000 MW Solar Project on Navajo Lands

The Paragon Plan



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EXECUTIVE SUMMARY

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- **Land**. The aggregate area suitable for solar development is over 17,000 acres, receiving Class 7 insolation. These sites are in an around the Paragon-Bisti Ranch, map at Exhibit 1.

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5	1,960	490	12- 17
6	870	220	8- 14
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- **Renewable Energy**. 6 sites have been identified, each with a generating potential of hundreds of megawatts-peak (MWp). The smallest can host 160 MW, the largest ten times that, well over 1 gigawatt (GW). If all these sites were developed, the aggregate generating capacity would be over 4 GW of peak power (GWp), annual capacity factor would be well over 33 percent.

  Of all renewable energy generation technologies, PV has the most potential for the "highest best use" of these Trust Status lands, in terms of land use (energy per square foot) and cost (dollars per kilowatt of capacity, cents per kilowatt-hour of electricity). The PV industry is the most rapidly improving (dramatic cost reduction as well as efficiency gains) and has the highest growth rate of the renewable energy market.

- **Transmission**. Developing the first recommended solar site, estimated cost $400-500M, would provide enough economy of scale to fully justify and pay for the first grid-tie, (estimated cost $10M for the substation plus a short transmission feeder to the nearby 230-kV line), putting the entire project on a "pay as you go" basis.

  Additional production from other sites will require connection to other lines, e.g. the three 345-kV lines to the east, or the construction of new lines and substations.

  A single, common permitting process for all the Paragon-Bisti sites would benefit all developers by minimizing the fixed costs each would bear alone otherwise.

- **Advantages and Critical Issues**. A solar ranch development on these lands offers many advantages, including: remoteness, proximity to existing transmission lines/corridor, availability of water and potential for expansion.

  An environmental study in some form may be required, an exception for streamlining under the National Environmental Policy Act ruling of 1969, 42 U.S.C. 4321 for Navajo-Partition Lands would greatly enhance this program.

1.0 INTRODUCTION

The Paragon-Bisti Solar Ranch program has the capacity to develop up to 4,000 megawatts (MW) of solar power on Navajo lands in northwestern New Mexico. Based on Tetra Tech's extensive experience developing some of the largest solar programs in the country, we recognize the great potential for this program as manifested in:

- Extensive inventory of suitable land receiving Class 7 insolation
- Proximity to roads, transmission lines and corridors
- Possible exemption from select environmental permitting actions
- Availability of 25,000 acre-feet of water allocable by the Navajo Nation
- Potential for ready expansion

Renewable Energy Potential. These factors could make this not just one of the largest tribal renewable energy projects, but the largest solar program in America. Additionally, development of solar energy is a national priority. Many states have landmark legislation requiring up to 33 percent of their total energy purchased be renewable. The most economical way to accomplish this is to develop large land parcels. Bringing together some of the largest major solar developers, the Navajo Nation and many federal agencies, makes this a strong partnership. The sovereignty of the Navajo Nation is also a key factor in this approach because it can assure the land will be put to solar use. The Navajo Nation's experience with large-scale energy leases demonstrates that this can be and has been accomplished in the past.

Lands. The Paragon-Bisti Ranch encompasses up to 22,000 acres of which 17,000 acres are available for solar development, suitable for solar use. Individual sites will be developed, along a staggered timeline, to develop solar ranches in capacities ranging from approximately 160 to 1,640 MW.

Concept. The concept is to develop six parcels within the Paragon-Bisti Ranch. The program's phases and intent are:

- Prepare the parcels for development – survey, permitting, environmental studies and documentation, transmission line studies
- Solicit and engage world-class developers to partner on the program
- Prepare bid packages and competitively select developers for the sites
- Apply for access to transmission lines, transmission rights-of-way (ROW), obtain power purchase agreements (PPA) and approvals for construction
- Provide Engineering, Procurement and Construction (EPC) for the solar sites
- Produce power
- Provide long-term operations and maintenance (O&M)

In preparing this report, the Tetra Tech team participated in the annual Tribal Energy Review workshop on "Renewable Energy Development in Indian Country." This workshop served to address key issues required for development.

2.0 CRITICAL ISSUES FOR THE PARAGON-BISTI RANCH PROJECT

2.1 CRITICAL ISSUES FOR DEVELOPMENT

It is our experience that large-scale commercial solar development projects have several critical issues in common. In this particular case, there are many very positive factors that can influence and expedite development. Some of these issues, such as the requirement for expensive and protracted environmental studies and approvals under National Environmental Policy Act (NEPA), may prove easier to resolve because the project will be located on Navajo Nation land, provided under the Navajo-Hopi Relocatee program. The critical issues that will have to be overcome as this project moves forward include the following:

- **Transmission Capacity and Interconnect.** An extensive presentation on the subject is presented in section 2.4, however, with the potential to develop 4,000 MW of solar energy, there may not be sufficient capacity on the existing transmission lines to transfer this amount of power. The application, permitting, and construction of new transmission lines and required substations can take a considerable amount of time, ranging from five to seven years. There may be some economic benefit if the transmission requirements from this program are combined with other programs such as the Navajo wind initiative in acquiring transmission capacity.
- **Remoteness.** This issue could be both a positive and negative factor influencing the program. The remote nature of the project makes it ideal for development in that there has been very little human activity in this area for an extremely long period of time; therefore, there is no demand for the property and potential interference from adjacent cities and metropolitan areas. On the other hand, the development of these sites, at the magnitude we are considering, could require developers to build construction camps and import materials a considerable distance to execute these projects. Additionally, facilities will have to be developed for the O&M staff that will remain after construction.
- **Social Economic**. The large influx of engineers, supplies, and construction workers in this area could have a positive impact on the growth of adjacent cities and their tax base. Additionally, high-tech jobs in the renewable energy market will be created by this large-scale program and could be a source for both training and long-term employment for Navajo tribal members.
- **Environmental**. Under the NEPA preparation of appropriate documents is required in connection with a "major federal actions." The BIA is the federal lead agency monitoring compliance with the NEPA process for the tribes. Generally preparation of an Environmental Impact Statement (EIS) or Environmental Assessment (EA) is required. More research is required to determine the degree to which this solar project may be exempt from the NEPA process. NEPA documents may be streamlined as a result of the completed BLM's 2008 Programmatic EIS. Assuming some form of an environmental assessment is required to satisfy tribal, state or federal requirements; this process could be lengthy and requires assets to conduct field work and prepare the studies and reports. More details on this subject are presented at Appendix A.

- **Coordination and Collaboration**. Administrative collaboration within the Navajo Nation, including the Navajo-Hopi Land Commission (NHLC), Tribal agencies, and Eastern Navajo organizations will be necessary to achieve development objectives of a large-scale renewable energy project at Paragon Ranch. Similarly, collaboration will be needed among the Navajo Nation, Federal agencies (primarily the BLM, BIA, and the Office of Navajo and Hopi Indian Relocation, Flagstaff, Arizona), and New Mexico state agencies for successful implementation of development and land use plans for the selected lands.
- **Changing Land Use**. Developing a solar energy project in the area will require that land uses be changed from historical and present use. Implementation of multiple use policies is a subject in which land managers at the Navajo Nation, BIA and BLM have experiences. These policies must be addressed early in the process and carefully planned to assure all stakeholder interests are satisfied. A more detailed discussion on this subject is presented at Appendix A.

2.2 OWNERSHIP OF SOLAR PROJECT LANDS BY THE NAVAJO NATION

The NHLC was delegated by the Navajo Nation Council with the authority to act and speak for the Navajo Nation with respect to land selections and land exchange provisions under Public Law 96-305, and the 1980 amendments to the Navajo-Hopi Land Settlement Act (NHLSA) 25 United States Code (U.S.C.) § 640 *et seq*. The Navajo Nation Council is required by NHLSA to assist the NHLC in acquisition of lands.

The NHLC exercised authority granted in the NHLSA (Public Law 93-531, as amended) for the selection of 35,000 acres of land for Navajo Nation acquisition within a management area known as the Paragon Ranch of Northwestern (San Juan County) New Mexico. Under all proposed scenarios the NHLC retains ownership of the 22,000 acres of land parcels initially examined for large-scale renewable energy development. This is also case for any additional lands transferred into this program for solar development.

2.3 LAND LEASING REQUIREMENTS

In accordance with the provisions of the NHLSA, lands acquired and proceeds from the development or use of those lands are to benefit Navajo families residing on Hopi-partitioned lands as of December 22, 1974, and to support the continuing rehabilitation and improvement of the economic, educational, and social condition of families, and the Navajo communities, that have been affected by the decision in the Healing case or related proceedings. The use of this land known as the Paragon Ranch of Northwestern (San Juan County) New Mexico is for the exclusive use and benefit of Relocatees and other affected Navajo communities in residence on Hopi Partitioned Land 25 U.S.C. §§ 640d-10(h) and 640d-30(b) and (d). The NHLSA provides for administration and management of lands acquired pursuant to the Act by the Office of the NHLC in Window Rock, New Mexico.

It is expected that the provisions of these regulations will be met under any of the leasing scenarios proposed under this development plan. In all instances, whether the Navajo Nation is the controlling partner with a major developer or chooses to simply lease their property to a

developer, the considerations under both of these situations will directly benefit tribal members of the Navajo Nation.

All terms of the leasing agreement will be carefully described and detailed in the final lease signed between the Navajo Nation and their partner company. It is expected that the Navajo will benefit from their experience on similar leasing arrangements ranging from coal leases to their latest wind energy project.

2.4 CULTURAL AND SOCIAL ECONOMIC ISSUES WHICH MUST BE CONSIDERED

Cultural Considerations. Our research of the parcels being considered for the development of the solar program indicates that there has not been any extensive habitation of these lands for hundreds of years, other than use for grazing by herders in the area. However, many of the sites adjacent to this property have cultural, archaeological and paleontological values. The extensive presence of archaeological and historical sites in the region surrounding the Ranch is well documented. These sites include Paleo-Indian sites, some dating to 12,000 years ago; Archaic sites of the Oshara Tradition, dating from as early as 5500 B.C. to 400 A.D.; Anasazi sites and prehistoric roadways created by the Chacoan culture as recently as A.D. 1300; Navajo sites dating from approximately A.D. 1600 to the present; and Euro-American sites dating from the colonization of the San Juan Basin beginning in the 1870s. Within the solar lease areas there are many fossil resources, and further inventory of these sites will be required as solar development proceeds. It is expected that a natural and cultural resources study will be conducted prior to a development of the solar ranch.

Social Economic Considerations. Possible issues that may have an impact on the Navajo Nation include:

- **Solar Energy Jobs.** Training and jobs in the solar renewable energy field should be a direct result of this large-scale program. Qualified tribal members should be favored for employment in all facets of this program from planning through operations and maintenance. Additionally, provisions in the partnering and leasing agreements should prescribe that training will be made available to tribal members in the area with a desire to be involved in this program.
- **Field Operations**. As this program moves into the construction phase, extensive field construction camps could be established to support workers. As the program transitions to the operations and maintenance phase, some personnel will remain on site for these functions. These activities could have an impact on any adjacent Navajo reservations and surrounding communities.
- **Engineering and Construction Personnel in the Area**. Any form of development that brings outsiders into the area could create conflict with Navajo living traditional lifestyles. With active participation of Navajo organizations and individuals, as well as participation of the federal agencies including the DOI BIA and the BLM, such conflicts can be minimized, and a beneficial development plan will be created.

2.5 SITE BOUNDARIES AND DEFINED PARCELS FOR SOLAR PROJECTS

These sites are a mixture of land conveyances from the Bureau of Land Management (BLM) to the Navajo Nation with existing Tribal lands that abut the boundaries of the Paragon-Bisti Ranch. These lands are located east of Highway 371, about half-way between Farmington and Crownpoint in Townships 22-24N, Ranges 11-13W.

The Paragon-Bisti Ranch boundary contains over 70,000 acres of land, 22,000 acres were initially selected by the Navajo Nation for large-scale solar energy development. The lands have a "checkerboard" land ownership pattern that describes the complex mix of surface and subsurface landowners and associated federal, state and tribal jurisdictions. It is expected that about 4 acres per MW will be required to produce an aggregate 4,000 MW of power.

The map in Exhibit 1 portrays the boundaries of the six sites, major and proposed road networks, transmission lines and ROWs. Site information on these parcels is shown in Exhibit 2.

Exhibit 1. Six Paragon-Bisti Solar Ranch Sites for Development

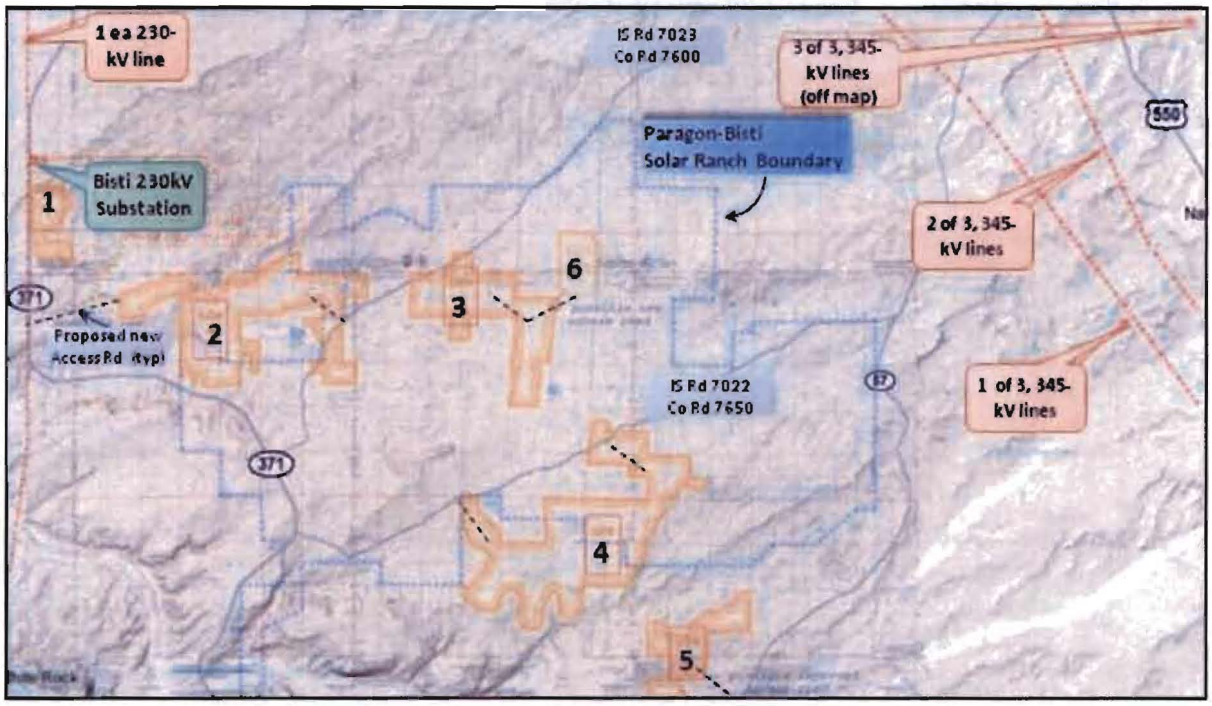


Exhibit 2. Summary of Six Solar Development Sites

Site	Township and Section	Acres	Potential Power, MW	Land Status	Miles to Road	Miles to 230kV Bisti sub.	Miles to 230kV Line BI	Miles to 345kV Line FW
1	Sec 31, T24N R13W; Sec 6, T23N R13W	640	160	ALL Selected & Conveyed – surf & min	0	2	0	16
2	Sec 9-14,23,24, T23N R13W; Sec 6-9,17,20,21 T23N R12W	4,000	1,030	ALL Selected & Conveyed – surf & min	0-3	6-9	3-7	11-14
3	Sec 2,10-12,14, T23N R12W Sec 7,18,19 T23N,R11W	3,330	830	BOTH Tribal (1280) AND Selected & Conveyed – surf & min (2050)	0-3	13-15	10-13	10-11
4	Sec 27,28,33-35, T23N,R11W Sec 3-5,8-10 T22N,R11W Sec 1,12,13, T22N R12W	6,560	1,640	BOTH Tribal (4960) AND Selected & Conveyed – surf & min (1600)	0-1	18-22	15	12-14
5	Sec 13-15,22,23,26,27 T22N,R11W	1,960	490	ALL Tribal	1	25	17	12
6	Sec 5,8 T23N,R11W	870	220	ALL Tribal but landlocked	2	16	14	8
	Totals	17,360	4,370					

The following criteria, in order of importance, were considered in selecting these sites:

- **Land Ownership Status**. Land had to be either Selected & Conveyed for Surface and Mineral Rights, or already Tribal. We excluded BLM, State, & PLO2198 Withdrawals.
- **Connectivity**. Except Site 6, we also excluded most landlocked squares in order to avoid getting rights-of-way (ROW) for roads or transmission across BLM, State, of other lands.
- **Topography**. We chose flat areas or south-facing slopes, picked nothing over 3% grade, and avoided permanent bodies of water, watercourses and rough terrain.
- **Road Access**. Proximity and access to existing roads is desirable for construction and O&M, but not critical.
- **Proximity to Transmission**. We gave preference to proximity to existing transmission, and access to transmission that did not require acquisition of ROW.

2.6 TOPOGRAPHIC LIMITATIONS

The land is very conducive topographically to the development of renewable solar energy. In performing this study, sites were selected that are in relatively flat areas, not over a 3% grade, south-facing slopes, do not contain permanent bodies of water or rough terrain.

2.7 EXISTING AND PROPOSED ROAD NETWORKS

The map at Exhibit 1 displays the major road networks in the area. as well as about 4 miles of proposed new roads or improvements to existing roads to provide initial access for construction and development of the sites. With improvements these can be utilized in the future operations

and maintenance of the project sites. As the project moves forward, these proposed access roads will be better defined along with all utility needs for development, water needs and requirements for a central wastewater system for the project and all other infrastructure needs for development.

2.8 EXISTING TRANSMISSION LINES AND ROW'S OF RECORD

The connection of this Navajo solar project to the grid is a critical component of the project and also a very expensive one and the remote location of the Paragon-Bisti ranch makes grid tie of more than a 160 MW challenging. ROW's for siting new power lines is an important consideration. A primer on the subject of power transmission is in Appendix B.

2.8.1 Local Electric Transmission and Distribution System

The local electric distributor on the Bisti-Paragon Ranch is Jemez Mountains Electric Cooperative (JMEC). The Navajo Tribal Utility Authority (NTUA) is not the distributor in the area of Paragon Ranch. Highway 371 is the eastern boundary of the NTUA territory, and NTUA does not have distribution lines to the east.

JMEC serves its customers with 24.9-kV three-phase distribution. However, only one phase of distribution is extended to Paragon Ranch area, so only 14.4-kV single-phase service is present. That circuit is fed out of JMEC's Lynbrook 69-kV substation, approximately 40 miles to the east in Rio Arriba County. The 69-kV transformer has a 10 megavolt-ampere (MVA) capacity. JMEC purchases its electricity from Tri-State Generation through 115-kV connections at the LaJara, Ojo, and Hernandez substations in Sandoval and Rio Arriba Counties. The *Jicarilla Apache Nation Utility Authority Strategic Plan for Energy Efficiency and Renewable Energy Development* (dated June 28, 2008), the JMEC system is fully utilized with little to no capacity to carry additional load. Connecting Paragon Ranch solar generation to JMEC's system is not practical.

Map at Exhibit 1 shows the **Bisti Substation** and existing transmission lines. Additionally there is another **major Substation in the Four Corners** area

2.8.2 Transmission Lines and ROW

Because of the gigawatt-scale of the Navajo solar project (4,000+ MW), connecting to a transmission line would be required. Exhibit 3 presents the current state of the transmission lines in the vicinity of the program and related facilities.

Exhibit 3. Transmission Lines and Capacities in the Area

Ownership	Line voltage	Available Capacity	Location	Connection and Substations
PNM Resources	230 kV	150 MW	West of the site, paralleling the north-south segment of Highway 371 for about 6 miles Paragon Ranch.	Line connects the Four Corners Power Plant to Ambrosia Substation in McKinley County (identified by PNM as segments AF, BP, and BI). Bisti Substation (coordinates 36°17'4.85"N, 108° 16'15.15"W) located along this transmission line on Highway 371 near a compressor station for the Transwestern gas pipeline and not far from Site #1
PNM Resources	3 ea 345 kV	unknown	East of the site, 8-16 miles	Line 1 connects Four Corners Power Plant to the Rio Puerco and West Mesa Substations near Albuquerque (line FW); Line 2, which mostly parallels the first, connects San Juan Power Plant to Rio Puerco Substation (line WW); Line 3 connects San Juan Power Plant to Ojo Substation in Rio Arriba County (line OJ)

A critical future issue for the success of this project is for the NHLC to gain control, and therefore ROW, of the current "checkerboarded" ownership situation. This would allow access to the 230-kV line to the west and the 345-kV lines to the east. Tetra Tech is developing a master transmission plan to assure ROW is developed to service the site adequately.

The *Pre-Feasibility Assessment of Renewable Generation Applications for NHLCO Paragon Ranch Solar* (dated May 13, 2010) indicates 150 MW of available capacity on the 230-kV line as well as available capacity on the 345-kV FW line.

Connecting to the PNM Resources 230-kV line may be the best option because of its proximity to Paragon Ranch. The project will be sequenced such that the first stage of construction is big enough to justify a 230-kV grid connection. The developer will also plan for the "collection system" (because electricity is being generated) between the 230-kV substation and the solar panels. An intermediate distribution voltage, such as 69 kV, may be needed, and multiple 13.2-kV or 24.9-kV transformers may be needed, depending on the number of solar fields, their sizes, and the distances between them.

The solar farm on the next site to be developed will be sized to justify by itself a grid-tie to one or more of the three 345-lines to the east, yet large enough to carry the production from all subsequent sites. It is understood that the Navajo Nation is presently considering a 500-kV transmission line from Desert Rock to Four Corners

A complete study will be commissioned and performed in the next phase of this assessment work to assess the capacities, routing and best alternatives for the transmission lines and systems.

2.8.3 Sequencing the Development

While the first site has the potential for 160MW, developing the nearby second site would increase the installed capacity by a factor of five, at a modest marginal cost for the second grid-tie-in if line capacity were available. The second site's output could not be accommodated on the 230-kV line without a significant and expensive line upgrade.

Therefore, it appears that the remaining five candidate sites, three of which are over a gigawatt each, will have to export their power to the east, connecting with one of three 345-kV lines, 8-17 miles away or ultimately to a purpose-built 500-kV line. The five sites could connect to a single feeder with several giga-volt-amperes of capacity running to the east, to tie into one or all three of the 345-kV lines. Any of the three gigawatt-class parcels alone would justify such a feeder. Since any developer must build at least one feeder anyway to service any of the five remaining sites, then the path of least resistance would be to connect all five remaining sites through the one feeder. Hooking up these sites will require longer higher-voltage feeder lines, which cost more per mile. 345-kV (or even 500-kV) substations will be much more expensive as well. Tetra Tech intends to definitively analyze these sequencing issues in Phase II of this assessment.

2.8.4 Key Points for Grid interConnects and Transmission Considerations

- The aggregate development producing 4,000 MW is more than the output of the Four Corners power plant output.
- Annual capacity factor would be well over 33 percent.
- Developing the first recommended solar site would provide enough economy of scale to fully justify and pay for the first grid-tie (an upgraded Bisti substation, plus a short transmission feeder), and put the entire project on a "pay as you go" basis.
- Succeeding with the first solar parcel / project will set the stage for completing the major development of the Paragon-Bisti Ranch.
- The first site would cost approximately $400-500M to develop.
- An assessment of Renewable Generation Applications for NHLCO Paragon-Bisti Ranch Solar indicates there is 150 MW of capacity on the 230-kV line, as well as possible available capacity on the 345-kV lines.
- Production from this first solar farm will fully occupy the available capacity of 150 MVA on the 230-kV line.

3.0 APPROACH TO SUBDIVIDING THE SITE

Successful Projects to Model After
So far in the western United States only the City of Boulder, Nevada has used a large land transfer concept and it has proven to be the best way to approach solar development. In that case the city acquired a large tract of BLM land which allowed them to develop a major solar energy park.

The rational for using the large Paragon property for up to six solar developments, most in the gigawatt (GW) range, is to reduce the fixed costs of land planning, environmental studies, permitting and government approvals, and transmission infrastructure for all of the solar developers. Costs and risks of permitting and approvals are extreme in the western United States, especially on Federal lands, and by consolidating the effort and bringing certainty to those issues the Paragon property project could be attractive to many companies. Solar developers want to sell megawatts hours at the highest price with the lowest development costs. It is this lack of large parcels that makes this project unique and of probable interest to developers.

This land has a class 7.0 direct solar radiation (per National Renewable Energy Laboratory [NREL)] making for a very good potential solar power site and has great wind power potential, as well.

4.0 SOLAR DEVELOPERS, SOLAR TECHNOLOGIES, PROCUREMENT OF DEVELOPERS AND RENTAL AMOUNTS

Tetra Tech will assist the Navajo Nation in preparing bid packages for major solar developers, with a goal of acquiring at least six major developers to build 4,000 MW or more of solar power facilities on the Paragon-Bisti site over the next decade.

Preparing the Sites. To enhance the attractiveness of these potential solar ranches, Tetra Tech proposes to conduct all planning, define boundaries, develop basic infrastructure to support solar power plants and complete environmental studies and gain approval for the entire property to address NEPA and permitting issues at one time in a focused and economical manner. Since the Navajo Nation, state of New Mexico, Department of Energy (DOE), and Department of Interior Bureau of Indian Affairs (DOI BIA) will all be partners in this project, we will be able to clearly identify and define the issues and address them in a focused effort. The site is remote enough that it does not have major issues associated with congestion, neighbors, and traffic that hamper many large solar developments.

Attracting Developers. Several solar developers, some with different technologies, will be interested in submitting a proposal for this project. Having permits in place, except those that are technology or site specific, will make it more economical for a developer to come in and begin building his solar plant in the shortest time. This economy of scale provided by having major developers in one place producing 4,000 MW should help obtain the funding from the Government agencies, other sources and from the major developers, to make the project a reality. The advantages of this approach include:

- Well defined and available parcels, not encumbered by typical federal government regulations and systems – the land is under Navajo tribal control and will be ready to develop
- Permits and NEPA prepared and approved or exemption obtained
- Planning a large scale cooperative effort to obtain Power Purchase Agreements and solving the transmission issues

The project will be unique in the United States. There are several other large-scale solar projects being developed in the world and the idea of achieving economies of scale from one solar site has gained traction in other places.

4.1 DEVELOPERS

A list of candidate developers includes companies that are active in developing solar projects of this size and who have been active in the southwestern United States. From this list and possibly others, Tetra Tech and the Navajo Nation will select those companies that have a solar technology that best fits the project and who have demonstrated the technical and financial capability to permit, design, build and operate solar power plants. These companies are the best in the industry. We propose to invite these firms to partner in helping craft this landmark national

renewable energy program by participating in the *Paragon-Bisti Solar Ranch Development and Transmission Committees*, bringing credibility and financial strength to the project. Tetra Tech believes that getting one or two of these large and capable companies to join the project upfront, will act as an "anchor" providing credibility for other major developers to join. Worldwide the solar companies tend to follow each other into the most developable areas. When a company like NextEra moves in others are sure to follow.

Potential Solar Developers include the following companies. The more complete details and background on these companies are at Appendix C.

NextEra Energy, Inc. – a leading clean-energy company with 2009 revenues of more than $15 billion, nearly 18,000 MW of installed generating capacity and more than 4,500 employees in 27 states and Canada.

Abengoa – Founded in 1941, headquartered in Spain, operating in more than 70 countries with over 23,000 employees. 2008 sales and revenue was 3200 M€ and 545 M€, respectively. 43 MWs are in operation, 350 MWs are under construction and hundreds of MWs under development. Abengoa's Rice project was recently approved by BLM and California Energy Commission; construction starts in 2010.

Solar Millennium – specializes in parabolic trough power plants, a proven and future-oriented technology, in which the company holds a globally leading position.

Renewable Energy Systems (RES) – one of the fastest growing renewable energy companies in the world and has been at the forefront of the industry since it was founded in 1982.

EnXco – Solar PV energy development is a priority, with a global target goal of 500 megawatts-peaks (MWp) of net-owned capacity by 2012. They presently have more than 15,000 MW of renewable energy projects in development.

First Solar – Achieved the lowest manufacturing cost per watt in the industry, breaking $1 per watt in 2008. First Solar will bring its total expected manufacturing capacity to more than 1.4GW by the end of 2010.

4.2 SOLAR TECHNOLOGIES

Tetra Tech has prepared a review of Renewable Energy Technologies relevant to development of the Paragon-Bisti Ranch and this review is provided in Appendix D.

4.3 RECOMMENDED PROCUREMENT PROCESS

After site-specific issues and alternative solar technologies are evaluated, the ultimate PV potential quantified, an independent capital cost estimates and an engineering economic analysis/ financial *proforma* generated, a draft Request for Proposal (RFP) document and Bid Package will be prepared. The purpose of the draft RFP is to help the developers understand the offering, the criteria for submitting a proposal and the evaluation factors and to respond. A Draft RFP will be prepared and provided to a screened list of candidate developers for review and comment.

Based on comments received, the Final RFP and Bid Package will be developed to provide the structure for selecting the best qualified solar developer, based on desirable qualifications. This package will contain sufficient bid specifications and drawings to allow for the successful selection of a solar developer, and will include many key elements such as: description of the project, terms and conditions for partnering or lease, transmission line studies and availability of capacity, permitting, utility requirements and any special requirements. Tetra Tech will provide professional engineering services to the Navajo Nation during the bidding phase of the project which will include: conducting a pre-bid meeting, publishing and distributing the bid criteria and evaluation factors, meeting addenda, reviewing bids, submitting permit applications (if required), and providing a recommendation for award of the development contract.

A listing of the criteria and desirable qualifications of a developer, to be used in preparing the RFP and evaluating the proposals received are shown below:

Financial Qualifications
Company's financial strength
Developer's credit worthiness, including a developer's managerial and financial qualifications
Past Performance
Description of recent completed similar projects
Performance
Project Management Experience, Key Resumes
Project Management Approach
Project design and engineering plan
Engineering, construction, operating and environmental team qualifications
Detailed operations and maintenance plan for the project
Technical Approach
Proposed technology that is commercially demonstrated
Commercial status of technology
Energy storage and associated dispatch flexibility
Identification of major equipment supplier(s)
Siting plan
Schedule
Detailed project schedule identifying all important development elements and milestones
Critical path defined
Pricing
Land Lease payments
Partnering opportunities and equity positions

The resulting proposal from each of the candidate developers will be reviewed and a short-list of the best qualified developers selected. The shortlisted contractors will be asked to give a short formal presentation on their proposed projects. Following these presentations and any final questions, a developer will be selected to negotiate the initial partnership terms or lease agreement.

4.4 CONTRACTING OPTIONS FOR PARTNERING OR LAND LEASING

Partnering. The Navajo Nation is interested in taking an active role in the development of the solar ranch sites, which may involve partnering with a developer, similar to their recent wind project. Defining the structure of such a relationship is beyond the scope of this study, but Tetra

Tech will support this arrangement in any capacity. The range of options for developing the solar ranch sites include:

- Partnering with a developer, Navajo in a majority role
- Partnering with a developer, Navajo in a minority position
- Direct land lease to a developer

Given that the overall cost of developing the six sites, which could be over $10B, all of these scenarios should be considered.

Leasing Land. One of the simplest options is the direct land lease. Under this relationship, the Navajo Nation could still exert a great deal of control over the project through the terms and conditions of the leasing agreement, as well as being in a position to monitor all aspects of the design through the construction and long-term operations and maintenance of the sites. A rate schedule example has been developed for this Paragon- Bisti solar ranch. This is a suggested rate similar to that which the BLM uses for solar projects on their land. The issues to consider in establishing the base land lease price are:

- Does the project land have higher or lower value than that used in the BLM
- Is there a difference in the BLM holding the land versus the Tribe as landlords
- What is the value added for improvements including completed permitting, environmental approvals, roads, utility approvals, etc.

This initial base rate could be a flat monthly fee for the land use that begins after some designated trigger point, such as the time the ROW is approved. The rent could start immediately or be delayed until construction and then an additional fee could be applied based on the amount of power that was produced.

Rental Example

Assumptions
22,000 acres rentable
4000 MW total capacity using concentrated solar thermal without storage
Base rate – 2 X $17.00 / acre = $34/acre-yr
MW rate – for concentrated solar thermal without storage = $6,570/yr-MW
Leasing values
Base rate – 22,000acres X $17/acre-yr = $274,000/yr
MW rate – $6570/MW-yr X 4000MW = $26,280,000/yr
Total rate after full operation - $274,000 + $26,280,000 = $26,554,000/yr

Technologies as a Function of Revenue. Some technologies use more real estate than others per MW generated. If a dollar rate per MW generated was used in the rental rate, then obviously a more compact technology type would yield a higher rental rate than the others. A less efficient project that may start up sooner and possibly be more reliable and offered by a very financially solid company may significantly influence this decision. However, several factors need to be considered in promoting or accepting a particular technology such as the reliability, time for

construction, and uncertainties with this particular project that can impact this decision. The actual selection of the technology type and final determination of the MW produced will be based on the factors previously discussed and review of the bids submitted by interested developers on each parcel.

5.0 MASTER PROJECT SCHEDULE

Tetra Tech has developed and provides a master project schedule in Microsoft (MS) Project which shows Phases 1, 2 and 3 of the Paragon-Bisti development plan. This schedule is provided in MS Project and will be updated throughout the life of the project and this schedule will evolve as the project moves forward through the three Phases until all 6 parcels are fully developed. Details of the schedule such as interrelated tasks and start/end requirements are shown. A separate schedule is shown for developing each of the six parcels. Some tasks may be common for all the parcels and some unique to each developer's plans.

Phase 1. This phase is the present project schedule, which will be completed in December 2010. The purpose of the Phase 1 study is to define a potential scenario where by planning for a six project solar field of approximately 4,000 MW or more could be possible.

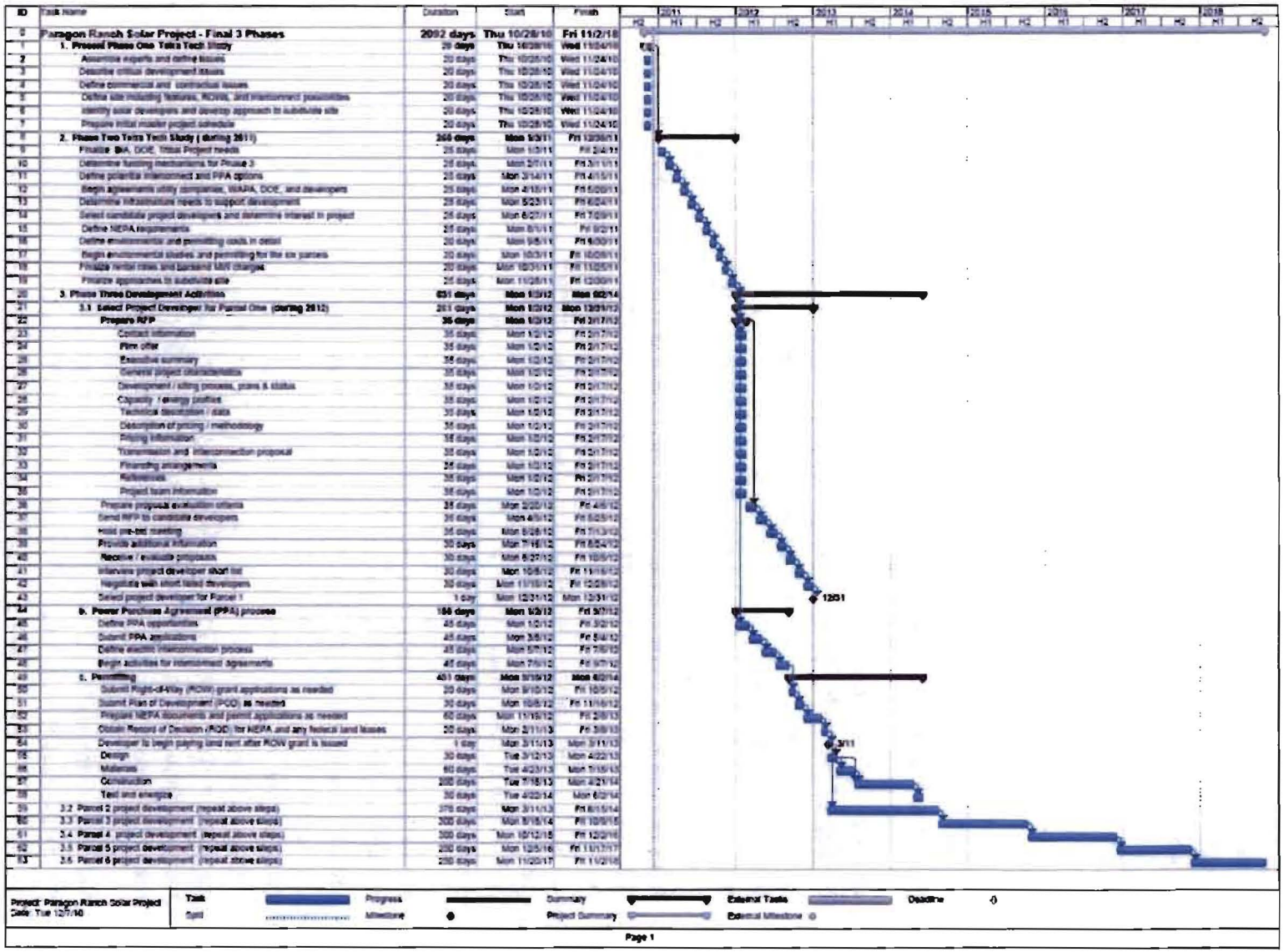
Phase 2. The Paragon Phase 2 schedule covers calendar years through 2012 and is dependent on funding of the study by the Navajo Nation or by the federal government or both. The Phase 2 study will open discussions with all applicable groups such as DOE, WAPA, area utility companies, and private transmission line developers with a focus on defining whether the project funding, power purchase agreements, interconnection agreements, and over all economics of the project can be achieved. Many complex questions arise in the Phase 2 study, and while it is risky, achieving feasibility could bring this world-class power project into reality. During this phase major solar developers would be recruited to help support the program, team with the Navajo Nation and serve on the *Paragon Site Development and the Paragon Transmission Committee.* Tetra Tech has contacts with all of the major solar developers and as a neutral party is well positioned to expedite this effort rapidly. Like any development risk is inherent, but by the completion of the Phase 2 study at the end of 2011, it will be established whether this project can proceed or not.

Phase 3. The Phase 3 effort is the development of the first parcel in the Paragon site. A solar facility of up to 150 MW is envisioned and the schedule elements required to bring the project into operation are given. The Phase 3 schedule cannot be exact at this point, but should be considered more representative and it will be updated as Phase 2 proceeds. At the end of Phase 3, based on the Navajo's timeline, subsequent projects at Ranch Parcels 2, 3, 4, 5 and 6 can be staggered at approximately one year apart. Following this schedule will result in 4,000 MW or more online by the end of 2018. Obviously many adjustments to this long term schedule are inevitable and it is shown as representative of logic and activities that are required to make the program successful with interconnects and PPA achieved.

We assume the six parcel project will be able to meet Federal, Tribal, and state environmental standards. Rarely are projects impossible because of permitting requirements, it is almost always an issue of proper environmental planning, the use of good and modern environmental design, and the proper application of mitigation and avoidance strategies.

The Project Schedule is included as Exhibit 4.

Exhibit 4. Project Schedule



6.0 TETRA TECH SOLAR EXPERTS WHO WILL SUPPORT THIS PROGRAM

Tetra Tech brings the expertise of a leading firm in the development of renewable resources, including solar, wind and many other forms of energy to the Paragon Project. We are supporting over 50 solar projects totaling over 5,000 MW in solar capacity. Our expertise in providing planning, environmental studies, permitting, engineering and construction support is best-in-class.

In addition to solar expertise, Tetra Tech is one of the largest developers of renewable energy projects including: wind resources, biomass, geothermal, ground source and offshore energies. Additionally, we support all aspects of these projects from conceptual planning, through permitting, studies and construction of transmission lines.

Tetra Tech is also unique in the renewable energy industry in that we can offer full-service energy support for this program. Our team is dedicated to supporting the Navajo Nation to meet their goals for site development through operations.

World Class Leader in Renewable Energy Projects

- 250 projects across North America
- More than 20,000 MW or wind and other renewables projects
- Over 12,000 MW of renewable energy in operation or scheduled for construction
- Currently providing construction services to clients on 19 wind construction projects valued > $340 million, which will produce 1,700 MW of power

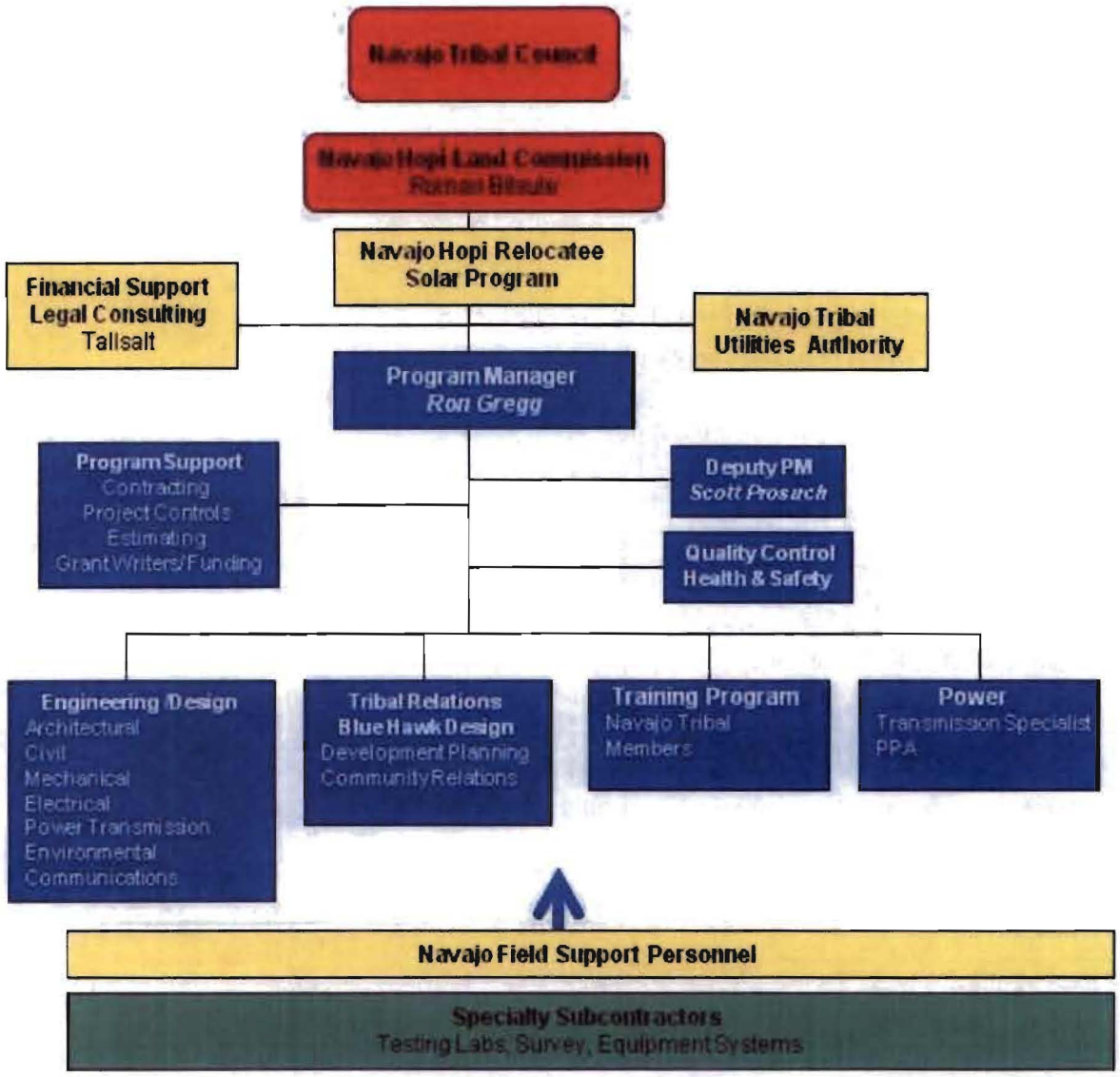
We provide support to 20 of the top 25 wind power project developers and owners in the United States. Our experience in wind and other projects is directly related to this solar program in that these projects face many of the same challenges such as: permitting, environmental, transmission, design, construction management and long term operations and maintenance.

Exhibit 5 depicts the Tetra Tech Project Organization which will support the Navajo Nation in developing this very important project.

As depicted on our organizational chart, we have added Blue Hawk Design (BHD) as a key Indian-owned partner to support our team. Annette Blue, president of BHD has been working with the Navajo-Hopi Land Commission on renewable energy projects. BHD has promoted activities and practices that support social well being of the tribes through the development, ownership and management of renewable energy projects and related infrastructure services. BHD has helped focus interested tribes on sustainable development and maximizing the natural resources of their lands for solar and other renewable development.

Our integrated team of managers, engineers, designers, transmission specialist, planners, grant writers and construction professionals are dedicated to supporting this program and seeing the Navajo nation achieve their desired operational objectives. The Tetra Tech specific team personnel are backed by the strength of an 11,000 person company. Our team of experts is presented in Appendix E along with a short biographical description of their experience.

Exhibit 5. Tetra Tech Project Organization



7.0 RECOMMENDATIONS

In an effort to maintain the momentum of this program and move towards successful production of alternative energies, maximizing the value of Navajo's natural resources, Tetra Tech would suggest the following steps:

1. The Navajo Nation should **appoint a single project manager** for the Paragon-Bisti Project and provide the funding and authority to make quick and definitive decisions to move the project forward. Major corporations need to have a sense of certainty to join in this effort. Time is important and now is the time to move rapidly on this.
2. The **Phase 2 study for Tetra Tech** should be further defined, funded, and begin as soon as possible.
3. To **stimulate developer interest**, preliminary layout of the 6 parcels should be performed and information made available for prospective developers. A website should be created containing evolving information on the sites as well as a schedule for developers. A future date for an Industry Day where all of the developers are invited to the site at one time, should be scheduled.
4. **Land ownership issues need to be confirmed and resolved**, if possible, some of the checker boarded land obtained for ROW, continuity and ease of developing sites. The BLM SF-299 ROW application process will be used to acquire other federal land corridors as needed.
5. A meteorological (Met) station should be built on the site and weather / DNI data collected and published on the website and otherwise for all users to evaluate.
6. Establish a **Paragon Site Development Committee** with a defined mission and charter from each stakeholder organization. The major solar developers will be contacted and each will be asked to provide a representative to sit on the committees. Purposely select the largest and most successful companies in the solar industry to initially participate in the project to assure the companies can provide the credibility and the resources to make this project a reality
7. Establish a **Paragon Transmission Committee** consisting of members from high level federal and state agencies: the Navajo Nation, the state of New Mexico, DOE, and the Western Area Power Administration (WAPA), representatives of utility companies, and BIA will all be requested to assign a representative. Utilize tribal contacts at the Congressional level to support participation from these federal and other agencies. Tetra Tech, with guidance from the Nation, will assist in managing the committee. The **scope of the Transmission Committee** will include: define the issues needed to get the site studies and permits completed, define potential PPA and interconnection opportunities, initiate low level power production from the site, followed by the first venture of 150 MW, and the development of transmission capability to handle the total generation from the Paragon site.
8. The Navajo Nation **develops their strategy regarding partnering** with developers and a **commercial leasing protocol**. Competitive bidding scenarios can be published with the proposed leasing terms for industry to comment on.

9. Tetra Tech should perform an environmental **"Critical Issues Analysis"** to quantify any environmental issues at each site. A permitting matrix and "Water Supply" study should be prepared also.
10. Resolution and interpretation of the degree to which this **property is exempt from NEPA** and other environmental assessments should be completed immediately. Required NEPA actions and preparation of key documents should begin as soon as possible.

APPENDIX A

CRITICAL ISSUES FOR DEVELOPMENT

LAND USE

There are some land use issues that must be considered in the development potential of the New Mexico Selected Lands since their acquisition by the Navajo Nation. These land use issues include changing resource values, land status-related development constraints, and potential conflicts among land uses. These concerns are very briefly introduced in this section and will require some detailed consideration and innovative responses for land use planning and development activities for the solar development of the area to be successful. The Navajo Nation and Navajo-Hopi Land Commission (NHLC) will resolve these issues before any project activities commence because the major solar developers have many options for land and the solar developers will not be interested in the project lands if clear title for leasing the land and a clear governmental system for managing the leases is not available. Many major solar developers are international companies who have not worked with Tribes and will expect common land lease provisions to be available or they will look elsewhere for project sites. Land is an important commodity to solar developers, but there is a great deal of land available in the western United States. For this program to be successfully developed by the Nation, the lands must be put into a competitive status to be selected for development. The Navajo must get the lands into leasable condition in 2011 if this project is to be competitive on a national scale. Time is of the essence for solar development in the west.

For more than 25 years, conducting development activities on this site has been limited by the lack of available development capital. Initial funding is needed for the Navajo Nation to develop detailed land use and business plans for the solar project. If the Navajo interests can fund Phase 2 of this study then the development costs can be moved forward to the solar industry in a variety of ways. The solar developers have investment capital of their own, they have access to major international funding sources and the American Recovery and Reinvestment Act stimulus bill funding has provided and will continue to be a major driving force pushing development in 2011. Timing is very good now for this project to move forward and to begin planning for development funding for each of the six parcels.

Developing a solar energy project in the area will require some of the land uses be changed from historical and present use. Implementation of multiple use policies is a subject that land managers at the Navajo Nation, the Bureau of Indian Affairs (BIA) and the U.S. Bureau of Land Management (BLM) have much experience with and is something that will be carefully planned to assure all stakeholder interests are addressed.

Special Considerations on Tribal Lands. The Navajo Nation has regulatory programs which have jurisdiction on these lands. The BIA generally approves energy leases and is the federal lead agency for the implementation of the National Environmental Policy Act (NEPA). The Navajo Nation can obtain "treatment as a state" status under certain federal laws.

Consideration and protections must be implemented to minimize impacts on areas such as sacred sites, traditional cultural properties or landscapes, past or present hunting, fishing, or gathering areas, and on the hydrologic or ecological conditions of springs, seeps, wetlands and streams that could be considered sacred or have historic use associations.

ENVIRONMENTAL ISSUES

It is proposed that the requirements for permitting and environmental documentation be identified in Phase 2 of the program. Tetra Tech is prepared to support the Paragon-Bisti Solar Ranch in this capacity based on the company's experience on over 50 solar start-ups. Doing this in partnership with the Nation, the state of New Mexico, Department of Energy, and BIA will be the best way to assure the natural resource issues of the site are addressed and that environmental issues are handled up front, thus making the site attractive to solar developers. There is enough land on the Paragon-Bisti Ranch that sensitive biological, cultural, and tribal lands will be excluded from development and protected.

In the Phase 2 Paragon report, Tetra Tech will define all of the natural resource, cultural resource, and physical environmental studies needed to meet permitting and NEPA requirements. We will meet with each of the agencies discussed above and determine a defensible position for NEPA compliance and will establish a Lead Agency for the NEPA action. It may be a full Environmental Impact Statement, or it may be something simpler such as a set of Categorical Exclusions under NEPA. Tetra Tech will conduct site visits, meet with all of the agencies and developers, and develop a plan to complete the studies and permits for the site. This approach to protecting the environment, preparing NEPA studies and NEPA documents, mitigating serious impacts, and developing solar power plants on federal lands in the western United States is well established and works.

Environmental Background. There is an existing Environmental Impact Statement (EIS) on Paragon Ranch for a coal-fired power plant. This EIS evaluates impacts related to biological resources, cultural, land use, visual, and hydrology, water quality and water use in the area. The information provided in the EIS for coal development will be very useful in evaluating the sites for the solar projects.

PARAGON RANCH NATURAL RESOURCES

The Paragon Ranch extends approximately 20 miles from northeast to southwest and with approximately 700 feet of relief between the highest and lowest elevation locations, resulting in relatively gentle topography with a mix of flat, gently sloping and relatively steep bluff areas. Elevations range from under 5,900 feet in the southwestern part of the area to about 6,600 feet in the northeastern part.

The Paragon Ranch offers a variety of valuable natural resources including coal and natural gas, premium solar and wind energy resources, water resources including ground water supplies, wildlife habitat for many species, significant scenic values, and the historic rangeland resources which have been used for grazing. Coal resources on the New Mexico selected lands have been the center of development consideration and unrealized for more than 25 years. Until now this

has been the natural resource in the area with the greatest identified monetary value. Now that the renewable energy potential of the area is beginning to be considered this use will become the main focus of development of the properties in coming years. Coal development on the site is no longer a focus. Solar energy will have to take precedence over coal on the 22,000 acres of Paragon Ranch.

The Paragon Ranch has good grazing land in the region, however substantial portions of the area have faced no sustained grazing pressure since the mid-1980s because the water supply infrastructure has deteriorated significantly during that same period due to lack of maintenance. Grazing is a traditional Navajo pursuit for which insufficient land exists today across Navajo Indian Country, including the Selected Land area. A significant amount of grazing land can be enhanced and protected along with the solar development.

The land offers other multiple use values including recreation such as off-road bicycling and horseback riding and tourism including sightseeing. There is opportunity for including wilderness area use, for hunting and for plant gathering. Land use planning for the entire Paragon Ranch will assure these other resource values are considered, developed and protected.

There are sites that have archaeological and paleontology values. The extensive presence of archaeological and historical sites in the region surrounding the Ranch is well documented. These sites include Paleo-Indian sites, some dating to 12,000 years ago; Archaic sites of the Oshara Tradition, dating from as early as 5500 B.C. to 400 A.D.; Anasazi sites and prehistoric roadways created by the Chacoan culture as recently as A.D. 1300; Navajo sites dating from approximately A.D. 1600 to the present; and Euro-American sites dating from the colonization of the San Juan Basin beginning in the 1870s. Within the solar lease areas there are many fossil resources and further inventory of these sites will be required as solar development proceeds.

If archaeological and paleontology surveys are required to be conducted and that existing laws such as the National Historic Preservation Act be complied with, Tetra Tech has the expertise in these areas and will lead all efforts if requested. These resource values will be addressed in the permitting and NEPA process. Tetra Tech is an expert on protecting critical resources values while proceeding with solar development and these issues will be worked out and resolved. The Paragon Ranch will continue to have multiple use values along with solar development. The areas with archaeological, fossil, cultural resources and Indian sacred sites will require careful siting of the solar generating facilities.

Soils in the area have poor agricultural value without significant irrigation development. The area produces little surface water except during storm events and groundwater quality is poor except at depths in the Morrison Formation that provides drinking water for a major portion of the Eastern Navajo Agency via wells at Crownpoint, New Mexico. A water resources report will be developed in Phase 2 to define the water sources and volumes possible for use on the solar projects. Master planning for water use will be an attractive enticement for solar developers.

The observed wild life in the vicinity of the Paragon Ranch consists of 34 species of mammals, 72 species of birds, 12 species of reptiles, and 6 species of amphibians. There are three threatened or endangered species of mammals and birds encountered on Paragon Ranch. The black-footed ferret, the bald eagle and the peregrine falcon are federally listed species that potentially may occur in the area. Mitigation and protection measures for common and special-status species will be built into all development plans.

On some of the acres, any form of development that brings outsiders into the area could create conflict with Navajo living traditional lifestyles. With active participation of Navajo organizations and individuals and participation of the federal agencies including the DOI BIA and the BLM, such conflicts can be minimized, and a beneficial development plan will be created.

APPENDIX B

MAPS, ROADS AND TRANSMISSION LINES

GRID CONNECTIONS AND TRANSMISSION CONSIDERATIONS – PRIMER ON TRANSMISSION AND DISTRIBUTION

Transmission is the movement of power across long distances at voltages such as 115-kilovolt (kV), 230-kV, 345-kV, and 500-kV. Line distances are long (dozens or hundreds of miles) and substations tend to be large. In northwest New Mexico, there are several operators of transmission lines, including Public Service Company of New Mexico (PNM), Arizona Public Service (APS), Tucson Electric Power (TEP), and Tri-State Generation. Distribution is what takes electricity to consumers. Distribution is often at 13.2-kV, or at 24.9-kV in remote areas with few customers. There is often an intermediate voltage such as 69-kV between transmission and distribution.

Many smaller solar projects (for example a few kilowatts or a few megawatts) are connected to the local distributor, and a 13.2-kV power line can usually handle that amount of generation. Many utilities offer a green power generators program and pay a premium for green power generated.

APPENDIX C

CAPABLE SOLAR DEVELOPERS

The following is a review of the capability of some the most successful, financially stable and experienced Solar Developers partners working in the United States and internationally. The following companies represent some of the most viable potential partners for this program:

NextEra Energy, Inc. – a leading clean-energy company with 2009 revenues of more than $15 billion, nearly 18,000 megawatts (MW) of installed generating capacity and more than 4,500 employees in 27 states and Canada. NextEra Energy Resources is the largest generator of solar energy in the country through operations at the Solar Electric Generating Systems (SEGS) in California's Mojave Desert. They have seven solar facilities located at Kramer Junction (SEGS III-VII) and Harper Lake (SEGS VIII, IX) in California. Total solar projects add up to 310 MW. These projects cover more than 2,000 acres in the desert with more than 900,000 mirrors that capture and concentrate sunlight. This represents approximately 1 percent of NextEra Energy Resources' total generation. NextEra has the Beacon project and the Genesis project in California approved by BLM and the California Energy Commission, two of the largest and highest profile projects, making NextEra a good candidate for this effort. Tetra Tech led the permitting on the Genesis Project.

Abengoa – operates in more than 70 countries with offices and projects in more than 35 of them thanks to its ability to export its products and services. Founded in 1941and currently headquartered in Spain. Sales and Gross Cash Flow in 2008 of 3200 M€ and 545 M€, respectively. The company has over 23,000 employees. The solar resources include 43 MWs in operation, 350 MWs under construction and hundreds of MWs under development. Abengoa has recently had the Rice project approved by BLM and the California Energy Commission and it is going to construction in 2010.

Solar Millennium – specializes in parabolic trough power plants, a proven and future-oriented technology, in which the Group holds a globally leading position. Besides the three Andasol projects in Spain, a parabolic trough power plant is being built in Egypt. Various further projects with an overall capacity of more than 2,000 MW worldwide are in the planning phase with focus on Spain, USA, China and North Africa. In the future, solar thermal power plants in the south will contribute to Central Europe's electricity supply. Headquartered in Erlangen Germany with 200 employees and has sales of € 200 EBIT. Solar Millenium is the largest developer in the western US. They have 4 four notable projects in the western US nearing construction including Ridgecrest, Blythe, Palen, and Amargosa Valley in Nevada. These projects have overcome the wide range of obstacles typical of western development and would be a great company to have on the Paragon-Bisti Ranch site.

Renewable Energy Systems (RES) – one of the fastest growing renewable energy companies in the world and has been at the forefront of the wind industry since it was founded in 1982. RES Americas, headquartered in Bloomfield, Colorado, has been active in North America since 1997 and during this time has either developed or constructed more than 10 percent of the installed wind capacity in the United States with 4,800 MW of projects. RES Americas has over 900 MW under construction and more than 12,500 MW under development. RES has a project on Indian land on the Moapa reservation north of Las Vegas and has successfully developed a working relationship with the tribe. They are also using the power tower technology developed by eSolar that has high solar efficiencies and is demonstrating the use of molten salt storage capability. Tetra Tech works with RES and can apply lessons learned from their tribal leasing work on the Moapa reservation.

EnXco – Solar PV energy development is a priority, with a global target goal of 500 megawatts-peaks (MWp) of net-owned capacity by 2012. EnXco is an EDF Energies Nouvelles Company, a 50 percent-owned subsidiary of the EDF Group. EDF Energies Nouvelles is a French Company and is a global leader in green electricity generation with an international presence in 10 European countries and the United States, Canada and Mexico. They presently have more than 15,000 MW of renewable energy projects in development. EnXco has several major projects in development in the western US and brings world class knowledge of the solar technologies to the project.

First Solar – Achieved the lowest manufacturing cost per watt in the industry, breaking $1 per watt in 2008. First solar will bring total expected capacity to more than 1.4GW by the end of 2010. Annual revenue was over $1 billion. By 2012, First Solar's total manufacturing capacity is expected to increase to 34 lines, equaling 1.8GW per annum based on the fourth quarter 2009 annual line run rate of 53.4 MW. In North America, First Solar built 50 MW of utility-scale projects, and in 2009 and early 2010, signed or acquired 1.7GW (AC) of new contracts. In 2009, sold an 80 MW Sarnia, Ontario project to Enbridge Inc. and a 21 MW Blythe, California project to NRG Energy. First Solar's 30MW project near Cimarron, New Mexico was recently sold to Southern Company. These sales demonstrate First Solar's ability to design and build utility scale PV solar projects that generate attractive rates of return.

APPENDIX D

RENEWABLE ENERGY TECHNOLOGIES

TECHNOLOGY REVIEW SECTION

Based on its deep understanding of both renewable and traditional fossil-fuel energy markets and trends, Tetra Tech provides a summary assessment of solar and other renewable technologies relevant to the Paragon-Bisti Ranch project.

Background: Long Term Pricing Trends in the Energy Markets

Over the past four decades, price inflation in motor fuels has run at more than double the long-term consumer price index (CPI), i.e. over 7 percent versus about 3 percent, while inflation in electricity (kWh, not kW) has lagged the CPI, i.e. about 2 percent versus about 3 percent. This long-term trend is unlikely to change direction which means that not only won't electric energy enjoy the upward market pressure that motor fuels enjoy, electricity will actually get cheaper in constant dollars which is a challenge to a business model predicted on scarcity. Offsetting this are the government requirements, such as California AB 32, which require 33 percent of electrical energy to come from renewable sources.

Renewable energy technologies appropriate for the Southwest are briefly compared below. A discussion of the pros and cons of each of the methods, plus brief forecasts, follows.

Technology	Capital cost [$/W] and Trend	Land Intensity [W/ft²]	Capacity Factor	Water Use
PV	$3 - $5, falling	5-10, rising	0.3-0.4	none
solar thermal	$3-$4, flat	2-5	0.4-0.5	some
solar chimney	$30-$40	0.3	0.35	none
wind	$2, flat	0.3	0.3-0.4	none
geothermal	$3, flat	30	0.9	heavy

Photovoltaic

Photovoltaics (both "hard" polycrystalline and "soft" thin-films, as well as new types) are a radically improving technology. It is in a great flux, but generally upward principally due to feed-in tariffs in Europe, and the entry by China into PV manufacturing. PV has by far the most "headroom" of any renewable energy technology. But PV is not baseload, and it has an intermittent duty cycle and low capacity factor compared to traditional thermal power. Many major technical areas are available for, and promise improvement. Current PV technology converts radiant energy in sunlight directly to electricity at 10s of percent efficiency (the fundamental limit seems to be about 40 percent). But what is captured is transferred to the grid with only modest losses. Currently PV power is capitalized at about three to five dollars per watt of capacity all-in, but this figure is falling rapidly – the fastest of all energy technologies. Unlike the other renewable energy technologies (except wind), once the grid-tie is established, PV fields can be constructed and generate revenue incrementally ("pay as you go"). This features helps

secure capital and reduce risk premium. PV can sell energy into the grid with feed-in tariffs greater than 20 cents per kWh. The production curve and incremental nature of PV power (its output peaks when the grid needs it most) guarantees its role as a high-value "peak shaver" for the foreseeable future. This is a critical factor for many solar projects in the western United States. Because higher-efficiency polycrystalline panels will be increasingly dominated by construction labor to install them, thin films have an opportunity to increase their market share, but so far this has not occurred. Overall cycle efficiency is in the low tens of percent (or tens of watts per square foot), which is at least an order of magnitude, perhaps two, better than windpower (or solar chimneys), at only a fraction of a percent (or a fraction of a watt per square foot).

The recent study conducted by Navigant Consulting reported that global manufacturing capacity for all types of photovoltaic material is presently 13 gigawatts per year, most of which is polycrystalline. The PV industry worldwide is growing at 33 percent compounded annually, and is now fully in the explosive near-vertical part of the exponential curve. PV production capacity has doubling every 20 months for over a decade, and the marginal price continues to fall ~20 percent for each doubling period. PV seems on track to cross under $1 per watt by 2020 (total installed cost including PV module plus "balance of plant"), with a total installed capacity worldwide exceeding one *trillion* watts. The gap of other energy technologies with respect to PV is rapidly increasing. PV is on the cusp of ubiquity, and when that trend becomes apparently irreversible, it is likely that incentives such as feed-in tariffs, tax credits, grants, will vanish. The PV market will have achieved critical mass and no longer need them. When these incentives disappear for PV, they are likely to vanish for all non-fuel forms of renewables. While the approach of the Paragon Project is to let the major developers select their own technologies, Tetra Tech recommends that the Navajo Nation fully understand the potential for PV technology to increasingly dominate the renewable energy market.

Solar Thermal

Solar thermal is a mature technology which is approaching its technical and economic limits. Currently solar thermal plants are capitalized at several dollars per watt of capacity and can sell energy into the grid at 10-12 cents per kWh without subsidy. Solar thermal is not quite baseload, but does provide a long, fairly predictable duty cycle. The remaining major technical area where major gains in performance might be had is viable, cost-effective thermal storage to stretch out the duty cycle, and alternative cooling arrangements to do away with the need for cooling water. Current solar thermal technology can capture a large fraction of the total heat energy in sunlight, at which point the cycle is subject to the usual thermodynamic limits. This suggests an overall thermal cycle efficiency of low tens of percent (or a spatial effectiveness about ten watts per square foot), which is at least an order of magnitude, perhaps two, better than wind, at only a fraction of a watt per square foot.

Solar Chimney

A solar chimney is a hybrid of solar thermal and windpower technology, in which a greenhouse collects air heated by the sun and delivers it to wind turbines inside a large chimney . Solar chimney power plants at multi-megawatt utility scale do not exist anywhere in the world yet. Solar chimney power is not baseload, has a modest duty cycle, and modest capacity factor. RoM capital cost is tens of dollars per watt of capacity, if not more. Electricity generated by a solar chimney would likely qualify to be sold into the grid at a feed-in tariff of about 20 cents per kWh, about the same as PV and wind. Solar chimney power is necessarily diffuse, in the same range of spatial efficiency as wind -- only a fraction of a percent, and a fraction of a watt per square foot.

Windpower

Windpower is a mature technology that is approaching its technical and economic limits on land. Windpower is not baseload, has an intermittent duty cycle, and low capacity factor. Currently windpower is capitalized at a couple dollars per watt of capacity can sell energy into the grid with a feed-in tariff about 20 cents per kWh, about the same as PV. The remaining major technical areas where major gains in performance might be won are: viable electrical storage, dealing with the intermittency, and integration with the grid. Current wind technology can capture only about a third of the total energy in an airstream, but converts that motion to electricity at high efficiency. Windpower is necessarily diffuse, only a fraction of a percent, or a fraction of a watt per square foot.

Geothermal

Geothermal (specifically hydrothermal) is a mature technology that is approaching its technical and economic limits. Currently geothermal plants are capitalized at several dollars per watt of capacity and can sell energy into the grid at 10-12 cents per kWh without subsidy. Alone among renewable energy technologies, geothermal is classified as baseload, with an arbitrarily long duty cycle, high capacity factor, and real dispatchability. The remaining major technical area where major gains in performance might be had is exploiting alternate heat resources, such as dry hot rock with engineered geothermal systems. Concerns with the technology mostly revolve around water resources, similar to those in hydrofracking for deep shale gas. Current geothermal technology is highly concentrated in terms of space, that is, the surface footprint of the power plant itself is small similar to traditional fossil-fired power. The fields of wellheads are relatively unobtrusive, especially if the water/steam manifolds connecting them are underground. Overall thermal cycle efficiency is tens of percent (and space intensity is tens of watts per square foot), which is at two orders of magnitude better than wind, at only a fraction of a percent, or a fraction of a watt per square foot.

APPENDIX E

TETRA TECH SOLAR EXPERTS

Expert Solar Team – Key Personnel Experience Highlights

Name Role	Title	Education / Registrations	Years of Experience
Experience Highlights			
Ron Gregg	Program Manager	BS and MS in Environmental Science	35
• Program manager of a dozen major solar developments in the western US • Experienced with NextEra, Iberdrola, Tessera, Cogentrix, Index Energy, SCE, NV Energy, Pacific Power, eSolar and other solar developers in the western US. • 9 years in US Department of Interior BLM federal lands leasing programs • Section Chief US EPA Region 8 • Director of Environmental Science and Regulatory Department, Fluor Corp 13 years.			
Scott Prosuch	Deputy Program Manager	BS and MS Mechanical Engineering	35
• Planned, coordinated and executed tribal projects, working with 26 tribes in the NW, in excess of $20M in project value • Instituted programs in S. Dakota to train over 100 tribal member in field technical skills • Developed alternative and conventional power and backups systems in remote locations supporting over 10K personnel and critical national tactical systems • Planned and coordinate renewable energy solar projects for two major DOD sites, encompassing over 18,000 acres to potentially produces over 2GWs of power.			
Teresa Harris	Senior Hydrologist	B.S., Geology, Certified Environmental Manager	20
• Planned, coordinated and managed solar technology feasibility assessment. • Planned, coordinated and executed tribal brownfield re-development projects, in excess of $5M • Planned, coordinated and executed tribal Sustainability Land End-Use Plan for 280 acres in Maricopa County Arizona • Planned, coordinated and executed land entitlement in support of solar power development, encompassing more than 30,000 acres in Arizona			
Mike Higgins, PE	Senior Civil Engineer – Project Manager Solar Energy	B.S., Civil Engineering, B.A., Wildlife & Fisheries Science / PE	29
• Managed multi-million-dollar projects involving multiple tasks and technical disciplines • Expertise includes cost and schedule management, project organization and execution, personnel management, and Titles I, II, and III engineering services • Experience in a wide range of engineering, facilities, and energy-related projects including: combined heat & power (CHP) systems, solar energy, design of potable water supply, wastewater collection and treatment, and facility renovation and demolition			
Doug Sutton	Principal Engineer Renewable Energy	Ph.D., Civil & Environmental Engineering, M.S., Civil & Environmental Engineering, B.A., Earth & Planetary Science / PE	35
• Formal training from solar manufacturers such as Sharp and Schott • Planning and develop with the full range of renewable energy systems including grid-tied photovoltaic, solar thermal systems, cogeneration, and geothermal systems • Executing small- and utility-scale PV systems • Experience in applying solar technologies to the problem of water treatment, as well as broad experience in energy economics, energy markets, and power purchasing agreements			

Name Role	Title	Education / Registrations	Years of Experience
Experience Highlights			
David Shevick	Senior Engineer Renewable Energy	B.S., Mechanical Engineering / PE / Licensed general contractor	32
• Executed large-scale, grid-tied photovoltaic systems, small and large-scale solar thermal systems, and biogas upgrade plants • Specializing in photovoltaic, plumbing, and HVAC • Experienced with air- and wet-side mechanical systems, package units, VAV retrofits, controls retrofits, recommissioning, central plants, cogeneration, optimal equipment control, boilers, chillers, pumping systems, and advanced lighting.			
Jim Davis	Senior Civil Engineer Renewable Energy & Transmission Grid	B.S., Civil Engineering / PE	18
• Specialized in renewable energy, cogeneration, hazardous waste management, field construction, risk assessment, and cost estimating • Experience liaising with regulators under the aegis of CERCLA/RCRA-mandated cleanups. • Worked on projects involving nuclear power, for both existing plants and new construction. In the course of these duties, Jim has developed a working knowledge of electricity generation, distribution, and interconnection issues.			
Kerry Saltmarsh	Project Manager Sustainable Engineering	B.A., Anthropology, Environmental Science and Renewable Energy	18
• Solar project manager - managed site analysis, planning, permitting, and installation of PV systems and solar thermal systems used for domestic hot water. • Designed and installed both solar electric and solar thermal systems in the southeast. Responsible for solar system design (roof mounted and ground-mounted), cost estimating, • Prepared grant documentation for commercial clients, project management, preparation of contractor licensing documentation, and a variety of educational programs for the public. • Prepared site-specific solar analyses to optimize system design for residential and commercial clients using the Solar Pathfinder. • Integrate grid-tied solar electric systems into the local Generation Partners program.			
Robert Kennedy	Green Energy Project Manager	M.A., National Security Studies, B.S., Mechanical Engineering / PE	18
• Energy-efficiency and renewable-resource policy and systems development at the local, state, and regional level • Energy audit plus renewable resource assessment (including PV and solar hot water) for 3M ft2 of facilities at Buckley AFB in Colorado, yielding $58K utility rebate and ~$200K savings • Economic appraisal of public water resources / well infrastructure in Arizona, avoiding $300+K in planned capital acquisition cost for ratepayers • Evaluating state-of-the-art utility-scale solar chimney (hybrid thermal-wind) • Initiated February 18, 2008 policy decisions to approve up to 5.15 MW of solar/wind power in the City of Oak Ridge; co-authored City's Climate Action Plan, which passed December 13, 2010. • Former Congressional Fellow with the Science Committee in the US House of Representatives			
Annette Blue	Green Energy Project Manager	B.S., Biology, A.A., Construction Management	14
• Work with others on development, planning and developing scope, schedule and cost for large-scale Concentrating Photovoltaic (CPV, CSP) and Wind renewable energy generating facilities on tribal lands. • Initiate and maintain coordination with all project stakeholders. • Plan and develop renewable energy programs that include utility-scale photovoltaic, co-generation, solar thermal, grid-tied photovoltaic systems, wind generation systems, geo-thermal systems and bio-mass energy generation. • Promote activities and practices that support the social well being of communities through Sustainable economic development. • Co-authored the Paragon Ranch Renewable Energy Project Feasibility Study 2009 (for the Navajo Nation) funded by grant from U.S. DOE – Tribal Energy Programs.			