



NORTHERN PUEBLOS HOUSING AUTHORITY

5 WEST GUTIERREZ, SUITE 10, SANTA FE, NM 87506

PHONE: (505) 455-7973 TOLL FREE: 1-888-347-6360 FAX: (505) 455-3789

Final Report Pueblo of Picuris Phase I Community Solar Project

**Department of Energy
Office of Indian Energy Policy and Programs
DOE Grant Number DE-IE0000033**

May 29, 2020

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prepared for

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**Final
05/29/2020**

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1.0 EXECUTIVE SUMMARY

The Pueblo of Picuris Community Solar Project (Project) is a 1-megawatt (MW) alternating current (AC) ground mounted, fixed tilt solar photovoltaic system that became operational on December 18th, 2017. The Project, which was partially funded by the DOE (Grant No. DE-IE0000033), generates revenue for the Tribe through a Power Purchase Agreement (PPA) with the electric utility, Kit Carson Electric Cooperative. The PPA revenue provides Tribal members with residential and commercial electric utility bill offsets and also supports critical Tribal programs.

This Final Report provides a technical overview of the Project, documents the Project's development process and outcomes, identifies successes and challenges, and offers recommendations for similarly funded tribal projects.

While the Project was successfully completed and provides an ongoing benefit to the Tribe, challenges faced during development and documented in this Final Report should be viewed as instructive for future tribal energy projects. The specific challenges identified for this Project involved planning, procurement and management of the solar developer, and commissioning and closeout.

2.0 PROJECT OVERVIEW

In August 2014, the U.S. Department of Energy (DOE) facilitated completion of a Strategic Energy Plan for the Pueblo of Picuris. The Pueblo of Picuris Phase I Community Solar Project (Project) was developed to meet the principle goal of Strategic Energy Plan of providing renewable energy for 100% of the Pueblo's electric needs. Under a designation of Tribal organization and a joint venture agreement, development of the Project was managed by Northern Pueblos Housing Authority (NPHA). On behalf of the tribe, on December 4th, 2015, NPHA executed a 25-year power purchase agreement (PPA) with the local electric utility, Kit Carson Electric Cooperative (KCEC). Under the PPA, which NPHA has since assigned the rights to the Tribe, power generated from Project is purchased by KCEC at a fixed price per kilowatt hour (kWh).

The Project objectives were as follows:

- Develop the first fully solarized Pueblo in New Mexico by covering most of the Pueblo's electricity costs;
- Provide stable income for Tribal government;
- Offset carbon emissions from the utility's conventional energy supply;
- Contribute to the renewable energy transition in northern New Mexico; and
- Create a replicable model for Indian Country using an innovative financial structure that combines conventional financing with grant funding.

2.1 Site Description

The Project occupies approximately 7 acres of a 10-acre parcel owned by the Pueblos on Tribal trust land in southern Taos County, NM. The Project site is located on the *Peñasco*, New Mexico US Geological Survey 7.5 minute topographical map (NE ¼ Section 32 of Township 32 North, Range 12 East, New Mexico). The Project site elevation ranges between 7,540 and 7,560 feet above sea level. The site and surrounding land is characterized by the piñon-juniper, sagebrush, and native grass vegetation.

As illustrated in Figure 1, the Project is interconnected with an existing KCEC transmission line that runs parallel to New Mexico State Road 75. The project site is located approximately 1 mile north of an existing KCEC substation.

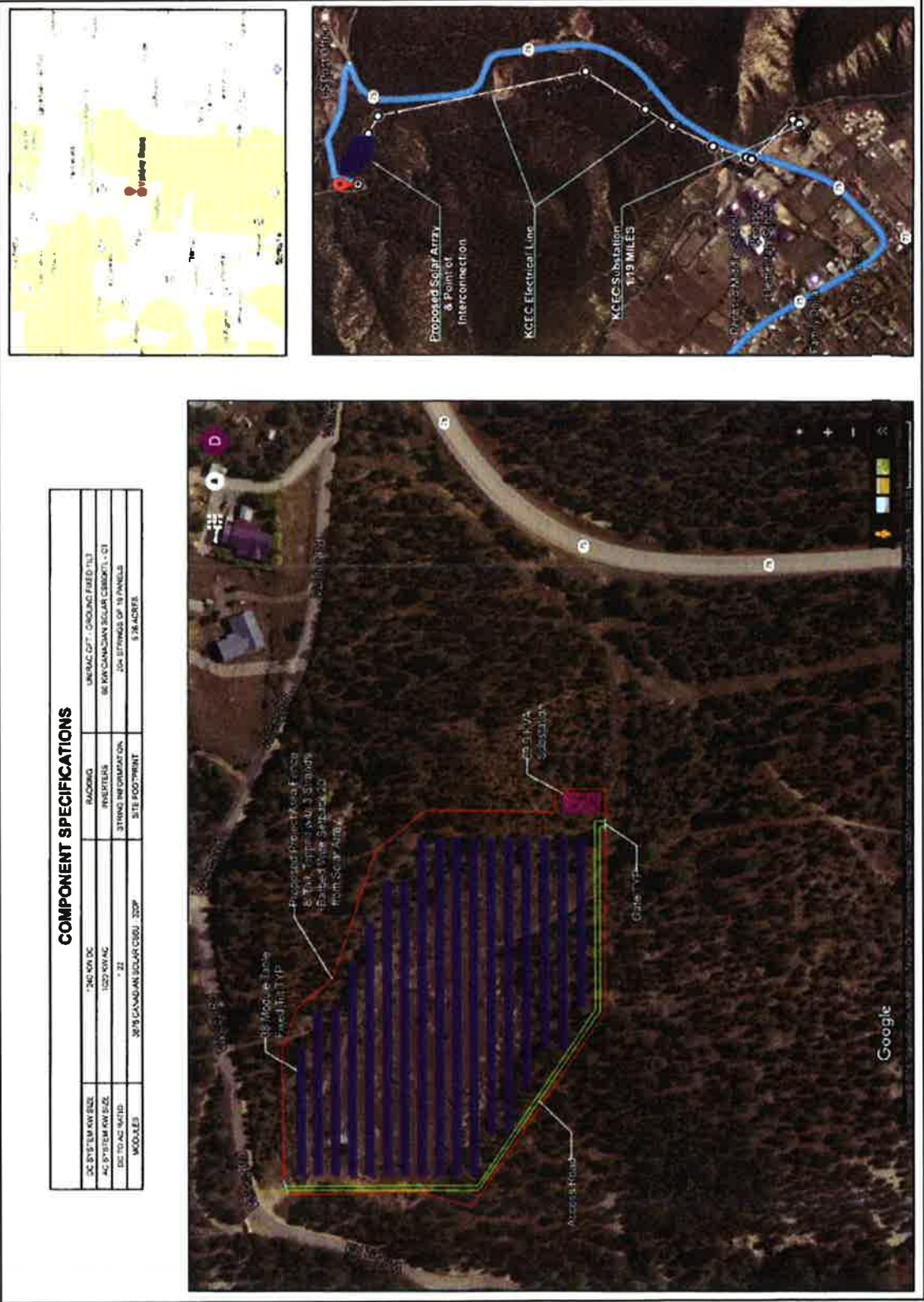


Figure 1. Project Location and Layout

2.2 Enabling Legislation and Agreements

2.2.1 Pueblo of Picuris Resolution

On July 28th, 2015, the Pueblo of Picuris adopted Resolution No. 2015-24, paraphrased below:

- Designated 10 acres of Tribal trust land for development of the Project (along with Travel Center and RV Park);
- Authorized NPHA to engage in fundraising for the Project and enter into negotiations with private investors to assist in Project financing; and
- Approved a Power Purchase Agreement (PPA) between NPHA and KCEC for the Project on behalf of the Pueblo.

2.2.2 NPHA Resolution

On November 3rd, 2016, NPHA adopted Resolution 2016-06, paraphrased below:

- Affirming NPHA's previous actions for the Project that include entering into the PPA with KCEC and applying for and securing the DOE grant;
- Authorizes NPHA to continue to pursue Project financing and provide services related to the Project, including but not limited to Project design; and
- Requiring NPHA to consult legal counsel on all such services.

2.2.3 Power Purchase Agreement

For the Project, a Power Purchase Agreement (PPA) between NPHA and KCEC was executed on December 4th, 2015. On June 29th, 2016, NPHA provided KCEC a notice of a 180-day extension of the Conditions Precedent Deadline and Commercial Operation Deadline; this extension notice was acknowledged and agreed by KCEC on July 18th, 2016. On December 7th, 2016, NPHA provided KCEC a second notice of a 180-day extension of the Conditions Precedent Deadline and Commercial Operation Deadline; this extension notice was acknowledged and agreed by KCEC on February 2nd, 2017. Per the second extension:

- Conditions Precedent Deadline is extended from December 27th, 2016, to July 30th, 2017; and
- Commercial Operations Deadline is extended from June 29th, 2017, to the end of 2017.

Subsequently, a third extension was agreed to by KCED, extending the Commercial Operations Deadline to the end of 2018.

2.3 Project Financing

To finance the planning and development of the Project, two federal grants were secured in addition to securing matching funds through conventional financing.

2.3.1 BIA Grant

On January 4th, 2017, BIA awarded a \$61,000 grant to NPHA for the “Picuris Renewable Energy Planning Study” (Grant No. A16AP00004). The grant’s period of performance is from March 30th, 2016 through June 30th, 2017.

2.3.2 DOE Grant

On October 27th, 2016, NPHA executed a Grant Agreement with the U.S. Department of Energy’s (DOE) Office of Indian Energy (OIE) to provide \$1 million in federal funds to partially finance development of the Project (Award No. DE-IE0000033). The Grant Agreement has a Cost Share requirement of \$1,221,000, based on an estimated total project cost of \$2,221,000.

2.3.3 Matching Funding through Conventional Financing

The Tribe secured a \$1,300,00 loan Peoples Bank as matching funding to the DOE grant.

2.4 Procurement of the Solar Developer

NPHA advertised a Request for Proposals (RFP) to solicit design-build proposals from solar developers from December 5th through 7th, 2016. The RFP was advertised in the Española-based Rio Grande Sun newspaper. On December 8th & 9th, 2016, NPHA and Picuris Pueblo held a non-mandatory site-visit meeting for prospective solar developers. Six proposals were received by NPHA by the submittal deadline, December 16, 2016. Interviews of the six proponents by NPHA were conducted on January 19th and 20th, 2017. Based on the proposals and interviews, NPHA established a preliminary ranking of the proponents. A request for supplemental information was then provided to the four top-ranked proponents. Each of the four top-ranked proponents submitted supplemental information by the deadline, February 2nd, 2017. Based on the proposals, interviews, and supplemental information, on February 6th, 2016, NPHA conducted a final ranking of the proponents to select the solar developer for the Project.

On behalf of the Pueblo, NPHA selected Albuquerque-based Osceola Energy to construct the Project. NPHA subsequently executed a design-build agreement with Osceola Energy on March 13th, 2017. The agreement called for construction of a for a 1.2 MW DC fixed-tilt solar PV system for \$2,109,000, with Project completion on August 9th, 2017.

Osceola Energy stipulated in their bid, which was incorporated into the contract documents, that cost and schedule were contingent on the geotechnical analysis. Notably, a geotechnical analysis of onsite subsurface conditions was not conducted prior to the procurement of the solar developer.

2.5 Project Authorizations and Compliance

2.5.1 Electric Utility Interconnection

Under the design-build agreement, the solar developer was responsible for facilitating Project interconnection with KCEC. This involved preparing the interconnection application and submittal to KCEC, paying interconnection fees, providing required technical information, and otherwise making all other reasonable efforts to facilitate interconnection of the solar project.

2.5.2 N.M. Construction Industries Division

As part of the design-build agreement, the solar developer was responsible for obtaining a permit from the New Mexico Construction Industries (& Manufactured Housing) Division (NMCID). The state agency conducted construction and electrical code inspections of the Project.

2.5.3 New Mexico Department of Transportation

As part of the design-build agreement, the solar developer was responsible for obtaining a New Mexico Department of Transportation (NMDOT) temporary construction permit and driveway permit for access to New Mexico State Highway 75 (NM 75). In addition, Osceola Energy was expected to develop a Transportation Safety Plan.

2.5.4 Clean Water Act, National Pollution Discharge Elimination System

As part of the design-build agreement, the solar developer was responsible for developing Stormwater Pollution Prevention Plan (SWPPP) and submit a Notice of Intent (NOI) to the EPA, as required by NPDES.

Section 401 of the CWA (See also 40 CFR §122.44(d)(3)) and §124.53(a)) provides that no Federal license or permit, including NPDES permits, to conduct any activity that may result in any discharge into navigable waters shall be granted until the State/Tribe in which the discharge originates certifies that the discharge will comply with the applicable provisions of sections 301, 302, 303, 306, and 307 of the CWA.

2.5.5 National Environmental Policy Act

The DOE grant for the Project required that DOE must comply with the National Environmental Policy Act (NEPA) prior to authorizing the use of Federal funds. DOE made a conditional NEPA determination for this Project award, and federal funding for certain tasks under this award were contingent upon the final NEPA determination.

The DOE grant authorized NPHA to proceed with pre-construction activities, including securing Project finance, procurement of engineering and construction services, project management, reporting, and Project design.

To facilitate issuance of the DOE's final NEPA determination for the Project, NPHA hired Marron and Associates to prepare an Environmental Assessment (EA) of the Project, which was completed in November, 2016.

On March 15, 2017, the BIA Northern Pueblos Agency issued a notice to proceed with the project based on the January 27, 2017 Finding of No Significant Impact which received no appeals during the 30-day advertisement period.

2.5.6 Federal Wage Requirements

Federal Wage Rates (Davis-Bacon Prevailing wages) were not required by the DOE for this Project (Principal Engineer/Team Lead, Allegheny Science and Technology, Contractor to the U.S. Department of Energy, Office of Indian Energy, personal communication, February 13, 2017).

2.5.7 Cultural Resources

On September 15, 2016, the New Mexico Historic Preservation Office (SHPO) concurred with the findings of the cultural resources report with the recommended measures for the Project. The solar developer was responsible for adhere to these recommendations.

2.5.8 NM Gross Receipts Tax Exemption

The 2007 New Mexico legislative session declared 2007 as the Year of Clean Energy. The New Mexico Comprehensive Clean Energy Legislative Package includes the enactment of the Solar Gross Receipts Tax (GRT) Deduction, a tax deduction for businesses from the sale and installation of solar energy systems. The Solar Gross Receipts Tax (GRT) Deduction (7-9-112 NMSA 1978) became effective July 1, 2007 (EMNRD, 2017).

The solar developer was responsible for obtaining a signed copy of Form RPD-41341 to claim the deduction or other evidence acceptable to EMNRD that the service or equipment was purchased for the sole use of the sale and installation of a qualified energy system.

3.0 TECHNICAL OVERVIEW

3.1 Description

The completed Project consists of a 1.2 MW DC (1.0 MW AC) ground mounted, fixed-tilt PV system with the following major components:

- Jinko 72 solar PV modules, 325 watt, 1500 volt, JKM325P-V
- GE 1.1 MW central inverter, 1,500 volt, LV5-1511-30-UL-SLR
- Eaton 1500 VDC PV Collection Systems (combiner boxes)
- PTI Step-up transformer (n = 1)
- Unirac ground-fixed-tilt (GFT) racking

3.2 Component Warranties

The Project's major components have the following warranties:

Table 1. Major Component Warranties

System Component	Warranty
Jinko 72 solar PV modules, 325 watt	25 year production warranty; 10 year warranty on materials and workmanship (replacement labor not included)
GE 1.1 MW central inverter	5 year product warranty; 10, 15, & 20 year extended warranty available at additional cost
PTI Step-up transformer	12 month standard warranty; 5 year extended warranty available at additional cost
Unirac GFT racking	10 year product warranty

3.3 PV System Design and Layout

The PV system is configured to have approximately 18 modules per string and approximately 199 strings in parallel. The fixed-tilt PV system is oriented on an azimuth of 180 degrees, with a tilt-angle of 30 degrees. Refer to Appendix A for construction photos and to Appendix B for Project design drawings.

3.4 Project Construction Cost

The original design-build agreement values, change order value, and work delay penalty value are summarized in Table 2. Construction costs summarized in Table 2 do not include Project planning and management costs, including feasibility assessment, geotechnical analysis, legal services, and project management support.

Table 2. Project Construction Cost

Category	Value
Engineering	\$60,000.00
Permitting	\$12,000.00
Interconnection	\$96,000.00
Mobilization / Equipment	\$60,000.00
PV Modules	\$636,000.00
Inverters	\$220,000.00
Transformers	\$125,000.00
Electrical materials (conduit, fittings, couplings, wire, connectors)	\$120,000.00
Unirac GFT Racking	\$180,000.00
Labor	\$600,000.00
Subtotal	\$2,109,000.00
Change Order No. 1: excavation and concrete foundation for racking system (4/14/17)	\$145,456.34
Subtotal	\$145,456.34
Work Stoppage Cost (6/2/17 through approx. 7/2/17)	\$30,000.00
Subtotal	\$30,000.00
Total	\$2,284,456.34

4.0 PROJECT DEVELOPMENT

4.1 Geotechnical Analysis

The geotechnical engineering analysis was completed by GeoTest on March 10th, 2017, with the final geotechnical report provided to NPHA on March 23rd, 2017.

The geotechnical analysis determined that the soils encountered at the test boring locations consisted of a surface layer comprised of clay with various amounts of fine sand. These soils, which extended to depths of about 1½ to 2 feet at the boring locations, are of medium plasticity, and ranged from soft to moderately firm. Directly underlying the surficial clay layer, clayey gravels with various amounts of sand and occasional cobbles were encountered and extended to auger refusal at depths of between 5 to 6 feet below existing site grade. It was determined that the auger refused on cobbles and/or possibly boulders, at the refusal depth. These soils ranged from non-plastic to low in plasticity and ranged from medium dense to very dense.

Based on the geotechnical profile underlying the site and the results of the standard penetration tests, it was anticipated that driving the piles would be very difficult, or impossible, to depths greater than about 5 or 6 feet, at least throughout most of the site. Thus, pre-drilling or heavier gauge piling would be required, or the piles could be placed in short straight, drilled, cast-in-place concrete piers.

4.2 Construction

Based on input from the geotechnical consultant, NPHA and the solar developer negotiated Change Order No. 1, dated 4/14/17 (\$145,456.34) to pay for additional construction costs for the concrete foundations of the solar PV array racking system.

NPHA issued the Notice to Proceed to the solar developer on April 14, 2017.

As shown in construction photos included in Appendix A, the solar developer excavated trenches for the concrete piers using an excavator and backhoe.

Due to a delay in securing matching funding from Peoples Bank for the Project, NPHA was unable to process the solar developer's initial pay application. This situation resulted in the solar developer issuing a Stop Work Notice on May 26th, 2017, effective on June 2nd, 2017. Once the Tribe secured the loan from Peoples Bank, NPHA processed the outstanding pay application and the solar developer subsequently returned to the Project site. Under the terms of the design-build agreement, NPHA was obligated to pay additional costs associated with the solar developer demobilizing/remobilizing, delay, and startup, plus interest.

Once the solar developer recommenced onsite construction, the Project development proceeded through completion without any significant issues.

The Project construction period lasted 249 days (8 months, 5 days), from the solar developer's Notice to Proceed (4/14/17) to beginning commercial operation (12/18/17). Putting aside the interim period when the solar developer stopped work, given the remote Project location and the additional time to complete the concrete foundations, the total construction duration was not excessive.

4.3 Local Workforce Training

Under the design-build agreement, the solar developer was responsible for hiring and training local workers from the Pueblo and Peñasco area as part of Project construction. During construction, NPHA and the Tribe indicated that the solar developer did not hire sufficient numbers of local workers, the workers were paid less than the prevailing wage rates, and the workers were not trained beyond the level required for manual labor.

5.0 PROJECT PERFORMANCE AND MONITORING

5.1 PV System Electrical Production

Using the modeling software PVsyst, the solar developer estimates that their proposed PV system will generate 2,293,000 kWh in year 1.

As part of the feasibility analysis for the Project, SMA developed financial and performance projections using the National Renewable Energy Laboratory (NREL) System Advisor Model (SAM). SMA projected that the solar developer's proposed PV system would produce approximately 2,207,465 kWh in year one, which is only 3.7% less than the solar developers estimate (SMA, 2017). This difference is likely due to the solar developer's use of a different model than SAM (NREL, 2014), and because the selected developer used data from a NREL NSRDB Station other than Peñasco, NM.

For this report, the Tribe provided Project power generation records from January 2018 through March 2020, summarized in Table 3.

Table 3. Project Power Generation and Revenue, January through October, 2018

Month	kWh	PPA Revenue (\$0.09/kWh)
Jan-18	53,451	\$ 4,811.00
Feb-18	98,853	\$ 8,897.00
Mar-18	137,280	\$ 12,355.00
Apr-18	214,689	\$ 19,322.00
May-18	235,691	\$ 21,212.00
Jun-18	83,745	\$ 7,537.00
Jul-18	128,927	\$ 11,603.00
Aug-18	200,514	\$ 18,046.00
Sep-18	195,997	\$ 17,640.00
Oct-18	149,142	\$ 13,423.00
Nov-18	140,677	\$ 12,661.00
Dec-18	103,348	\$ 9,301.00
Jan-19	96,186	\$ 8,657.00
Feb-19	90,733	\$ 8,166.00
Mar-19	149,337	\$ 13,440.33
Apr-19	176,355	\$ 15,871.95
May-19	203,726	\$ 18,335.34
Jun-19	203,956	\$ 18,356.04
Jul-19	50,786	\$ 4,570.74
Aug-19	190,542	\$ 17,148.78
Sep-19	156,388	\$ 14,074.92
Oct-19	65,623	\$ 5,906.07
Nov-19	32,301	\$ 2,907.09
Dec-19	25,496	\$ 2,294.64
Jan-20	76,276	\$ 6,864.84
Feb-20	45,829	\$ 4,124.61
Mar-20	173,951	\$ 15,655.59

The first two months of operation, January and February, 2018, the Project was not generating power every day due to startup testing and issues with the GE central inverter. The GE central inverter faulted again in June and July, 2018, in July, 2019, and September through February, 2019, causing additional days with no generation. In 2018, NPHA and the solar developer coordinated with GE regarding these issues, resulting in GE service technicians visiting the Project and correcting the faults. In 2019 and in 2020, the Tribe coordinated directly with GE to address the reoccurring inverter issues.

Based on the assumed full production months from both 2018 and 2019, and assuming 200,000 kWh were generated in July, the Project generates approximately 1,988,390 kWh per year. This value is approximately 200,000 kWh less than the solar developer's and feasibility study estimated annual power generation. Clearly, the Tribe needs to closely monitor Project performance to address issues as they arise and limit periods of non-production. Project power generation data should routinely be compared to the feasibility study's annual and monthly power generation.

5.2 PV System Performance Monitoring

For at least the first year after Project completion, a redundant production meter owned by the Tribe was not in-place. Therefore, the Tribe was reliant on KCEC's Project production data from the KCEC-owned meter. As specified in the PPA, the Tribe should independently monitor Project production to ensure that the Tribe is compensated for all Project generation and to resolve any discrepancies between production records.

Under the design-build agreement, the solar developer was responsible for providing NPHA and the Tribe with remote, real-time performance monitoring of the Project. There were protracted issues with NPHA and the Tribe's infrastructure to accommodate this monitoring capability through the central inverter. NPHA was able to remotely monitor the inverter status for several months in 2018. The Tribe coordinated with GE in 2019 to resolve technical issues, resulting in the Tribe being able to remotely monitor Project status sometime in 2019.

SMA is not aware of the current status of the Tribe's production meter or the Tribe's monitoring or recording production data.

6.0 CONCLUSION AND RECOMMENDATIONS

Despite several challenges, the Project was successfully completed and provides the opportunity for the Tribe to generate long-term revenue to offset the Pueblo's electric utility costs and support critical Tribal programs. To ensure that the Project continues to provide benefits to the Tribe, it is incumbent on the Tribe to actively maintain the Project.

It is critically important that the Tribe install a redundant Tribally-owned production meter to record Project power generation. The power generation data from this meter will be used to calculate the invoices under the PPA and reconcile any discrepancies between the Tribe's meter and KCEC's meter.

The Tribe should pay for PV system operation and maintenance (O&M) training for several Tribal employees who can be consistently relied upon to perform Project O&M. These Tribal employees should be responsible for: 1) operating and maintaining the Tribally-owned production meter and remote monitoring equipment; and 2) ensuring production data is recorded and maintained. Monitoring Project performance is critical to ensure that the PV system is operating normally and that any issues are addressed in a timely manner.

As discussed in the feasibility assessment, the Tribe should contribute a portion of the PPA revenues to reserve fund to pay for O&M expenses, including central inverter replacement. It is anticipated that the central inverter would need to be replaced or undergo significant upgrade every 10-15 years.

7.0 LESSONS LEARNED

Through the course of developing the Project, there were several important lessons learned that should be viewed as instructive for all future tribal energy projects:

1. The Project would have benefitted from having the RFP advertised more broadly and for a longer period of time. Because the RFP was only advertised in a local paper for three days, very few firms requested the RFP from NPHA. This resulted in having to choose from less competitive proposals from experienced contractors and relatively cost competitive proposal from less qualified firms.
2. The geotechnical analysis should have been completed before the Project procurement process began. The completed geotechnical analysis report should have been included in the RFP document. Not performing geotechnical analysis before advertising the RFP resulted in technical and cost proposals that did not take into account problematic subsoil conditions and additional costs associated with concrete foundations for racking. At the point that geotechnical analysis was completed, NPHA had already selected the solar developer, so the Project did not benefit from competitive costs proposals from multiple

solar developers that took into account the additional work required for the concrete foundations.

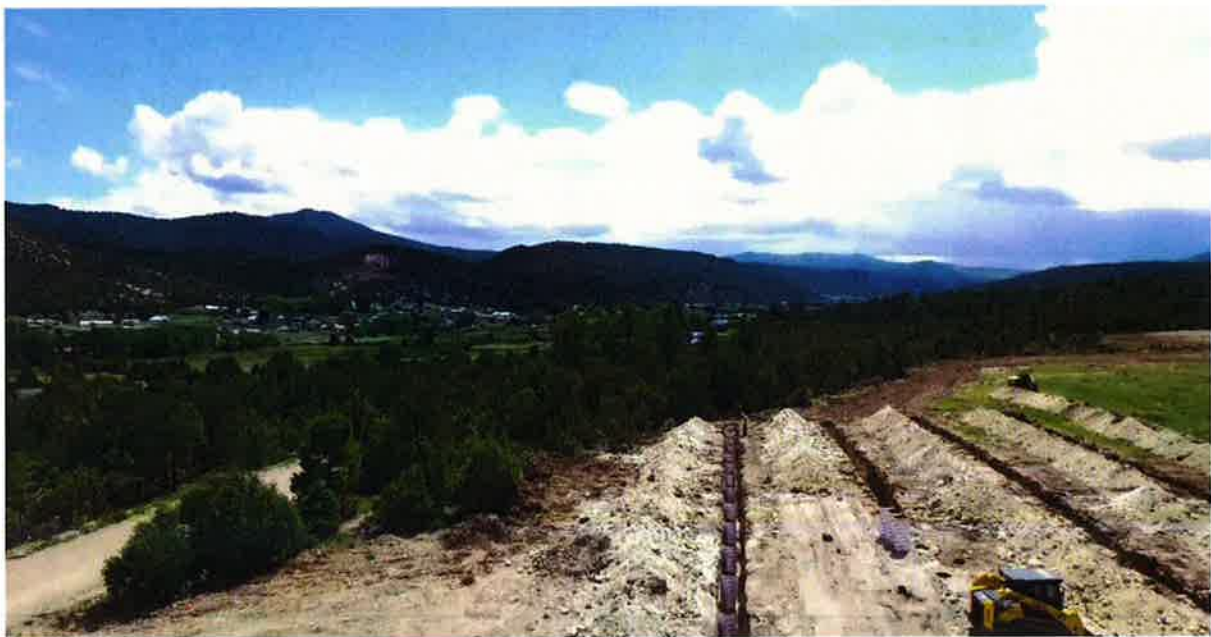
3. By issuing the notice to proceed to the solar developer before the matching funding (conventional financing) was secured, The Pueblo of Picuris put the project in (1) grave danger of not being completed timely and (2) not being completed at all. This was due to the Pueblo's lack of financial commitment to honor cost sharing requirements for the administration of the grant. Additionally, the Pueblo had committed to NPHA, cost share funds through a Tribal Resolution(s) and a letter from the Governor. This issue resulted in a significant period of time when the solar developer stopped work due to delay in payment of the solar developer's first pay application and also caused additional Project costs associated with the solar developer's demobilization/remobilization and incurred interest. To avoid this problem in the future, all projects should resolve funding matters before initiating construction.
4. The design-build agreement did not sufficiently detail the solar developer's responsibilities for Project start-up, testing, commissioning, and provision of remote system monitoring. To avoid this problem in the future, all agreements with contractors should be explicit about the contractor's responsibilities for construction and start-up, testing, commissioning, and monitoring.

8.0 REFERENCES

Souder, Miller and Associates (SMA). 2017. Final Feasibility Study of Economics, Development and Performance of Solar Photovoltaics at the Pueblo of Picuris for the Northern Pueblos Housing Authority, Pojoaque, NM., March 15, 2017.

9.0 APPENDICIES

Appendix A - Construction Photos





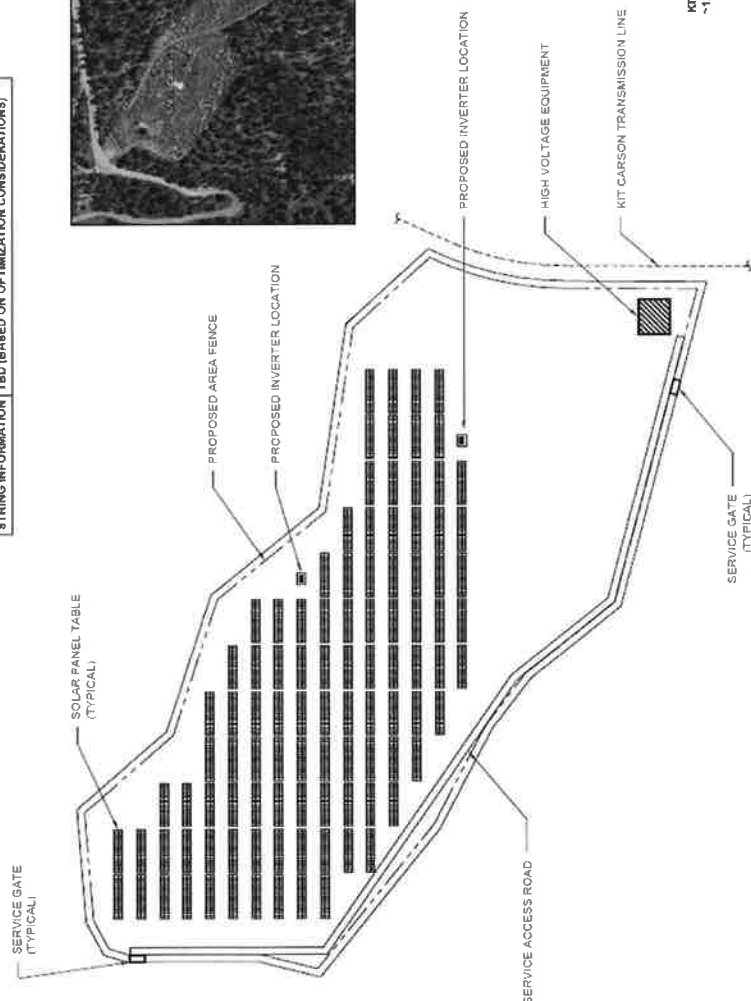
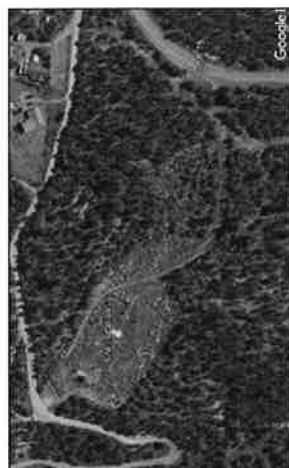




Appendix B - Project Design Drawings

SYSTEM COMPONENTS

DC SYSTEM SIZE	1.2 MW
AC SYSTEM SIZE	1.0 MW
DC TO AC RATIO	1.2
MODULES	CANADIAN SOLAR C80L355M
PACKAGING	UNIRAC GROUND FIXED TILT
INVERTER	
WARRANTY INFORMATION	20 YEAR
OTHER INFORMATION	TBD (BASED ON OPTIMIZATION CONSIDERATIONS)



- A. THIS DRAWING IS A SCHEMATIC IN NATURE AND IS NOT TO BE INTERPRETED OR CONSIDERED AS AN ATTEMPT TO CONSTITUTE A FINAL SYSTEM DESIGN. CONTRACTOR SHALL COORDINATE EXACT LOCATIONS WITH THE ELECTRICAL CONTRACTORS IN FIELD.
- B. ALL FEEDERS / BRANCH CIRCUITS SHALL BE INSTALLED AT DEPTHS AS DICTATED BY NEC ARTICLES TABLE 300.5
- C. ALL ELECTRICAL MATERIALS SHALL BE LISTED ALL EXPOSED COMPONENTS SHALL BE UV RESISTANT.
- D. SYSTEM WIRING TO A MAXIMUM OF 7% VOLTAGE DROP.
- E. EXPOSED CONDUIT SHALL BE ROUTED AT AN ANGLE TO MINIMIZE PROTRUSIONS FROM VIEW AS MUCH AS POSSIBLE.
- F. PIP EQUIPMENT SHALL BE LABELED PER NEC REQUIREMENTS.
- G. ALL PV WIRING SHALL BE PV WIRING.

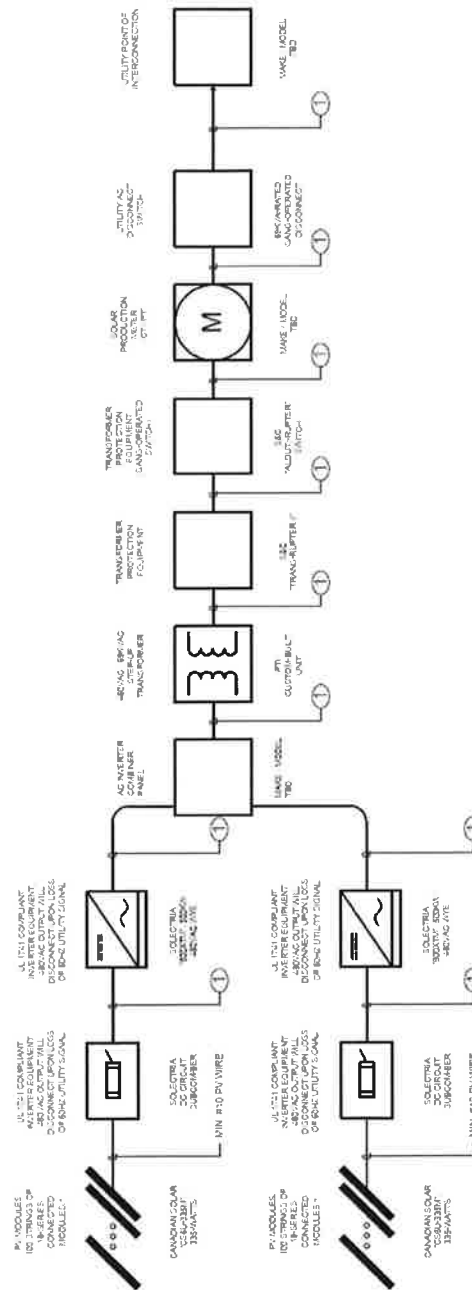
PICURIS PUEBLO
VALDEZ ROAD
PENASCO, NM 87553
GPS SITE COORDINATES:
36.19, -105.68

OSCEOLA ENERGY
3004 2ND STREET NW
ALBUQUERQUE, NM 87107

Student	Name		Class	Page
Pr. 1	Matr. No.	Gr.		

KT CARSON SUBSTATION
-1.2 MILES SOUTH OF SITE

PICURIS PUEBLO PV LINE DIAGRAM



*ACTUAL SOURCE CIRCUIT
ON F5 AND MODULE COUNT
ED (BASED ON OPTIMIZATION
CONSIDERATIONS)

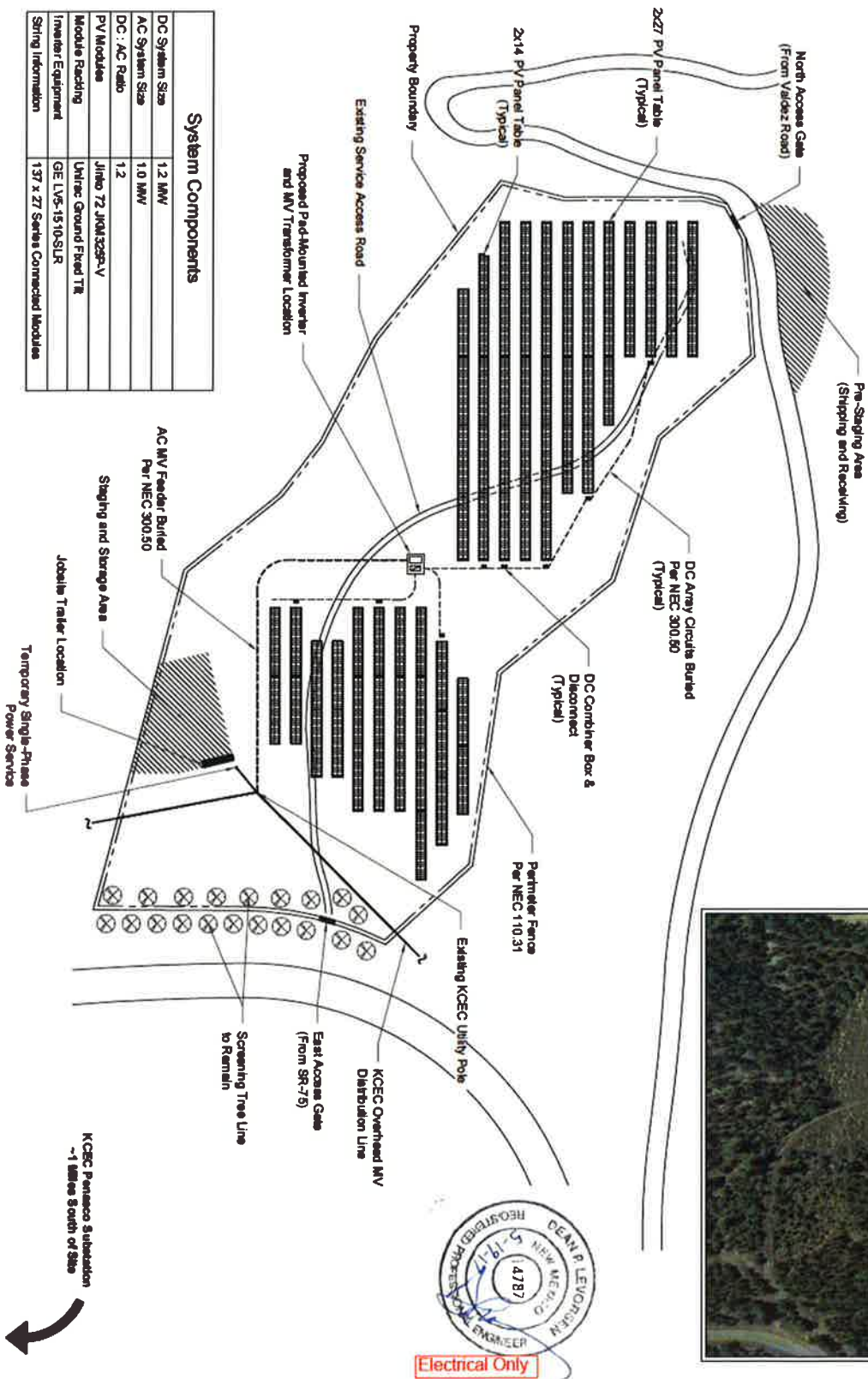
General Notes	Notes	Revisions
A. THIS DRAWING IS SCHEMATIC IN NATURE AND IS NOT INTENDED TO CONSTITUTE A FINAL SYSTEM DESIGN. B. ALL ELECTRICAL COMPONENTS SHALL BE UL LISTED, ALL EXPOSED COMPONENTS SHALL BE UL RATED. C. RESISTANCE WELDING SHALL BE USED TO A MAXIMUM OF 3% VOLTAGE DROP. D. EXPOSED CONDUIT SHALL BE ROUTED AT PARALLEL AND PERPENDICULAR ANGLES TO CONCEAL FROM VIEW AS MUCH AS POSSIBLE. E. PV EQUIPMENT SHALL BE LABELED PER 69.1.1.1. F. ALL PIPING SHALL BE PV WIRE KEYED NOTE: 1. TBD, BASED ON EQUIPMENT SPECIFICATIONS AND VOLTAGE DROP CONSIDERATIONS		

PICURIS PUEBLO
VALDEZ ROAD
PENASCO, NM 87553
GPS SITE COORDINATES:
36.19, -105.68

OSCEOLA ENERGY
3004 2ND STREET NW
ALBUQUERQUE, NM 87107

Project	PAC URBAN INTERL. O
By	Paul J. Zapp
Date	11/15
Sheet	Page
Sheet	Page 2

PICURIS PUEBLO PV SITE PLAN



Electrical Only

General Notes

- Coordinate exact equipment locations with contractor in field.
- All feeder circuits shall be buried at depth as directed by NEC 300.30.
- Contractor shall provide working space clearances as directed by NEC 110.26.
- Contractor shall provide all labeling and signage as directed by NEC 600 Part V, Article 110, Article 228, & Article 404.

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DESIGN, BUILD, MAINTAIN

PICURIS PUEBLO
VALDEZ ROAD
PENASCO, NM 87653
GPS SITE COORDINATES
36.16, -106.68

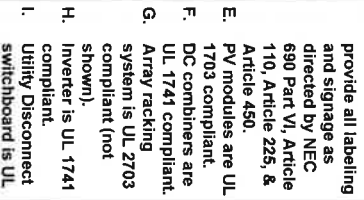
OSCEOLA ENERGY
3004 2ND STREET NW
ALBUQUERQUE, NM 87107

Project Number	Rev	Issued To
2017-001	1	DR
2017-001	1	DR
2017-001	1	DR

System Components

DC System Size	12 MW
AC System Size	1.0 MW
DC: AC Ratio	1:2
PV Modules	Jinko 72 JKH325P-V
Module Racking	Unirac Ground Fixed TR
Inverter Equipment	GE LV5-1510-SLR
String Information	137 x 27 Series Connected Modules

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Wine Schedule		
Wine	Wine	Max. length
PV Source Ctr	2 x #10 Cu. PV/Mm	~350
PV Output Ctr	2 x #400 N. PV/Mm	~550
Inverter/Output Ctr	5 ea. #6000cmi Cu THWN-2	~57'

Project Project Position	Board PV-2-1
Date May 17, 2017	Drawn By PT
Drawn NTS	Checked By DF
	Page 1

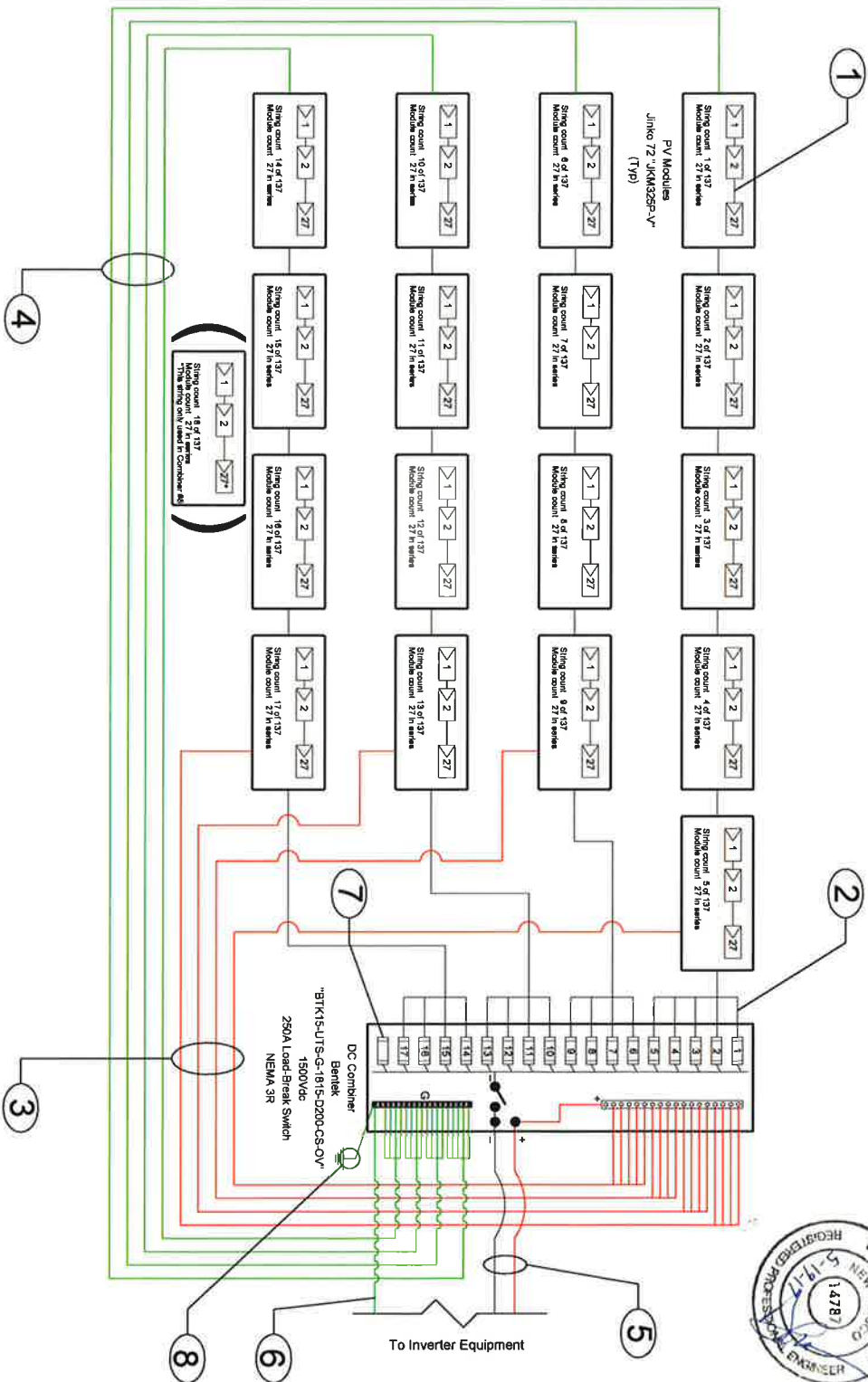
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PENASCO, NM 87553
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Line Diagram: PV Source Circuit Detail

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General Notes

- Refer to Site Plan for equipment location details.
- All feeder circuits shall be buried as depth as directed by NEC 300.50. Contractor shall provide working space as directed by NEC 110.26.
- Contractor shall provide all labeling and signage as directed by NEC 690 Part VI, Article 110, Article 226, & Article 450. PV modules are UL 1703 compliant.
- DC combiners are UL 1741 compliant.
- Grounding system is UL 2703 compliant (not shown).

Keyed Notes

- Manufacturer-Supplied #12 Cu PV Wire XLPE, Free Air (TYP)
- #10 Cu PV Wire XLPE, Free Air (TYP)
- #10 Cu PV Wire XLPE, Free Air
- #6 Cu Solid / Stranded (EGC)
- #40 Al PV Wire XLPE, Direct bury
- #4 Cu Solid / Stranded (EGC), Direct bury
- Input #18 only used in dc combiner #6, and in no other dc combiners
- #6 (min.) Solid / Stranded (EGC), Bare, to grounding electrode rod

PICURIS PUEBLO
VALDEZ ROAD
PENASCO, NM 87553
GPS SITE COORDINATES
36.19, -105.68

OSCEOLA ENERGY
3004 2ND STREET NW
ALBUQUERQUE, NM 87107

Revised	By	Checked	Date
Rev 11-2017	Rev 11-2017	Rev 11-2017	Rev 11-2017
Rev 11-2017	Rev 11-2017	Rev 11-2017	Rev 11-2017

Line Diagram: PV Output Circuit Detail

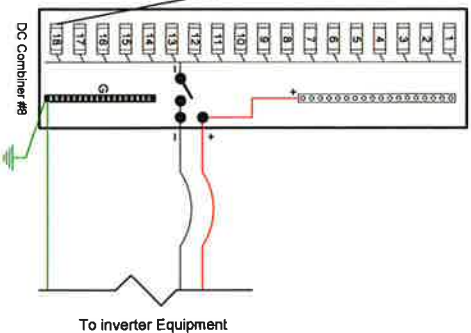
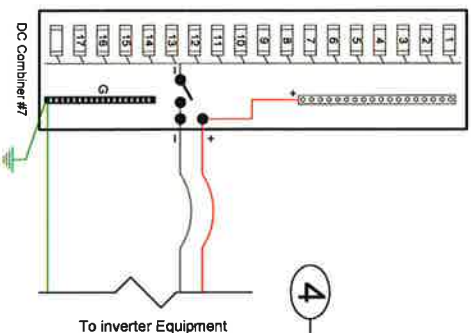
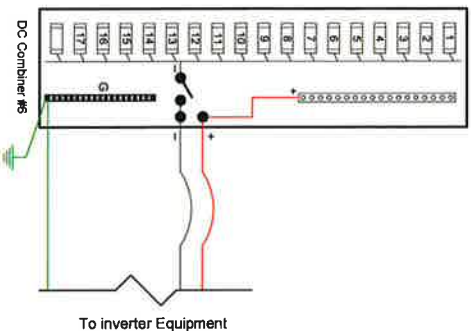
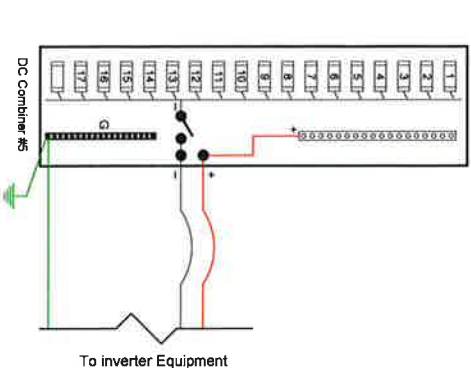
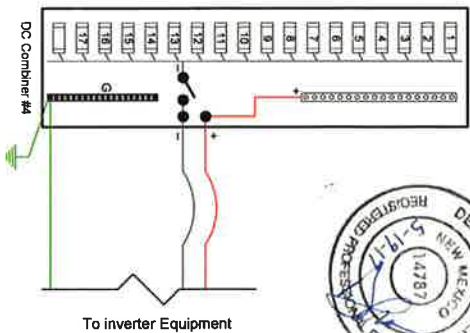
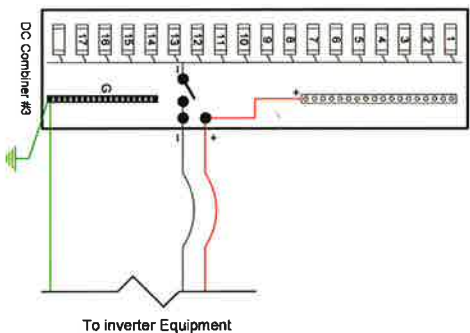
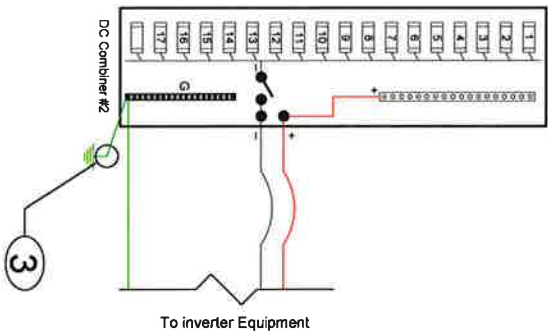
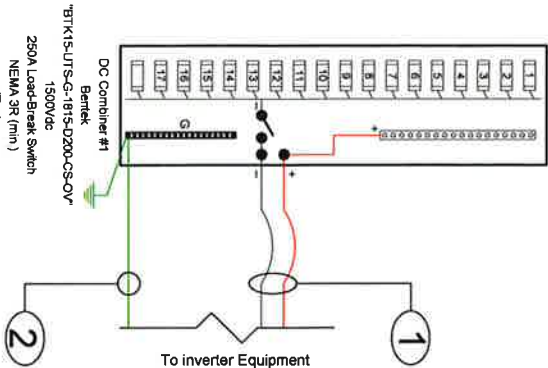
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- General Notes**
- Refer to Site Plan for equipment location details.
 - All feeder circuits shall be buried at depth as directed by NEC 300.50.
 - Contractor shall provide working space clearances as directed by NEC 110.26.
 - Contractor shall provide all labeling and signage as directed by NEC 690 Part VI, Article 110, Article 225, & Article 450.
 - DC combiners are UL 1741 compliant.

Keyed Notes

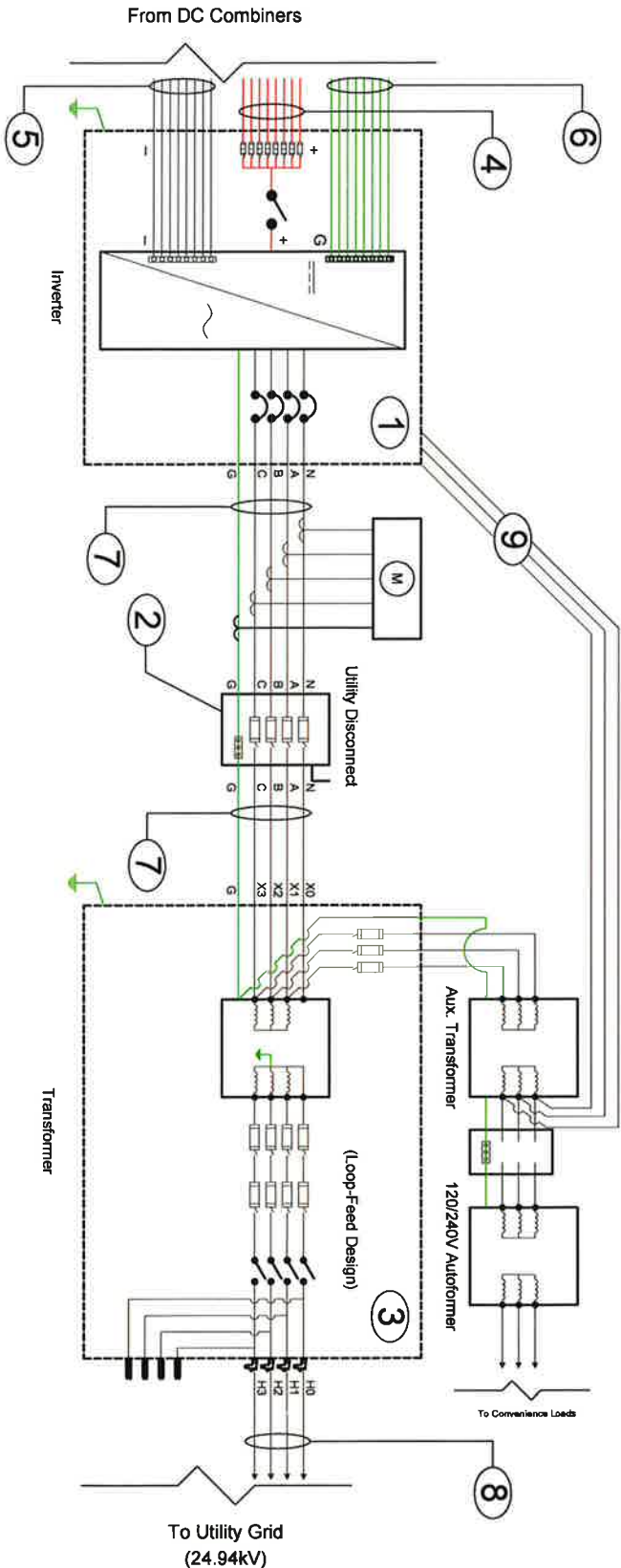
- #40 AL PV Wire XLPE, Direct bury, Above ground in 1 1/2" PVC conduit (Typ)
- #4 Cu Solid / Stranded (EGC), Bare, Above ground in 1 1/2" Sch. 80 PVC conduit (Typ)
- #6 (min.) Solid / Stranded (EGC), to grounding electrode rod (Typ)
- DC Source circuit Input #18 only used in dc combiner #8, and in no other dc combiners



PICURIS PUEBLO VALDEZ ROAD PENASCO, NM 87553 GPS SITE COORDINATES 36.19, -105.88		OSCEOLA ENERGY 3004 2ND STREET NW ALBUQUERQUE, NM 87107	
Project Number	17413	Drawn By	3
Issue	1	Checked By	3
Date	May 11, 2017	Project	3
Sheet	3	Drawn	3

Line Diagram: Inverter, Utility Disconnect, & Transformer Details

OSCEOLA ENERGY
OSCEOLA FIELD MAINTENANCE

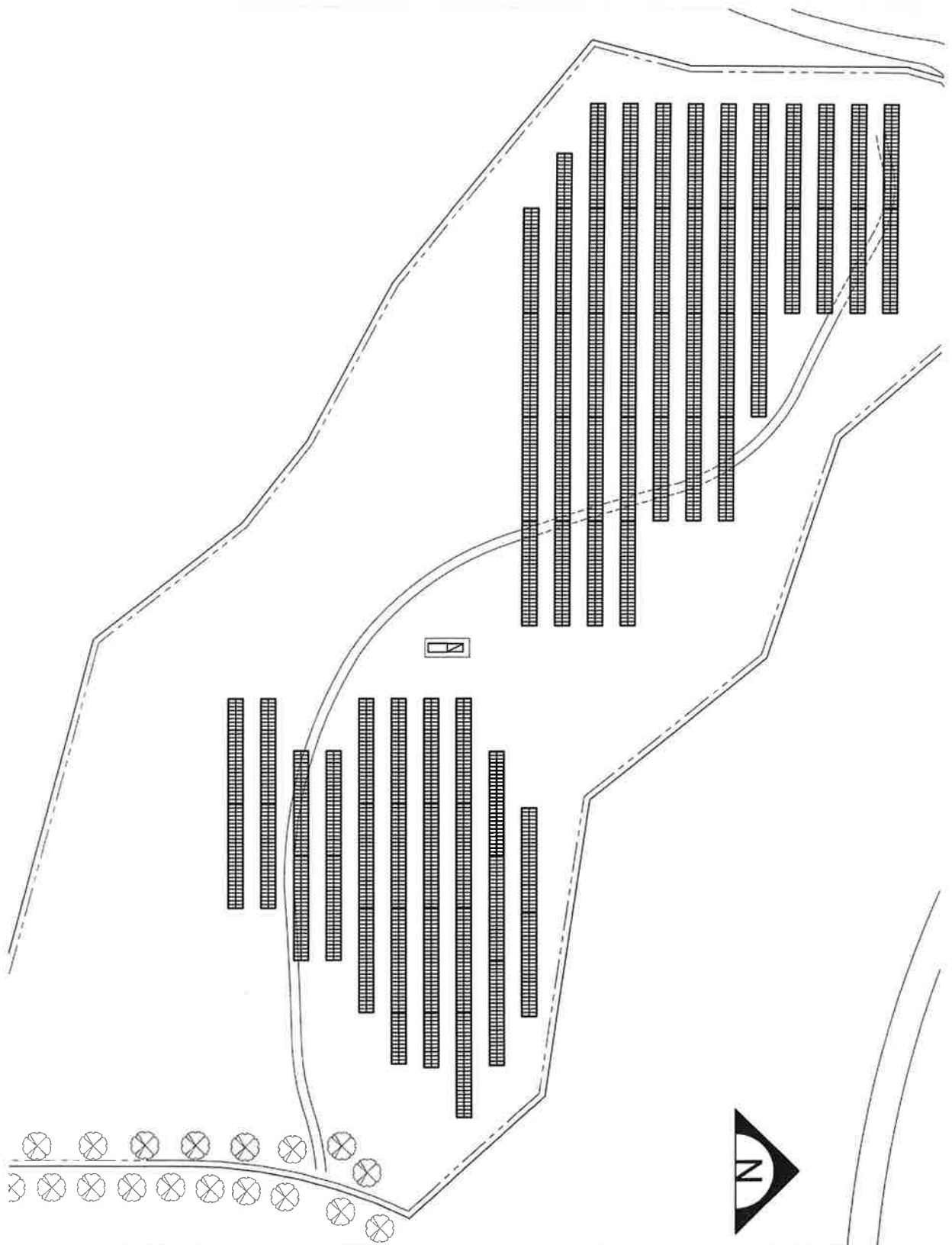


- General Notes**
- Refer to Site Plan for equipment location details.
 - Refer to PV 2.1 One Line for additional information.
 - All feeder circuits shall be installed in accordance with NEC 300.40.
 - Contractor shall provide working space clearances as directed by NEC 110.26.
 - Contractor shall provide all disconnects as directed by NEC 690 Part V, Article 460.
 - Inverter is UL 1741 compliant.
 - Utility Disconnect Switch is UL 981 compliant.
 - All equipment shall be UL certified to IEEE standards.

- Keyed Notes**
- Nominal 250Vdc output @ 60Hz. Inverter will internally disconnect upon loss of utility grid signal.
 - Service entrance rated. Shall be accessible, manually operable, lockable, KCEC listed, and per KCEC MV 550Vdc : 25kVdc Step up transformer equipment.
 - 440 AL PV Wire XLPE. Direct bury. Underground to above ground in 1 1/2" PVC conduit (Type).
 - 440 AL PV Wire XLPE. Direct bury. Underground to above ground in 1 1/2" PVC conduit (Type).
 - 44 Cu Solid / Stranded (ECC), 3mm. Underground to above ground in 1 1/2" PVC conduit (Type).
 - 6 se. 4 x 600kcmil THWN 2 conduct (Type).
 - and 440 Cu ECC in 3" EMT conduit (Type).
 - Utility feeders, installed by KCEC, disconnect from auxiliary transformer to inverter equipment.

Project Name	PV 2.1	Drawn By	OSCEOLA ENERGY
Rev	11/2017	Rev	11/2017
Rev	11/2017	Rev	11/2017
Rev	11/2017	Rev	11/2017

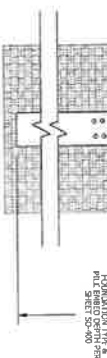
OSCEOLA ENERGY 3004 2ND STREET NW ALBUQUERQUE, NM 87107
PICURIS PUEBLO VALDEZ ROAD PENASCO, NM 87553 GPS SITE COORDINATES 38.18, -105.68

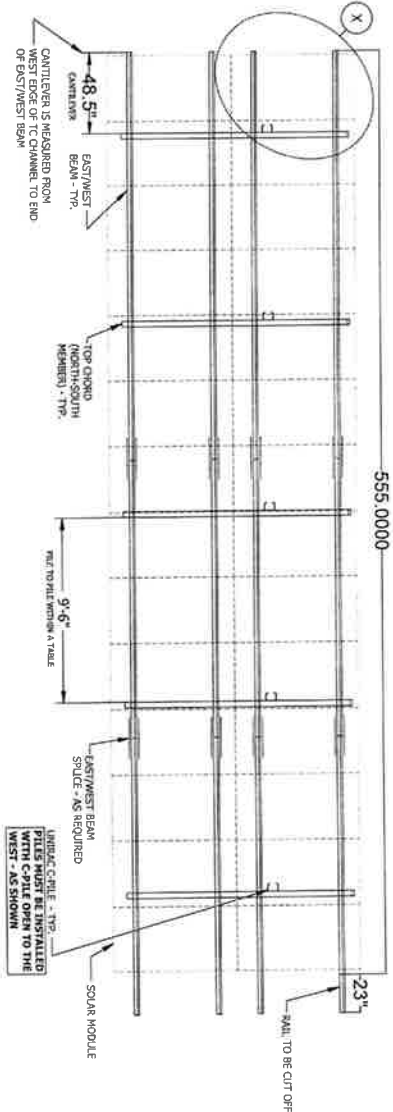


SD-200	APRIL 2000	UNIRAC 1411 Broadway Boulevard SE Albuquerque, New Mexico 87102 Phone: (505) 242-8411 Fax: (505) 242-8412 www.unirac.com	UNIRAC'S GFT PICURIS PUEBLO STRUCTURAL RACKING DRAWINGS	PROFESSIONAL SEAL	OSCEOLA ENERGY	<table border="1"> <tr> <th>DATE</th> <th>BY</th> <th>REVISION</th> </tr> <tr> <td>1/1/2000</td> <td>UNIRAC</td> <td>ORIGINAL DESIGN</td> </tr> </table>	DATE	BY	REVISION	1/1/2000	UNIRAC	ORIGINAL DESIGN
DATE	BY	REVISION										
1/1/2000	UNIRAC	ORIGINAL DESIGN										

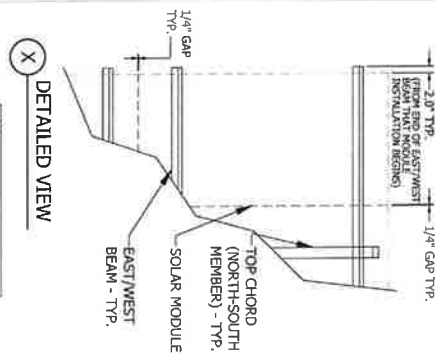


- SECTION VIEW OF DGFT TABLE - 20° TILT
(72 CELL SOLAR PANELS)

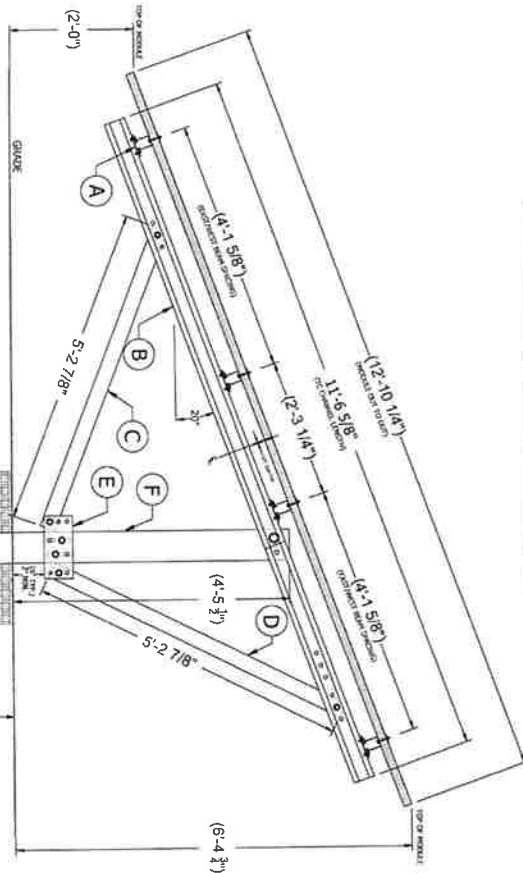
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PLAN VIEW OF 2 X 14 TABLE



NOTE:
FOR INFORMATION REGARDING 1 BOLT
FROM SOLAR SECTION A EAST/WEST
BEAM TO TOP CHORD MEMBER SEE
DETAIL 502 ON SHEET SD-300.



SECTION VIEW OF DGT TABLE - 20° TILT
(72 CELL SOLAR PANELS)

- BACKING DIMENSION NOTES:**
1. THE CROSS SECTION WITH DIMENSIONS ARE SPECIFIC TO A JAMBO 72 CELL SOLAR MODULE. IN A JAMBO 72 CELL SOLAR MODULE, THE CLAMPING BARS ARE SPECIFIC TO THE JAMBO 72 CELL SOLAR MODULE. THE LINE ADJUSTMENTS IN THE JAMBO 72 CELL SOLAR MODULE ARE SPECIFIC TO THE JAMBO 72 CELL SOLAR MODULE. THE LINE ADJUSTMENTS IN THE JAMBO 72 CELL SOLAR MODULE ARE SPECIFIC TO THE JAMBO 72 CELL SOLAR MODULE.
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 3. THE CLAMPING BARS ARE SPECIFIC TO THE JAMBO 72 CELL SOLAR MODULE. THE LINE ADJUSTMENTS IN THE JAMBO 72 CELL SOLAR MODULE ARE SPECIFIC TO THE JAMBO 72 CELL SOLAR MODULE.

SECTION VIEW OF DGT TABLE - 20° TILT
(72 CELL SOLAR PANELS)

REF. NUMBER	PART DESCRIPTION	QTY/LOC #	QUANTITY/THICKNESS	FINISH
A	ALUMINUM CHANNEL (180° OR 90°)	411240	SEE SHEET SD-100	
B	TOP CHORD CHANNEL	40010	SEE SHEET SD-100	
C	FRONT CHANNEL		SEE SHEET SD-100	
D	REAR CHANNEL	40011	SEE SHEET SD-100	
E	DIAGONAL BRACE		SEE SHEET SD-100	
F	PLATE	40012	SEE SHEET SD-100	

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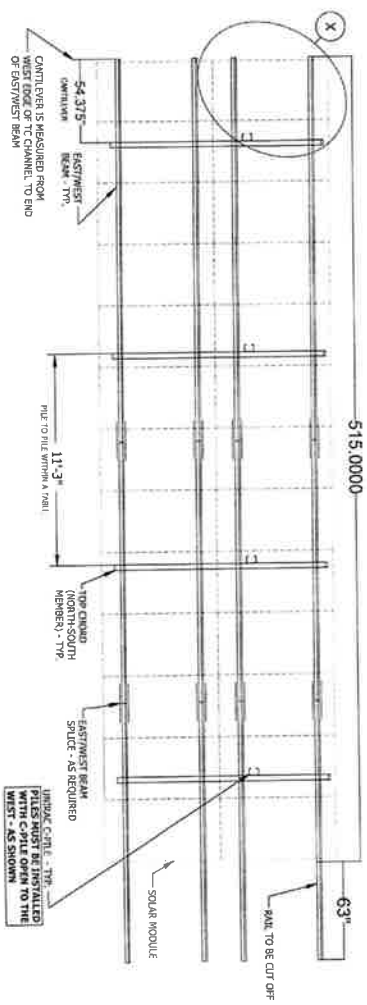
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Fax: (505) 842-2424
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PICURIS PUEBLO

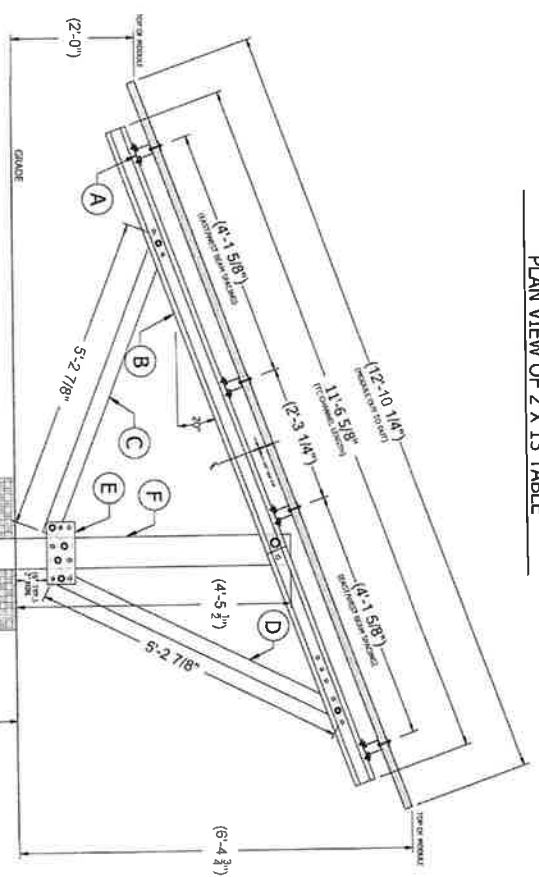
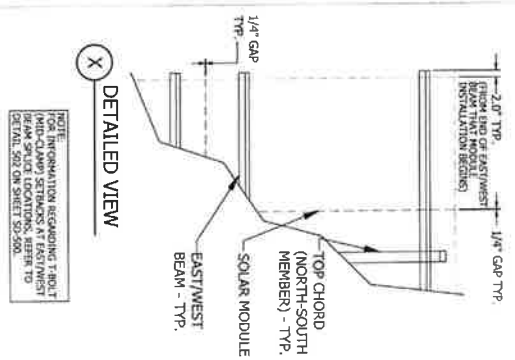
STRUCTURAL RACKING DRAWINGS

OSCEOLA ENERGY

Professional Seal



PLAN VIEW OF 2 X 13 TABLE



RACKING DIMENSION NOTES:

- THE FRONT SECTION AND DIMENSIONS ARE SPECIFIC TO A 72 CELL SOLAR MODULE.
- THE 72 CELL SOLAR MODULE IS BASED ON A COMBINATION OF CHASSIS RACKS SPECIFIED IN THE INSTALLATION MANUAL FOR THE 72 CELL SOLAR MODULE. THE 72 CELL SOLAR MODULE IS BASED ON A COMBINATION OF CHASSIS RACKS SPECIFIED IN THE INSTALLATION MANUAL FOR THE 72 CELL SOLAR MODULE.
- THE 72 CELL SOLAR MODULE IS BASED ON A COMBINATION OF CHASSIS RACKS SPECIFIED IN THE INSTALLATION MANUAL FOR THE 72 CELL SOLAR MODULE.
- ALL DIMENSIONS SHOWN WITH PARENTHESES () ARE DIMENSIONS FOR THE 72 CELL SOLAR MODULE. ALL OTHER DIMENSIONS ARE FIXED DIMENSIONS FOR THE RACKING SYSTEM.
- ALL DIMENSIONS ARE IN FEET AND INCHES. ALL OTHER DIMENSIONS ARE IN INCHES.

SECTION VIEW OF DGFT TABLE - 20° TILT
(72 CELL SOLAR PANELS)

REF.	PART DESCRIPTION	QUANTITY	GLASS/THICKNESS	FINISH
A	ALUMINUM E-W BEAM (18" OR 24")	411288	SEE SHEET SD-100	
B	TOP CHORD CHANNEL	40410	SEE SHEET SD-100	
C	FRONT DIAGONAL BRACE (20")	40411	SEE SHEET SD-100	
D	REAR DIAGONAL BRACE (20")	40411	SEE SHEET SD-100	
E	DIAGONAL BRACE	40402	SEE SHEET SD-100	
F	C-PILE 9.8 FT	40402	SEE SHEET SD-100	

UNIRAC'S GFT
PICURIS PUEBLO
STRUCTURAL RACKING DRAWINGS

PROFESSIONAL SEAL

OSCEOLA ENERGY

OSCEOLA ENERGY

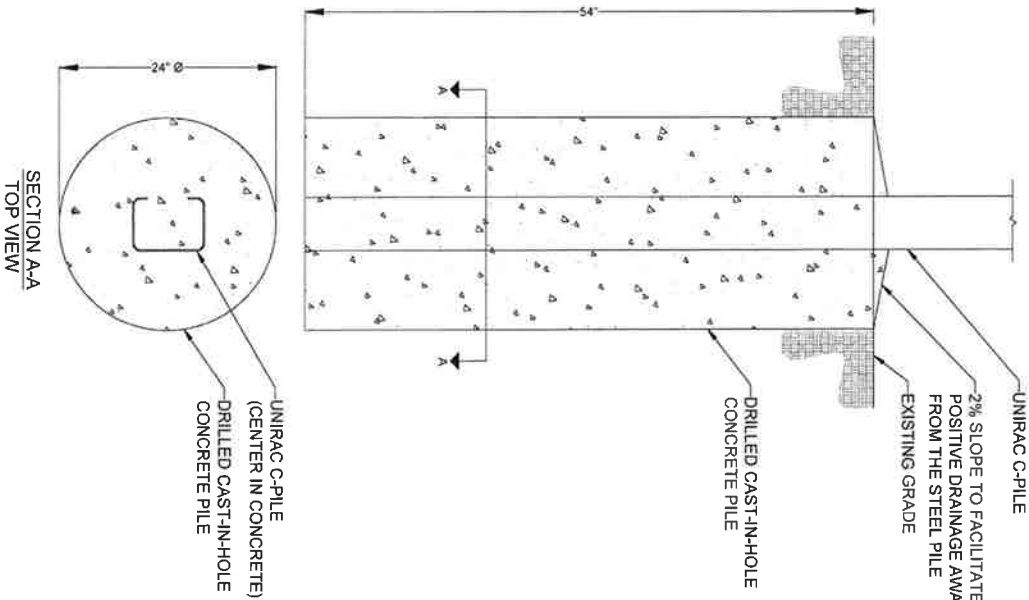
OSCEOLA ENERGY

400

DRILLED CAST-IN-HOLE CONCRETE PILE FOUNDATION

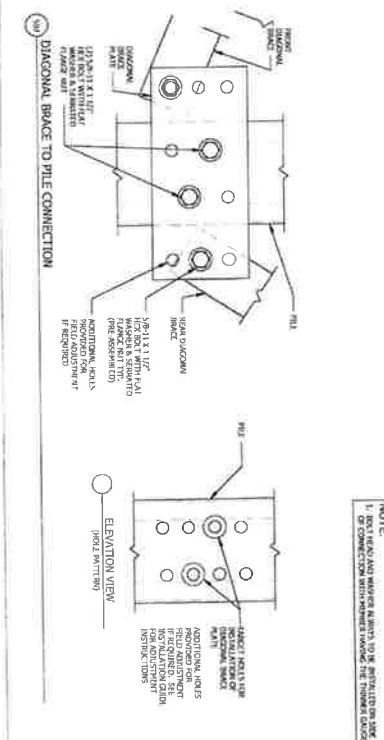
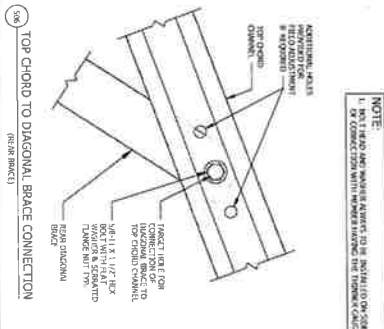
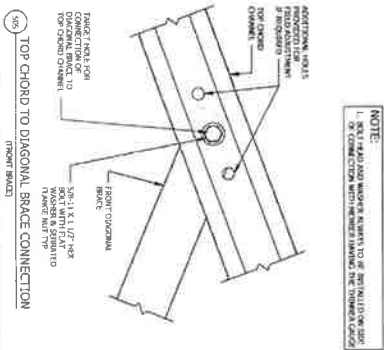
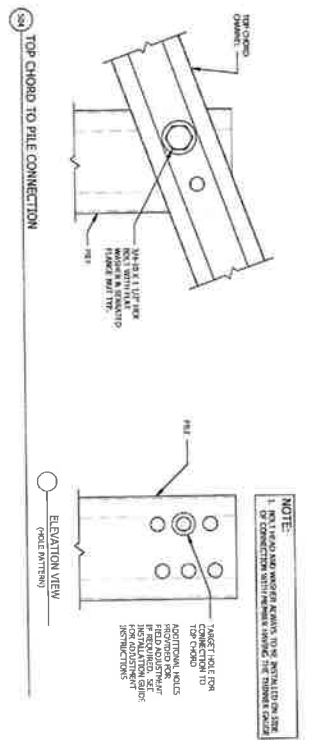
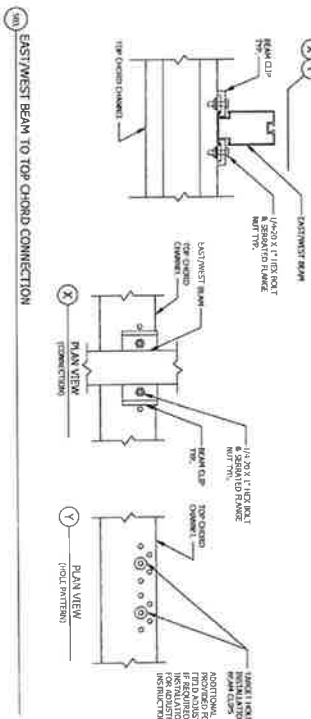
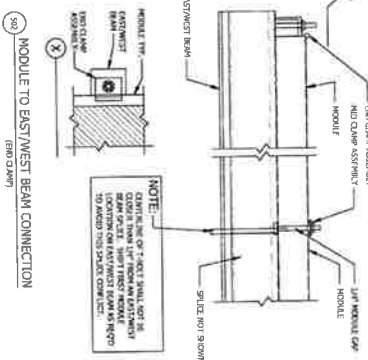
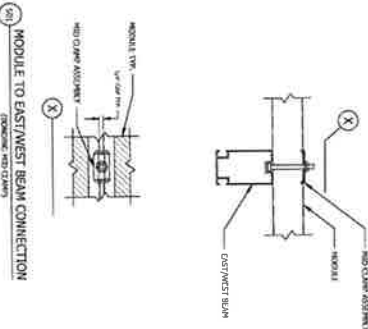
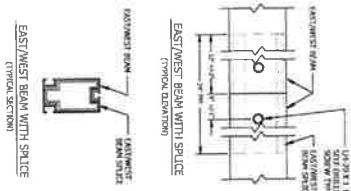
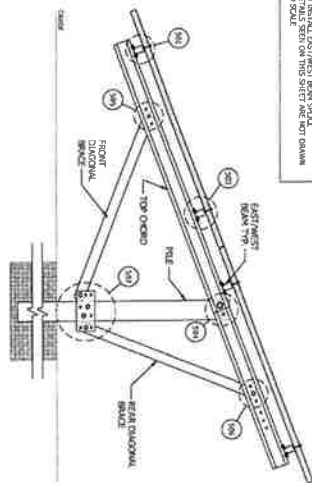
NOT TO SCALE

- FOUNDATION 400: DRILLED CAST-IN-HOLE CONCRETE PILE FOUNDATION
1. THE FOUNDATION MUST BE EXCAVATED WITH LITTLE TO NO LOOSE MATERIAL IN THE BOTTOM.
 2. IF THE FOUNDATION IS BELOW THE GROUND WATER LEVEL, THERE MUST BE A TEMPORARY CASING IN PLACE TO STABILIZE THE EXCAVATION.
 3. THE PILE MUST BE CENTERED IN THE HOLE WITH EQUAL AMOUNTS OF CONCRETE AROUND THE CASING.
 4. CONCRETE SHALL CONFORM TO THE CONCRETE SPECIFICATIONS LISTED ON DR-100.
 5. CONCRETE DEPTH SHALL CONFIRM TO THE DEPTHS LISTED SPECIFIED ON THIS DRAWING.
 6. THE TOP OF THE CONCRETE MUST BE ABOVE GRADE.
 7. THE CORE OF THE CONCRETE CAST-IN-DRILLED HOLE PILE WILL CONSIST OF THE UNIRAC C-PILE AS DEPICTED IN THE FIGURE.
 8. THE C-PILE CAN REST ON THE BOTTOM OF THE BORING AND IS NOT REQUIRED TO BE SUSPENDED ABOVE THE BOTTOM.



UNIRAC 1411 Broadway Boulevard NE Albuquerque, New Mexico 87102 Phone: (505) 242-8411 Fax: (505) 242-8412 www.unirac.com		UNIRAC'S GFT PICURIS PUEBLO STRUCTURAL RACKING DRAWINGS		OSCEOLA ENERGY David J. Johnson, Engineer 1411 Broadway Boulevard NE Albuquerque, NM 87102 Phone: (505) 242-8411 Fax: (505) 242-8412 www.unirac.com	PROFESSIONAL SEAL	FOUNDATION 400 DRILLED CAST-IN-HOLE CONCRETE PILE FOUNDATION	FOUNDATION 400 DRILLED CAST-IN-HOLE CONCRETE PILE FOUNDATION
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- RACKING DETAIL NOTES:**
1. SEE INSTALLATION GUIDE FOR PILE FOUNDATIONS
 2. SEE INSTALLATION GUIDE FOR RAIL TRACKS
 3. SEE INSTALLATION GUIDE FOR RAIL TRACKS
 4. TO INSTALL DIAGONAL BRACE WITH SPACE TO SOUL
 5. TO SOUL



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STRUCTURAL RACKING DRAWINGS

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PROFESSIONAL SEAL

Seal of the State of New Mexico
Professional Engineer
No. 12345
Exp. 12/31/2025

REVISIONS

NO.	DATE	DESCRIPTION
1	12/31/2024	ISSUED FOR CONSTRUCTION

PROJECT DATA

Project Name: OSCEOLA ENERGY
Project No.: 12345
Drawing No.: SD-500