Albuquerque International Sunport
Rental Car Facility
Photovoltaic System & Pavement Assessment

January 29, 2021

WHPacific
AN NV5 COMPANY

TABLE OF CONTENTS

INTERNATIONAL SUNPORT RAC PV & PAVEMENT ASSESSMENT REPORT

1. INTRODUCTION

1.1. Overview

The Albuquerque International Sunport Rental Car Center (RAC) PV and Pavement report is an assessment to determine the feasibility of utilizing PV arrays located on parking canopies to offset the power the facility utilizes and to assess the condition of the asphaltic parking areas and the concrete bus lanes at the facility for repair.

2. SITE & CIVIL DESIGN RECOMMENDATIONS

2.1. Existing Pavement Conditions

The existing concrete drive lanes located at the bus drop-off lane and loading area at the RAC facility appear to have alkali-silica reactivity (ASR) causing deterioration of the concrete. ASR is a chemical reaction between the alkalis in Portland cement and certain types of silica minerals present in some aggregates. ASR also appeared to be present in the visitor parking lot west of the Rental Center. The more severe damage to the concrete, however, was present within the bus drop-off and loading area where there is major cracking due to repeated heavy traffic. There are cracks occurring on the existing curb and gutter adjacent to the concrete pavement as well.

The existing asphalt pavement condition within the Rental Facility parking lot is considered to be poor due to the weathering and age of the asphalt. Cracks have been repaired with crack seals. The approximate age of the existing asphalt is about 20 years, the typical design life of asphalt pavement is 25 years.

Based on WHPacific's site visit and discussions with Aviation personnel, there are also ponding issues occurring within the sidewalk area in the front entrance of the Rental Center, and there are cracks within the sidewalks around the facility as well. There are ADA compliance issues within existing concrete ADA ramps, and additional investigation of this issue is required prior to reconstruction.

EXISTING CONDITIONS

2.2. Pavement Repair Recommendations

The most current geotechnical investigation report obtained by the project team was produced by Geo-Test Inc. “Geotechnical Engineering Services Remote Rental Car Facility, Albuquerque, New Mexico” dated 4/30/1999. The asphalt pavement section recommended by this report is 3 inches of asphaltic concrete over 6 inches of compacted aggregate base course over 12 inches of compacted native soils subgrade. With the provided information, WHPacific recommends removing a minimum of 3 inches of existing asphalt pavement, recompacting the existing aggregate base course, applying a new layer of prime coat, and providing a new 3 inch asphalt pavement section. However, a new geotechnical investigation with asphalt pavement design recommendations will be needed to verify this design recommendation. Due to the large area of asphalt pavement removal and replacement and operation of Rental Car Facility tenants, we recommend the pavement replacement to be done by phases, final construction phase planning will need to be coordinated with RAC Operation and the selected contractor.

Portland cement concrete (PCC) repair recommendations: From the geotechnical investigation report, the existing PCC pavement section for bus traffic was designed to be a minimum of 7 inches of Portland cement concrete placed over 6 inches of aggregate base course over 12 inches of compacted subgrade. Based on conversations with RAC personnel, a portion of the existing PCC within the bus drop-off lane was replaced in 2011; however, the existing PCC appears to be damaged due to daily traffic loading. WHPacific recommends removing the existing PCC and aggregate base course, installing new 8 inch reinforced PCC with a minimum of a 6 inches aggregate base course per City of Albuquerque standards within the bus drop-off and loading area. A new geotechnical investigation with Portland cement concrete pavement design recommendations will be needed to verify this recommendation. The existing damaged concrete curb and gutter adjacent to the bus lane also needs to be removed and replaced.

2.3. Site Improvements

The proposed new canopy design with solar panels will be installed within the existing east parking area and achieve net zero energy savings for the Albuquerque International Sunport Rental Car Facility. The existing curved canopies in this area will be relocated to the north and south parking areas and will not be retrofitted with new solar panels. The existing foundations for curved canopies will be demolished above grade and abandoned in place below grade where they will remain under the new asphalt pavement discussed above. Existing light poles including the associated foundations and steel bollards will be demolished and removed in the east parking area as well as the north and south parking areas that receive relocated curved canopies.

Existing concrete parking islands and lights within the southeast parking area will be demolished and removed for the new canopies installed for future expansion of the solar panel array. Trenching with conduits is required from new the new solar panel

inverters to the new electrical head-end for this system located in the “solar demonstration room” that serves the current system proposed to be demolished under this scope of work. See architectural and electrical narratives for more details.

Prior to new asphalt replacement, existing pre-cast concrete parking bumpers, existing concrete barriers and existing signposts shall be removed and replaced. New traffic control and parking striping will be replaced after the new asphalt replacement is completed.

Concrete sidewalk and ADA ramps will be removed and replaced as required. New pavements and concrete walks shall be replaced to existing grade elevation to maintain existing drainage patterns, and all existing underground utilities shall be protected unless otherwise noted.

See Appendix A and B for Overall Site Plan and Options that reference new and relocated canopy locations. Appendix A is the preferred layout recommended under this report.

3. ARCHITECTURAL SUMMARY

3.1. Sunshade Canopies

During preliminary design review meetings with Sunport stakeholders, it was determined that the facility's existing curved sunshade canopies are not well suited for the addition of PV arrays due to their curved roof canopy and unknown structural capacity. Instead, new flat, south-sloping canopies would best support the installation of the new PV system. Moreover, configuring the new canopies with a longer east-west axial orientation and a shorter north-south cross section would offer greater density and a more efficient PV layout. The opposite orientation with a longer north-south axis is less efficient due to inherent panel spacing requirements.

Once WHPacific verified the quantity of new canopies needed for sun-shading purposes, it was determined that only a portion of the total proposed new canopies would be needed to adequately support the 525kW solar system to reach net-zero performance. The importance of this outcome is severalfold:

- Existing canopies do not require modification or analysis for retrofitting the new PV system
- A single design solution can be used for all new canopies: flat roof sloped to drain across the short axis of its cross section
- All new canopies can be designed to structurally accommodate a PV array
- The PV array van be expanded to meet future demand without building additional PV canopies

Consequently, it was determined that relocating the existing curved canopies currently located within the east parking lot would provide an opportunity to install a greater quantity of the preferred and more efficient east-west oriented canopy design. This solution allows for a more compact and centrally located PV array, and the greater density adds further efficiency as conduit runs to the PV head-end are shorter and not spread out.

Architecturally, this approach also allows existing curved canopies to be relocated adjacent to other curved canopies where they will match one another in design. The existing canopies will be relocated to the north and south parking areas as needed. The new PV canopies are, therefore, proposed to be installed in the east parking area to provide a new PV array that is both efficient and uniform in design. Two options have been provided with Option 2 being a slightly wider canopy to provide more coverage for rental vehicles (see Figure 3, page 7).

3.2. Phasing

Construction phasing will utilize the fourth floor of the existing short-term parking structure north of the terminal building as swing space for the rental car companies' fleet. With fleet vehicles relocated to this area, the RAC's existing east parking canopies can be dismantled and immediately reinstalled on new footings in the north parking area (Phase 1). Once the north parking area is complete, the same can be

accomplished at the south parking where existing canopies can be installed on new footings (Phase 2). Finally with all the existing canopies relocated, the new PV canopies can be constructed in the east parking area (Phase 3). The asphalt improvements and electrical work will align with these three phases.

For the bus lane, the construction can be competed one lane at a time with appropriate barricading, or bus service can be relocated to the north or south parking areas as was done during previous reconstruction of the bus lane.

4. STRUCTURAL DESIGN RECOMMENDATIONS

4.1. General

The existing covered shade canopies contained in the east parking area of Albuquerque International Sunport RAC are proposed to be removed and relocated so the southern and northern parking areas. New PV mounted shade canopies are proposed to replace the relocated structures. In addition, canopies will be installed near the southeastern parking area where no canopies currently exist.

4.2. Removal and Relocation of Existing Shade Canopies

The existing structures consists of a corrugated steel deck, bearing on continuous purlins which are bolted to a curved steel I-Girder beam supported by two steel columns on concrete foundations. The existing canopy's deck will likely not be reusable and is proposed for replacement once removed. The existing purlins and frame may be unbolted and relocated. Damage during disassembly, relocation or misalignment of foundations once placed into their new position may require replacement of members in-kind. The relocated canopies will require new foundations.

Figure 1: Existing Canopy in Mid-Eastern Block

4.3. Proposed PV Shade Canopy Design

The existing canopy foundations are spaced longitudinally at 27'-0" O.C. Currently, the proposed structural concept will provide new foundations offset 9'-0" east from the existing foundations to preserve the parking stall configuration and parking stall counts currently available. The new drilled shaft pier foundations will extend approximately 2'-6" above grade to protect the steel columns from damage due to errant vehicle collision. The new canopy structure will consist of five rows of transversely placed PV modules on top a steel deck supported by Z or C purlins or steel channels as determined in design. The overall width is proposed to be 34'-0" which is 7' wider than the existing canopy. The new canopy will provide two columns spaced at 7'-0" on center to provide similar vehicle parking buffer as currently exists between stalls. The canopy will be tilted 10° south and provide 14'-0" minimum clearance as measured from the low chord purlin to match the existing canopy's requirements. The canopy structure will need to be designed to prevent excessive deflection to protect the panels from damage. The structural design of new canopies is proposed in the next phase for this project based on the requirements provide by a new geotechnical report. See Figure 2 and Figure 3 for conceptual canopy elevations.

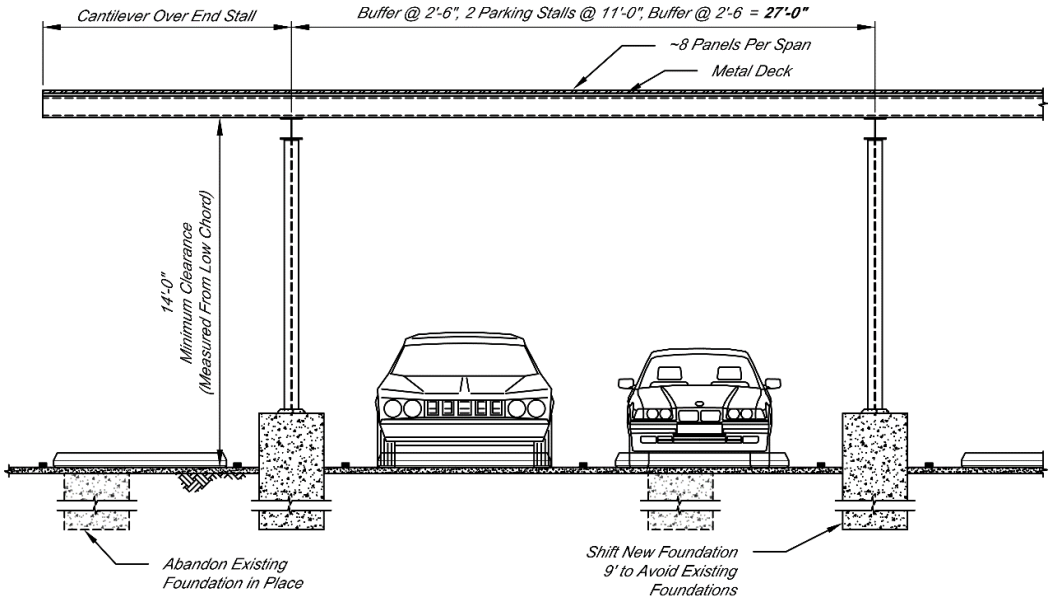


Figure 2: Conceptual Solar Canopy Shade Structure Elevation

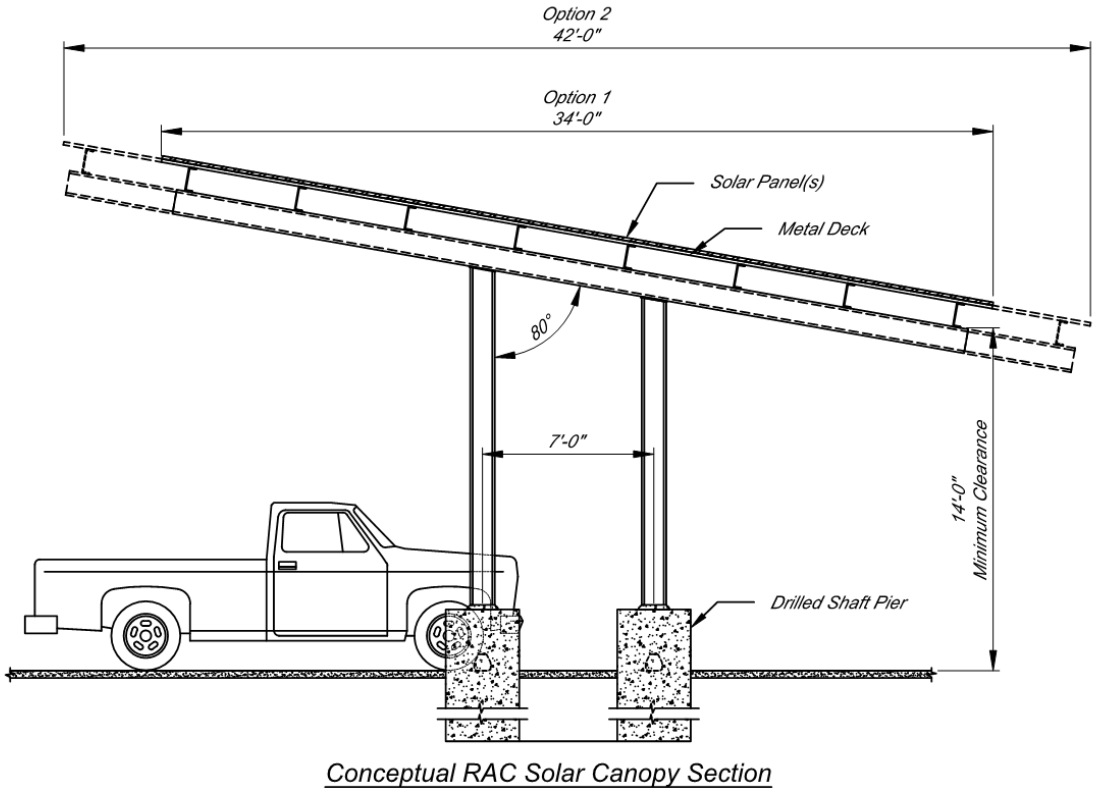


Figure 3: Conceptual Solar Canopy Shade Structure Section

4.4. Geotechnical

The most current geotechnical investigation report obtained by the project team was produced by Geo-Test Inc. and is dated 4/30/1999. Borings 3, 4 and 11 are located in the parking lot areas and were taken to depths of approximately 40'. These borings produced medium blow counts indicating adequate soil conditions, however that report did not include recommendations for canopy foundations. Due to the age and scope of the original report, additional geotechnical borings will be needed for the design of the new solar sunshade structures and for the foundations of the relocated existing curved canopies.

5. SOLAR STEAM HEAT GENERATING SYSTEM DEMOLITION

5.1. General

An experimental steam powered solar array is currently installed on canopies on the east side of the Rental Car Facility. The solar array was designed to generate power by heating water to boiling and then using that heat to produce power. There is a steam generator located in its own detached building on the east side of the facility. The system is not currently functional and WHPacific is tasked to determine an approach and cost estimate to remove the system.

STEAM SOLAR HEAT GENERATING SYSTEM

5.2. Demolition

The steam solar array will have to be dismantled in place and removed with the use of a small crane. The water piping for the array consolidates to a trench that goes underground located east of the building housing the steam chiller and terminates in that building. The piping will have to be removed in its entirety back to the building. The trench for the piping will be re-utilized for the new solar array that is going to be installed in the east parking area. All of the piping and associated pumps, Aroace water fired chiller heater, control panel and power serving equipment will have to be removed in their entirety. There is an 120V/208Y electrical panel “P1” in the room dedicated to this system that can remain in place once all of the feeders going to the system are removed. All associated equipment in the room serving the steam solar array will also be removed and any piping that goes back to the main facility will have to be capped in place. The room is going to serve as the head-end location for the new solar power array equipment that is going to be installed for this facility.

6. ELECTRICAL SOLAR ARRAY DESIGN BASIS

6.1. General

With the goal of achieving a net zero energy rental car facility, the Aviation Department suggested using a 525kW solar system to offset the power consumption at the facility. Based on data received by WHPacific from PNM, WHPacific has designed a slightly larger system of solar panel arrays to provide approximately 574kW AC of power. This design will provide enough power to offset the entire facility to bring it to net-zero.

WHPacific also looked at a second option to have additional infrastructure in place to provide additional PV panels located on new canopies that will provide up to 40% additional capacity for future growth including future electric vehicle charging stations. This second, future option can provide up to a total of approximately 804kW AC of power and is anticipated to handle any future loads needed at the facility.

6.2. Electrical Service

The electrical service at the Sunport RAC facility is a 2000Amp, 277V/480Y service from a PNM pad mounted transformer. The main switch board is a Siemens SB with a 2000Amp SBS2020 main breaker. There is adequate space in the main switchboard to install one 1000Amp breaker for the solar array input. The current load on the system, based on 12 months of data from PNM, is currently 207 kW of max demand on peak.

6.3. Solar arrays Option 1, Net-Zero

The Solar arrays will be located on eight of the new canopies that will be installed on the east side of the facility. There are canopies currently installed on the east that will be removed and reinstalled on the north and south parking areas. The solar array is designed to provide approximately 574kW of AC power. The system will consist of eight arrays placed on top of eight parking canopies running East/West on the East side of the facility. The solar design is based on Hyundai HIS-S435YI PV modules and SMA TRIPOWER CORE1 inverters. There are 1216 PV Modules that each produce 435 Wp per module. The glass on the PV Modules will be anti-glare type to reduce the glare seen by incoming aircraft to the Sunport. The modules are designed to be strung in series and there 16 modules per string. There are a total of 85 strings that are combined at the inverters. There are 8 inverters in total that combine the strings together. There are 2 different sizes of inverters utilized in the design CORE1 50-US and CORE1 62-US. The 50-US is utilized on 1 array to provide 50kWAC of power per inverter. The 62-US is utilized on 7 large arrays to provide 62.5kWAC of power per inverter. The option 1 design will also incorporate infrastructure to allow the system to be extended to the south onto the 4 remaining new canopies. A 2” conduit with a nylon pullstring going back to the solar electrical building and junction box will be placed at the base of each canopy to provide the capability of putting one 62.5kW array on each canopy.

6.4. Solar arrays Option 2, Future

Each additional solar array is designed to provide approximately 62.5kW of AC power. The system can be placed on top of the remaining four parking canopies running east/West on the east side of the facility. The solar design is based on Hyundai HIS-S435YI PV modules and SMA TRIPOWER CORE1 inverters. Each array can be up to 76 PV Modules that each produce 435 Wp per module. The modules are designed to be strung in series and there are 16 modules per string. The inverters utilized in the design are CORE1 62-US. The 62-US can be utilized on each large array to provide 62.5kWAC of power per inverter. This option is anticipated to provide enough extra capacity to power the electric vehicle charging stations and any future expansion at the RAC facility.

6.5. Solar Electrical Connection

Each individual inverter will be mounted onto the canopy that holds the corresponding strings of arrays to provide the stated power. The inverters are provided with an integral DC and AC disconnect to comply with NEC Article 690. The output from each inverter will be routed via PVC schedule 80 conduit underground to a new 1000Amp 277Y/480V combiner panelboard to be located in the existing steam solar building. For Option 1,the panel will be provided with 1-60Amp breaker and 7-80Amp breakers. For Option 2 the board can be provided with an additional 80Amp breaker for each new array. The panel is designed to provide the facility with approximately 1000Amps of 277Y/480V 3-Phase power. The panel will be connected to a new 1000 Amp fused disconnect that will be labeled Solar Array Main Disconnect. The 1000 Amp disconnect will be located on the outside of the building to allow access by PNM. A new solar REC meter will need to be placed next to the disconnect on the exterior of the facility. A Placard will be placed at the main facility disconnect indicating that a Solar PV System is in place on site with a map showing where the disconnect for the PV system is located.
See attached solar array site plan and proposed one-line diagram.

6.6. Solar cost payback analysis, Net-Zero

The solar array is designed to offset approximately 574kW AC of power for the facility. Per PNM the rental car agency utilizes 347,100 kWH On Peak and 633,000kWH Off Peak per year at a cost of $105,670. The cost of the system to install is approximately $2.19 per watt for a total construction cost of $1,300,000. The solar array will pay back the cost for construction for the solar array itself in approximately 21 years. See attached payback analysis in appendices for more information. The payback only takes into account the cost of the solar array itself. The payback for the complete system including the 1000Amp Panelboard, conduit, and conductors will be approximately 25 years.

6.7. Canopy Relocation

The Sunport has determined that the existing canopies located on the east side of the facility will be dismantled and moved to the north and south sides of the facility. This will allow space for the new solar array canopies. The electrical power to each existing canopy will be disconnected and the circuits will be extended to the new canopies.

The lighting will be removed and retained for re-use on the relocated canopies. The relocated canopies will be fed power, for lighting, by extending the power from existing canopies and utilizing the same lighting control system. The new solar array canopies will receive new lighting to match the existing and be powered from the circuit(s) retained during removal of existing east side canopies.

6.8. Electric Vehicle Charging Stations

The attached electrical site plan (see Appendix D) includes locations for a pull box to each canopy for future electric vehicle charging stations. Each pull box will have a conduit homerun back to the solar power electrical room for connection to a future 277Y/480V panelboard.

7. PROJECT COST ESTIMATE

7.1. Project Cost Estimate

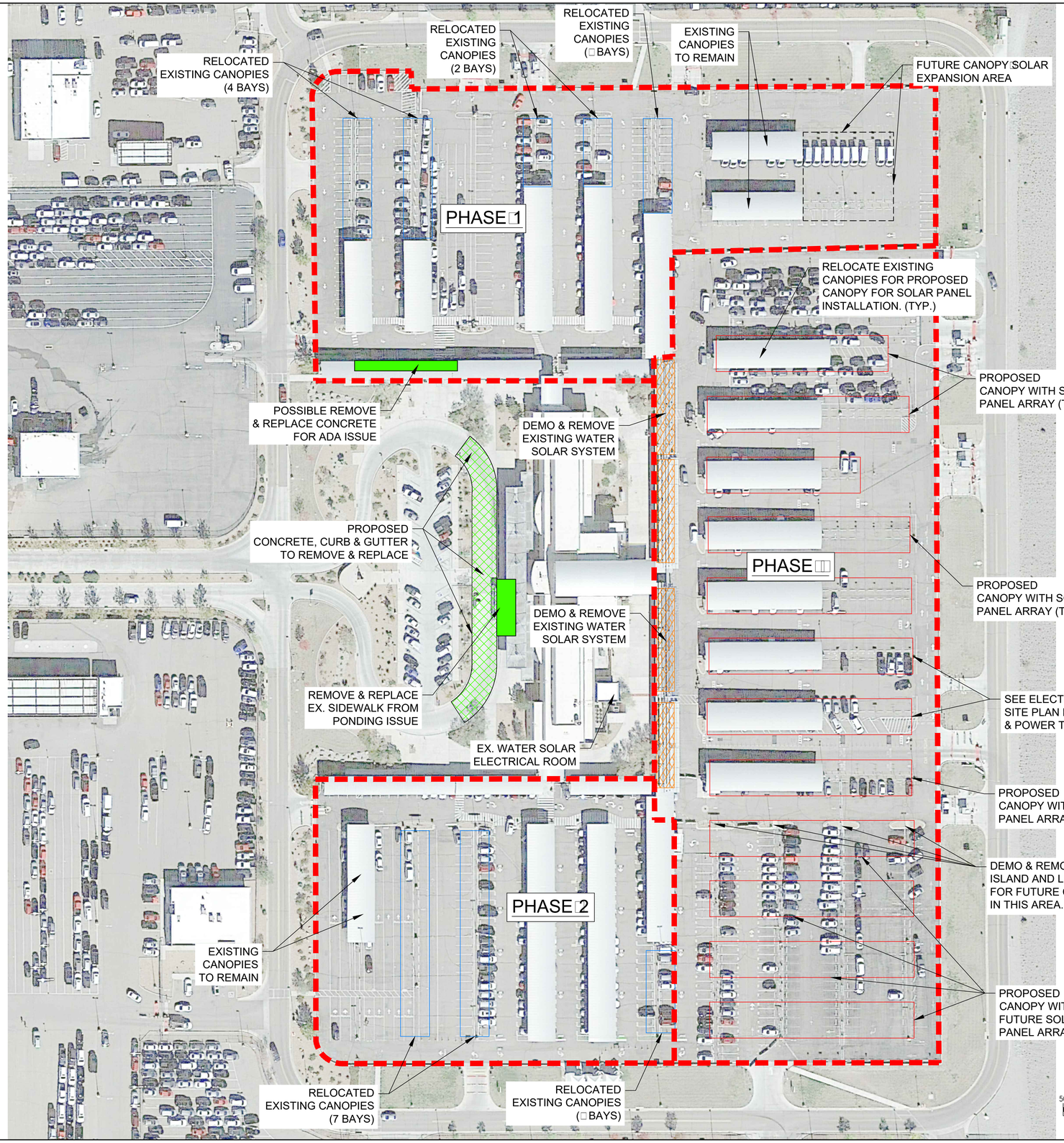
The following project cost estimate incorporates project construction costs as well as an allowance for A/E, geotechnical, survey, and special inspections. It is estimated that the Option 1 project will cost roughly $8.5M-$8.75M prior to adding contingency and NMGRT. The total project cost is anticipated to be approximately $10.3M.

Sunport RAC PV Project Costs-Option 1 *(see Figure 3, page 7)*	
Civil	$3,175,000
Structural: (102,750 s.f. x $35/s.f.)	$3,596,250
Electrical	$1,535,000
A/E Fees, Geotech, Survey, Special Inspections (Allowance)	$350,000
Subtotal:	$8,656,250
Contingency: 10%	$865,625
NMGRT (8%)	$761,750
TOTAL:	$10,283,625

Sunport RAC PV Project Costs-Option 2 *(see Figure 3, page 7)*	
Civil	$3,175,000
Structural: (120,950 s.f. x $35/s.f.)	$4,233,250
Electrical	$1,535,000
A/E Fees, Geotech, Survey, Special Inspections (Allowance)	$350,000
Subtotal:	$9,293,250
Contingency: 10%	$929,325
NMGRT (8%)	$817,806
TOTAL:	$11,040,381

8. APPENDICES

APPENDIX A: OVERALL SITE PLAN OPTION 1



LEGEND

- DEMO & REMOVE EXISTING WATER SOLAR SYSTEM
- DEMO & REPLACE EXISTING CONCRETE PAVEMENT
- DEMO & REPLACE EXISTING CONCRETE SIDEWALKS
- PROPOSED CANOPY FOR SOLAR PANEL
- RELOCATED EXISTING CANOPY
- FUTURE CANOPY AREA

N

SCALE
50 0 25 50 100
(FEET)
1 INCH = 50 FT.

AS BUILT INFORMATION
Contractor
Work Started By Date
Inspector's Acceptance By Date
Verification By Date
Drawings Delivered By Date

MICRO-FILM INFORMATION
Recorded By Date
No.

BENCH MARKS
No. Date By

SURVEY INFORMATION
Field Notes
No. Date By

STAMP & SIGNATURE

REVISIONS
No. Date By Remarks
DESIGN
Designed By: Date:
Drawn By: Date:
Checked By: Date:

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CITY OF ALBUQUERQUE
PUBLIC WORKS DEPARTMENT
ENGINEERING DEVELOPMENT GROUP

TITLE: ALBUQUERQUE INTERNATIONAL AIRPORT
RENTAL CAR FACILITY (RAC) SITE IMPROVEMENTS & PV ARRAY
OVERALL SITE PLAN

Design Review Committee	City Engineer Approval	Last Design Update	Mo./Day/Yr.	Mo./Day/Yr.

City Project No.	Zone Map No.	Drawing No.	Sheet	Of
6564.00-T1	M-16			X

FINAL REPORT DRAWINGS – JANUARY 28, 2021

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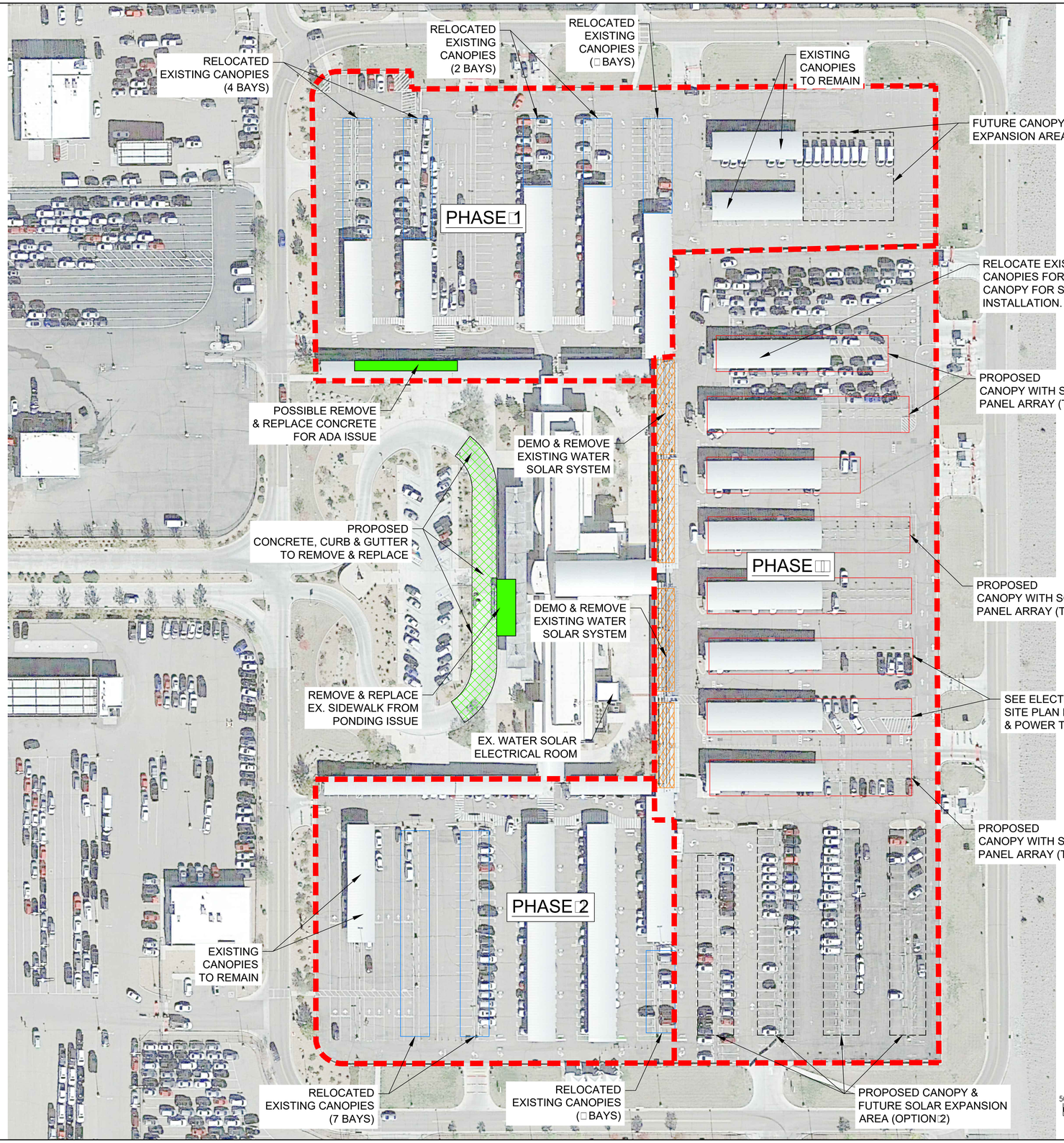
[PATH: P:\Albuquerque International Sunport\229020-A000171.00\Execution\Drawings\Civil\RAC PV-CX-SP00.dwg] [LAYOUT: SITE PLAN – OPTION 1]

APPENDIX B: OVERALL SITE PLAN OPTION 2



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N

SCALE
50 0 25 50 100
(FEET)
1 INCH = 50 FT.

AS BUILT INFORMATION
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Drawings Delivered By Date
MICRO-FILM INFORMATION
Recorded By Date
No.

BENCH MARKS

SURVEY INFORMATION
Field Notes
No. By Date

STAMP & SIGNATURE

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REVISIONS
No. Date Remarks By
Designed By: Date:
Drawn By: Date:
Checked By: Date:

CITY OF ALBUQUERQUE
PUBLIC WORKS DEPARTMENT
ENGINEERING DEVELOPMENT GROUP

TITLE: ALBUQUERQUE INTERNATIONAL AIRPORT
RENTAL CAR FACILITY (RAC) SITE IMPROVEMENTS & PV ARRAY
OVERALL SITE PLAN – OPTION 2

Design Review Committee	City Engineer Approval	Last Design Update	Mo./Day/Yr.	Mo./Day/Yr.

City Project No.	Zone Map No.	Drawing No.	Sheet	Of
6564.00-T1	M-16			X

FINAL REPORT DRAWINGS – JANUARY 28, 2021

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[PATH: P:\Albuquerque International Sunport\229020-A000171.00\Execution\Drawings\Civil\RAC PV-CX-SP00.dwg] [LAYOUT: SITE PLAN – OPTION 2]

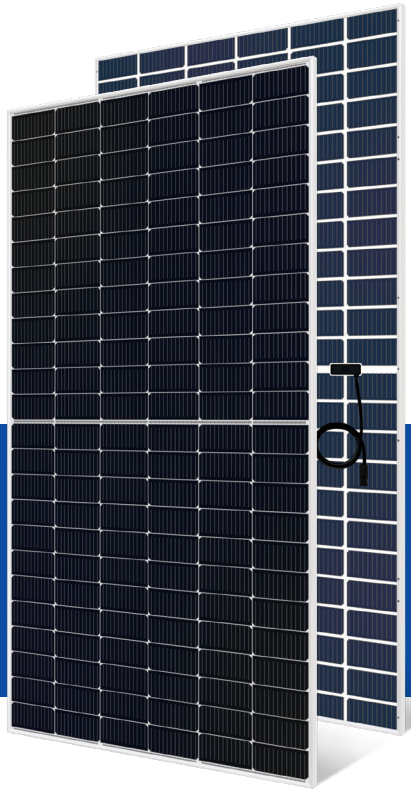
APPENDIX C: SOLAR SYSTEM CUT SHEETS

HYUNDAI SOLAR MODULE

YI SERIES

Double Max™
Bifacial PV Module

HiS-S430YI HiS-S435YI HiS-S440YI
HiS-S445YI HiS-S450YI



Bifacial Cells

More Power Generation In Low Light

UL 1,500V
IEC 1,500V
Saves BOS Costs

For commercial & Utility Applications

Maximized Power Generation

Increased total power output through capturing light from both the front and back of Bifacial solar modules. Back side power gain up to 25% of the front output depending on PV system design.

Half-Cut & Multi-Wire Technology

12 Wires

Improved current flow with half-cut technology and 12 thin wiring technology allows high module efficiency of up to 20.7%. It also reduces power generation loss due to micro-cracks.

Anti-LID / PID

Both LID(Light Induced Degradation) and PID(Potential Induced Degradation) are strictly eliminated to ensure higher actual yield during lifetime.

Mechanical Strength

Tempered glass and reinforced frame design withstand rigorous weather conditions such as heavy snow and strong wind.

UL / VDE Test Labs

Hyundai's R&D center is an accredited test laboratory of both UL and VDE.

Reliable Warranty

HYUNDAI

Global brand with powerful financial strength provide reliable 25-year warranty.

Hyundai's Warranty Provisions

12 YEARS
- 12-Year Product Warranty
  - Materials and workmanship

25 YEARS
- 25-Year Performance Warranty
  - Initial year : 97.6%
  - Linear warranty after second year: with 0.6%p annual degradation, 83.2% is guaranteed up to 25 years

About Hyundai Energy Solutions

Established in 1972, Hyundai Heavy Industries Group is one of the most trusted names in the heavy industries sector and is a Fortune 500 company. As a global leader and innovator, Hyundai Heavy Industries is committed to building a future growth engine by developing and investing heavily in the field of renewable energy.

As a core energy business entity of HHI, Hyundai Energy Solutions has strong pride in providing high-quality PV products to more than 3,000 customers worldwide.

Certification

- UL61730 certified by UL, Type 1(for Fire Class A)
- KS C 8561 certified by KEA

HYUNDAI ENERGY SOLUTIONS

Electrical Characteristics

		Mono-Crystalline Type(HiS-S____YI)				
		430	435	440	445	450
Nominal Output (Pmpp)	W	430	435	440	445	450
Open Circuit Voltage (Voc)	V	49.0	49.2	49.4	49.6	49.8
Short Circuit Current (Isc)	A	11.18	11.25	11.33	11.40	11.47
Voltage at Pmax (Vmpp)	V	40.8	41.0	41.2	41.4	41.6
Current at Pmax (Impp)	A	10.54	10.61	10.69	10.76	10.83
Module Efficiency	%	19.8	20.0	20.2	20.5	20.7
Cell Type	-	Mono-crystalline, 12busbar, bifacial				
Maximum System Voltage	V	1,500				
Temperature Coefficient of Pmax	%/K	-0.347				
Temperature Coefficient of Voc	%/K	-0.268				
Temperature Coefficient of Isc	%/K	0.032				

*All data at STC (Standard Test Conditions). Above data may be changed without prior notice.

Additional Power Gain from rear side		430	435	440	445	450
5%	W	452	457	462	467	473
15%	W	495	500	506	512	518
25%	W	538	544	550	556	563

Mechanical Characteristics

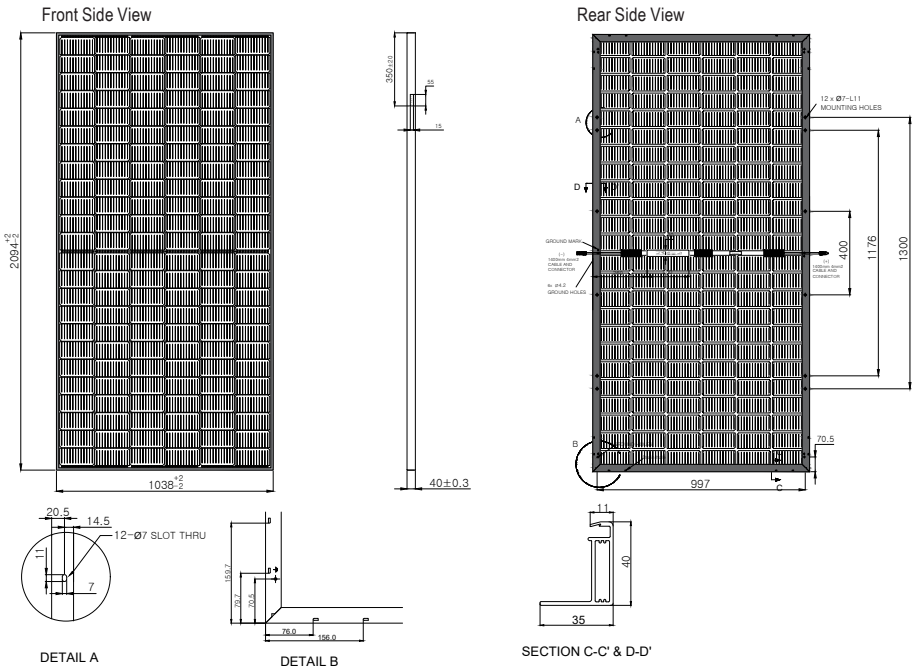
Dimensions	1,038 mm (W) x 2,094 mm (L) x 40 mm(H)
Weight	Approx. 23.7 kg
Solar Cells	144 half cut bifacial cells (2 parallel x 72 half cells in series)
Output Cables	H1Z2Z2-K 4mm2 (12 AWG), 1.4m, IP68 weatherproof connectors, IEC&UL certified, MC4 compatible
Junction Box	IP68, weatherproof, IEC certified (UL listed)
Bypass Diodes	3 bypass diodes to prevent power decrease by partial shade
Construction	Front : Anti-reflection coated glass Encapsulant : EVA I Back Sheet : Transparent Back Sheet (White grid)
Frame	Clear anodized aluminum alloy type 6063

Installation Safety Guide

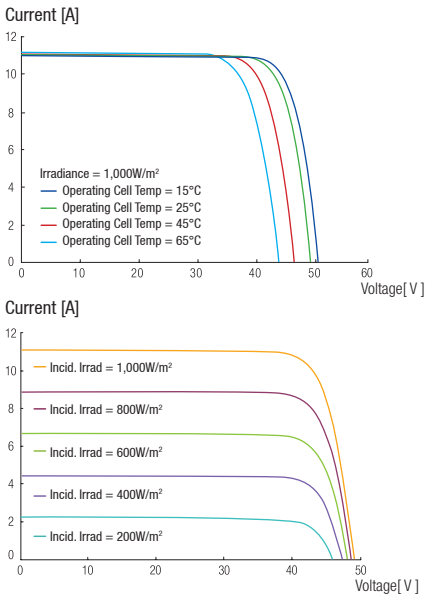
- Only qualified personnel should install or perform maintenance.
- Be aware of dangerous high DC voltage.
- Do not damage or scratch the rear surface of the module.
- Do not handle or install modules when they are wet.

Nominal Operating Cell Temperature	45.5°C ± 2
Operating Temperature	-40°C ~ +85°C
Maximum System Voltage	DC 1,500V
Maximum Reverse Current	20A
Maximum Test Load	**Front 113 psf** (5,400 Pa) **Rear 50 psf** (2,400 Pa)

Module Diagram (unit : mm)



I-V Curves (HiS-S435YI)



HYUNDAI ENERGY SOLUTIONS

Printed on FSC certified eco-friendly paper.

Printed Date : 10/2020

SUNNY TRIPOWER CORE1 33-US / 50-US / 62-US

Fully integrated

- Innovative design requires no additional racking for rooftop installation
- Integrated DC and AC disconnects and overvoltage protection
- 12 direct string inputs for reduced labor and material costs

Increased power, flexibility

- Multiple power ratings for small to large scale commercial PV installions
- Six MPP trackers for flexible stringing and maximum power production
- ShadeFix, SMA's proprietary shade management solution, optimizes at the string level

Enhanced safety, reliability

- Integrated SunSpec PLC signal for module-level rapid shutdown compliance to 2017 NEC
- Next-gen DC AFCI arc-fault protection certified to new Standard UL 1699B Ed. 1

Smart monitoring, control, service

- Advanced smart inverter grid support capabilities
- Increased ROI with SMA ennexOS cross sector energy management platform
- SMA Smart Connected proactive O&M solution reduces time spent diagnosing and servicing in the field

SUNNY TRIPOWER CORE1 33-US / 50-US / 62-US

It stands on its own

The Sunny Tripower CORE1 is the world's first free-standing PV inverter for commercial rooftops, carports, ground mount and repowering legacy solar projects. From distribution to construction to operation, the Sunny Tripower CORE1 enables logistical, material, labor and service cost reductions, and is the most versatile, cost-effective commercial solution available. Integrated SunSpec PLC for rapid shutdown and enhanced DC AFCI arc-fault protection ensure compliance to the latest safety codes and standards. With Sunny Tripower CORE1 and SMA's ennexOS cross sector energy management platform, system integrators can deliver comprehensive commercial energy solutions for increased ROI.

Technical data	Sunny Tripower CORE1 33-US	Sunny Tripower CORE1 50-US	Sunny Tripower CORE1 62-US
Input (DC)			
Maximum array power	50000 Wp STC	75000 Wp STC	93750 Wp STC
Maximum system voltage		1000 V	
Rated MPP voltage range	330 V … 800 V	500 V … 800 V	550 V … 800 V
MPPT operating voltage range		150 V … 1000 V	
Minimum DC voltage / start voltage		150 V / 188 V	
MPP trackers / strings per MPP input		6 / 2	
Maximum operating input current / per MPP tracker		120 A / 20 A	
Maximum short circuit current per MPPT / per string input		30 A / 30 A	
Output (AC)			
AC nominal power	33300 W	50000 W	62500 W
Maximum apparent power	33300 VA	53000 VA	66000 VA
Output phases / line connections		3 / 3-(N)-PE	
Nominal AC voltage		480 V / 277 V WYE	
AC voltage range		244 V … 305 V	
Maximum output current	40 A	64 A	80 A
Rated grid frequency		60 Hz	
Grid frequency / range		50 Hz, 60 Hz / -6 Hz … +6Hz	
Power factor at rated power / adjustable displacement		1 / 0.0 leading … 0.0 lagging	
Harmonics THD		<3 %	
Efficiency			
CEC efficiency	97.5%	97.5%	97.5%
Protection and safety features			
Load rated DC disconnect		●	
Load rated AC disconnect		●	
Ground fault monitoring: Riso / Differential current		● / ●	
DC AFCI arc-fault protection		●	
SunSpec PLC signal for rapid shutdown		●	
DC reverse polarity protection		●	
AC short circuit protection		●	
DC surge protection: Type 2 / Type 1+2		O / O	
AC surge protection: Type 2 / Type 1+2		O / O	
Protection class / overvoltage category (as per UL 840)		I / IV	
General data			
Device dimensions (W / H / D)		621 mm / 733 mm / 569 mm (24.4 in x 28.8 in x 22.4 in)	
Device weight		84 kg (185 lbs)	
Operating temperature range		-25 °C … +60 °C (-13 °F … +140 °F)	
Storage temperature range		-40 °C … +70 °C (-40 °F … +158 °F)	
Audible noise emissions (full power @ 1m and 25 °C)		65 dB(A)	
Internal consumption at night		5 W	
Topology		Transformerless	
Cooling concept		OptiCool (forced convection, variable speed fans)	
Enclosure protection rating		Type 4X, 3SX (as per UL 50E)	
Maximum permissible relative humidity (non-condensing)		100 %	
Additional information			
Mounting		Free-standing with included mounting feet	
DC connection		Amphenol UTX PV connectors	
AC connection		Screw terminals - 4 AWG to 4/0 AWG CU/AL	
LED indicators (Status / Fault / Communication)		●	
Network interfaces: Ethernet / WLAN / RS485		● (2 ports) / ● / O	
Data protocols: SMA Modbus / SunSpec Modbus / Webconnect		● / ● / ●	
Multifunction relay		●	
ShadeFix technology for string level optimization		●	
Integrated Plant Control / Q on Demand 24/7		● / ●	
Off-Grid capable / SMA Fuel Save Controller compatible		● / ●	
SMA Smart Connected (proactive monitoring and service support)		●	
Certifications			
Certifications and approvals		UL 1741, UL 1699B Ed. 1, UL 1998, CSA 22.2 107-1, PV Rapid Shutdown System Equipment	
FCC compliance		FCC Part 15 Class A	
Grid interconnection standards		IEEE 1547, UL 1741 SA - CA Rule 21, HECO Rule 14H	
Advanced grid support capabilities		L/HFRT, L/HVRT, Volt-VAr, Volt-Watt, Frequency-Watt, Ramp Rate Control, Fixed Power Factor	
Warranty			
Standard		10 years	
Optional extensions		15 / 20 years	
O Optional features ● Standard features – Not available			
Type designation	STP 33-US-41	STP 50-US-41	STP 62-US-41

Accessories

SMA Data Manager M
EDMM-US-10

SMA Sensor Module
MD.SEN-US-40

Universal Mounting System
UMS_KIT-10

AC Surge Protection Module Kit
AC_SPD_KIT1-10, AC_SPD_KIT2_T1T2
DC Surge Protection Module Kit
DC_SPD_KIT4-10, DC_SPD_KIT5_T1T2

Toll Free +1 888 4 SMA USA
www.SMA-America.com

SMA America, LLC

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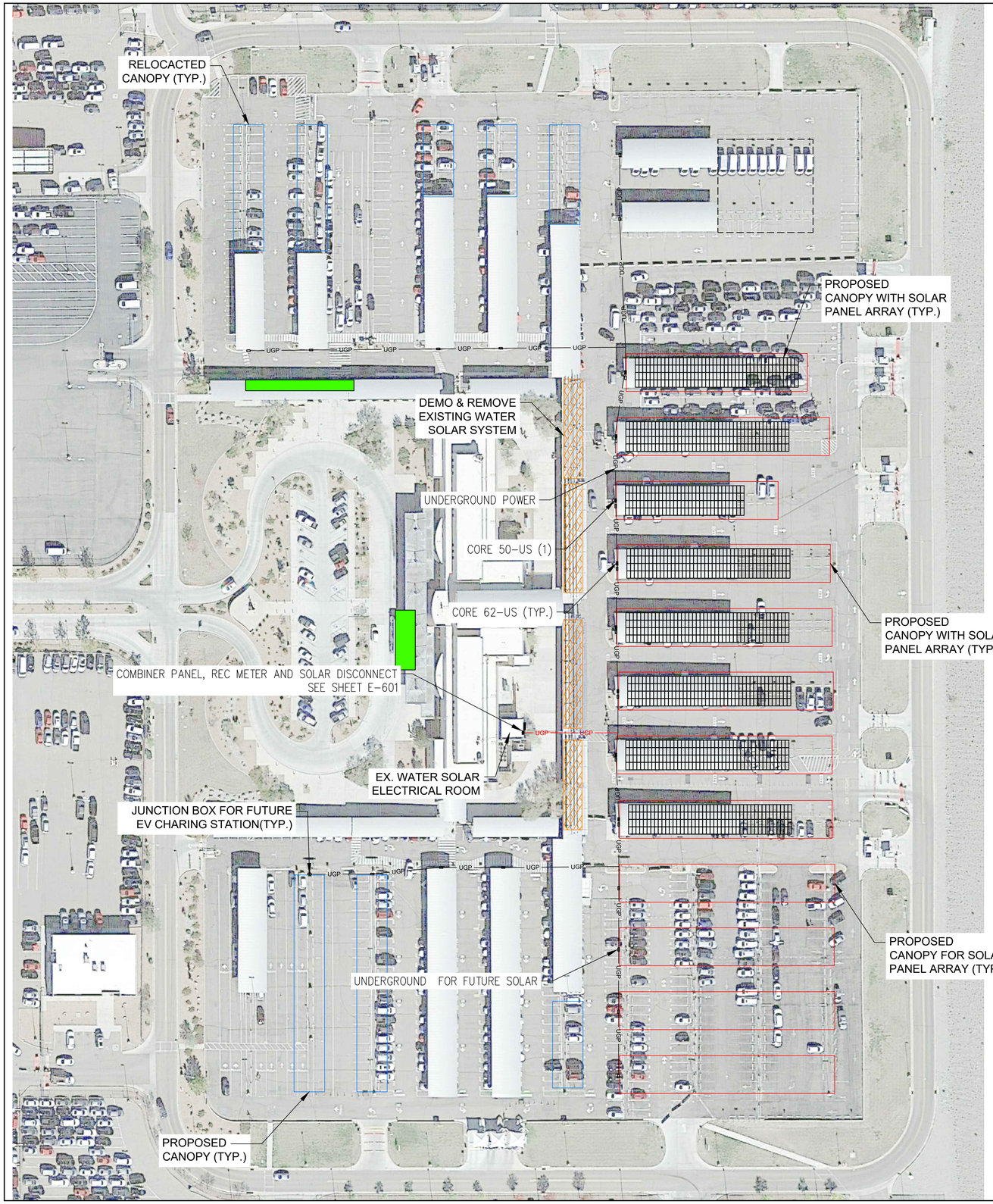
APPENDIX D: ELECTRICAL SITE PLAN



LEGEND

- DEMO & REMOVE EXISTING WATER SOLAR SYSTEM
- PROPOSED PANEL ARRAY (EAST-WEST DIRECTION)
- PROPOSED CANOPY
- UGP — PROPOSED ELECTRICAL TRENCH

SOLAR PV SUMMARY **OPTION ONE NET-ZERO**

MAIN FEATURES:

NOMINAL POWER AC:	574 kWac
PEAK DC POWER:	592 KWp
MODULE TECHNOLOGY:	MONO-CRYSTALLINE
INVERTER TOPOLOGY:	3PH STRING – UL1741

PV MODULES:

MANUFACTURER:	HYUNDAI
MODEL:	HIS-S435YI
PEAK POWER:	435 Wp (EA)
NUMBER OF MODULES:	1360

ELECTRICAL CONFIGURATION:

MODULES PER STRING:	16 IN SERIES
MAX DC VOLTAGE:	1000V (UL)
TOTAL QTY OF STRINGS:	(85) STRINGS

INVERTER CONFIGURATION:

MANUFACTURER:	SMA TRIPOWER
MODEL:	(1) CORE 50-US (7) CORE 62-US
NOMINAL POWER:	50kWAC,62.5 kWAC
QUANTITY:	(8) INVERTERS
INV. OUTPUT VOLTAGE:	480V (3PH/4W)
ARRAY COMBINER:	INTEGRATED/FUSED
DC DISCONNECT:	INTEGRAL/LOCKABLE (OFF)
AC DISCONNECT:	INTEGRAL/LOCKABLE (OFF)

ABQ INTERNATIONAL SUNPORT

AS BUILT INFORMATION
Contractor
Work Started By / Date
Inspector's Acceptance By / Date
Field Verification By / Date
Drawings Completed By / Date
MICRO-FILM INFORMATION
Recorded By / Date
No.

BENCH MARKS

SURVEY INFORMATION
Field Notes
No. / By / Date

STAMP & SIGNATURE

WHPacific
6501 Americas Pkwy NE , Suite 400
Albuquerque, NM 87110
505.247.0294 Fax 505.242.4845
www.whpacific.com

REVISIONS

No.	Date	Remarks	By
DESIGN		Date:	Designed By: PJS
		Date:	Drawn By: PJS
		Date:	Checked By: WPF

N

SCALE
50 0 25 50 100
(FEET)
1 INCH = 50 FT.

CITY OF ALBUQUERQUE
PUBLIC WORKS DEPARTMENT
ENGINEERING DEVELOPMENT GROUP

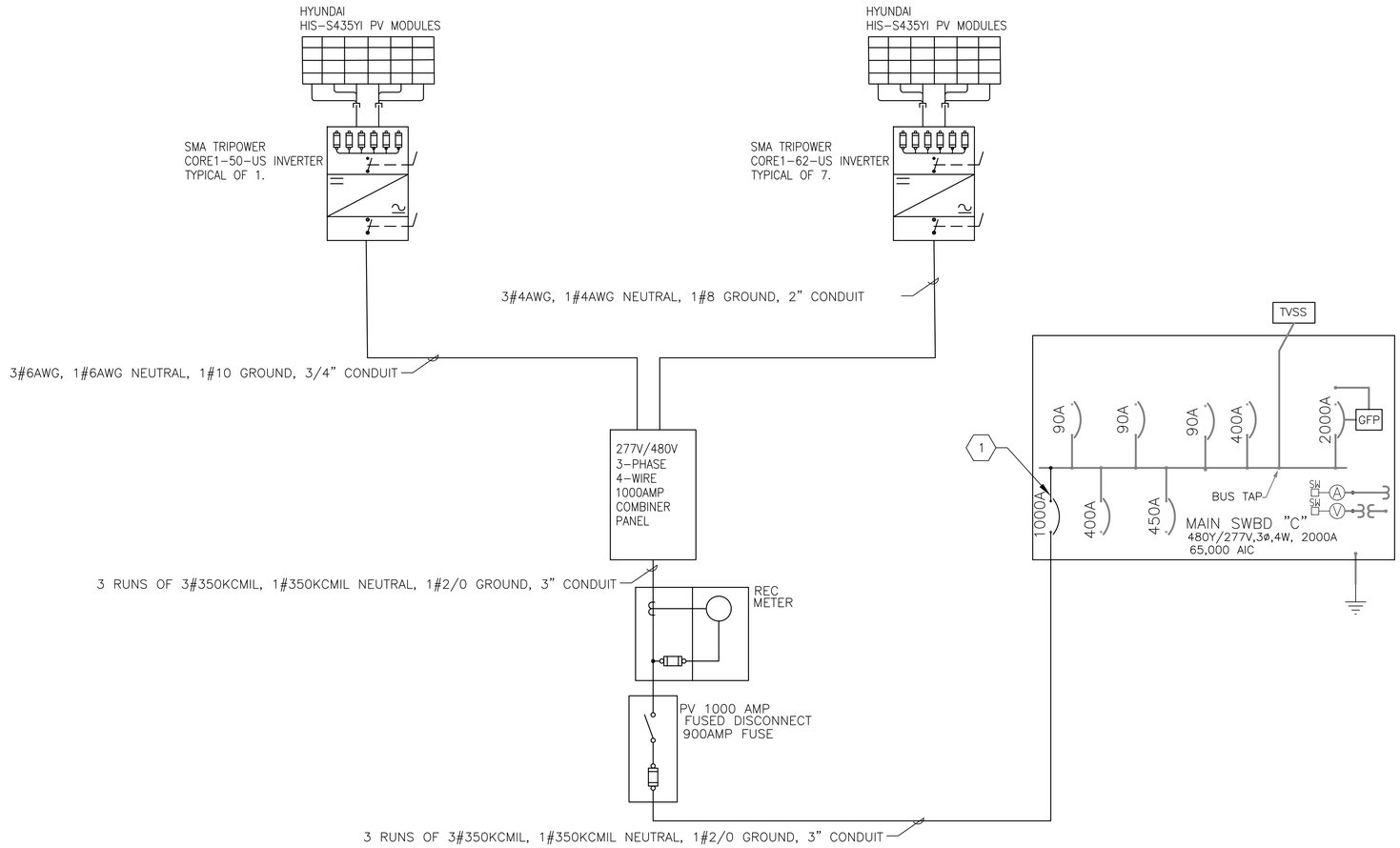
TITLE: ALBUQUERQUE INTERNATIONAL AIRPORT
RENTAL CAR FACILITY (RAC) SITE IMPROVEMENTS & PV ARRAY
ELECTRICAL SOLAR SITE PLAN

Design Review Committee	City Engineer Approval	Last Design Update	Mo./Day/Yr.	Mo./Day/Yr.

City Project No.	Zone Map No.	Drawing No.	Sheet	Of
6564.00-T1	M-16			X

FINAL REPORT DRAWINGS – JANUARY 28, 2021

APPENDIX E: ELECTRICAL ONE-LINE DIAGRAM



KEYED NOTES ⟨X⟩

1. NEW 1000AMP BREAKER FOR PV ARRAY INPUT.

1 / E-601 SUNPORT RAC PV ONE-LINE

SCALE: NTS

0 4' 8' 16'

SCALE:1/8"=1'

WHPacific
6501 Americas Pkwy NE , Suite 400
Albuquerque, NM 87110
505.247.0294 Fax 505.242.4845
www.whpacific.com

AS BUILT INFORMATION
Contractor
Work Started By Date
Inspector's Acceptance By Date
Field Verification By Date
Drawings Corrected By Date
MICRO-FILM INFORMATION
Recorded By Date
No.

BENCH MARKS

SURVEY INFORMATION
Field Notes
No. By Date

STAMP & SIGNATURE

REVISIONS
No. Date By Remarks
DESIGN
Designed By: PJS Date:
Drawn By: PJS Date:
Checked By: WPF Date:

CITY OF ALBUQUERQUE
PUBLIC WORKS DEPARTMENT
ENGINEERING DEVELOPMENT GROUP

TITLE: ALBUQUERQUE INTERNATIONAL AIRPORT
RENTAL CAR FACILITY (RAC) SITE IMPROVEMENTS & PV ARRAY
POWER ONE-LINE DIAGRAM

Design Review Committee	City Engineer Approval	Last Design Update	Mo./Day/Yr.	Mo./Day/Yr.

City Project No.	Zone Map No.	Drawing No.	Sheet	Of
6564.00-T1	M-16	E-601	X	X

APPENDIX F: SOLAR ENERGY PAYBACK ANALYSIS

Solar Energy Solutions Proposal

Canopy - 100% Offset

Prepared for:

CITY ABQ AVIATION RENTAL CAR CENTER

affordable solar
commercial | government

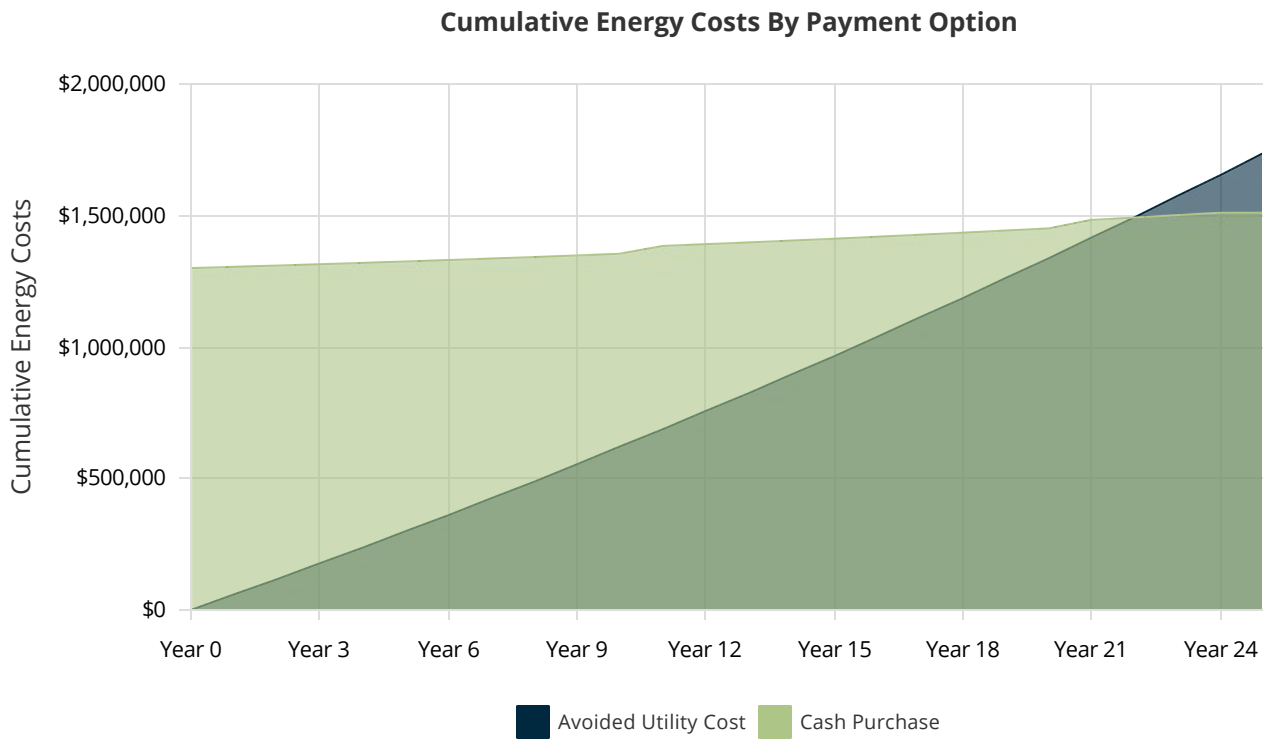
Prepared By: Dylan Connelly
P: 505.926.1764 , **E:** dylan@affordable-solar.com

Table of Contents

1 Project Summary

Payment Options	Cash Purchase
Upfront Payment	$1,300,000
Total Payments	$1,300,000
Rebates and Incentives	-
Net Payments	$1,300,000
25-Year Electric Bill Savings	$1,736,660
25-Year IRR	1.17%
25-Year LCOE PV	$0.056
25-Year NPV	($468,463)
Payback Period	22 Years
Blended Savings Per kWh PV	$0.059

Combined Solar PV Rating
Power Rating: 592,000 W-DC
Power Rating: 537,054 W-AC-CEC



2.1.1 PV System Details

General Information
Facility: Facility #1
Address: 3400 University Blvd SE Albuquerque NM 87106

Solar PV Equipment Description
Solar Panels: 592.0kW-DC Premium Modules
Inverters: Standard Inverter

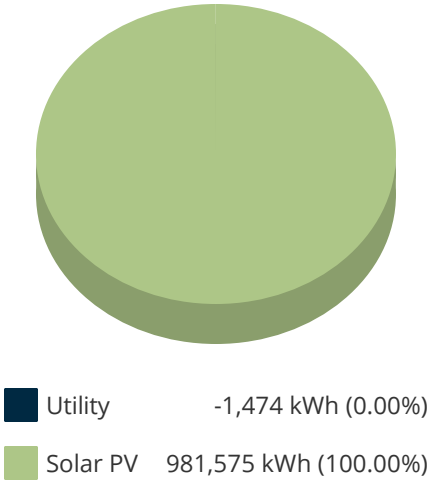
Solar PV Equipment Typical Lifespan
Solar Panels: Greater than 30 Years
Inverters: 10 Years

Solar PV System Cost And Incentives

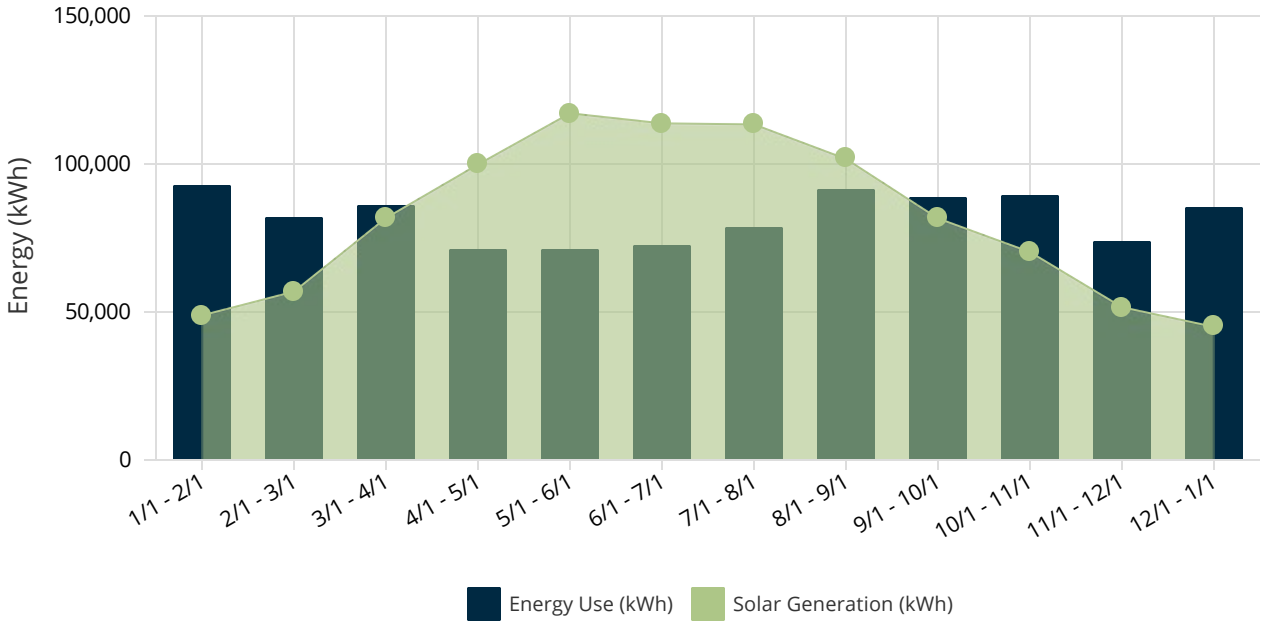
Solar PV System Cost	$1,300,000
Net Solar PV System Cost:	**$1,300,000**

Solar PV System Rating
Power Rating: 592,000 W-DC

Energy Consumption Mix
Annual Energy Use: 980,101 kWh



Monthly Energy Use vs Solar Generation



2.1.2 Rebates and Incentives

This section summarizes all incentives available for this project. The actual rebate and incentive amounts for this project are shown in each example.

2.1.3 Utility Rates

You have the option to remain on your current rate schedule (3B) or switch to an alternative rate schedule (3B). The rates for each are shown below and your estimated electric bills are shown on the following page for each rate schedule.

Fixed Charges			Energy Charges			Demand Charges		
Type	3B	3B	Type	3B	3B	Type	3B	3B
W Monthly	$84.32		W On Peak	$0.06591		W On Peak	$19.65	
S Monthly	$84.32		W Off Peak	$0.05359		S On Peak	$26.31	
			S On Peak	$0.07174				
			S Off Peak	$0.05359				

2.1.4 Current Electric Bill

The table below shows your annual electricity costs based on the most current utility rates and your previous 12 months of electrical usage.

Rate Schedule: PNM - 3B

Time Periods	Energy Use (kWh)		Max Demand (kW)	Charges			
Bill Ranges & Seasons	On Peak	Off Peak	On Peak	Other	Energy	Demand	Total
1/1/2019 - 2/1/2019 W	29,700	63,000	171	$84	$5,334	$3,360	$8,778
2/1/2019 - 3/1/2019 W	26,100	55,500	162	$84	$4,695	$3,183	$7,962
3/1/2019 - 4/1/2019 W	26,400	59,700	168	$84	$4,940	$3,301	$8,325
4/1/2019 - 5/1/2019 W	23,700	47,100	177	$84	$4,086	$3,478	$7,648
5/1/2019 - 6/1/2019 W	25,200	45,600	183	$84	$4,105	$3,595	$7,785
6/1/2019 - 7/1/2019 S	24,900	47,400	180	$84	$4,327	$4,736	$9,147
7/1/2019 - 8/1/2019 S	30,600	47,700	195	$84	$4,752	$5,130	$9,966
8/1/2019 - 9/1/2019 S	36,600	54,900	207	$84	$5,568	$5,446	$11,098
9/1/2019 - 10/1/2019 W	34,800	53,400	201	$84	$5,156	$3,949	$9,189
10/1/2019 - 11/1/2019 W	33,300	55,800	198	$84	$5,185	$3,890	$9,160
11/1/2019 - 12/1/2019 W	27,300	46,200	195	$84	$4,275	$3,831	$8,191
12/1/2019 - 1/1/2020 W	28,500	56,700	174	$84	$4,917	$3,419	$8,420
Totals:	347,100	633,000	-	$1,012	$57,340	$47,318	$105,670

2.1.5 New Electric Bill

Rate Schedule Option 1: PNM - 3B

Time Periods	Energy Use (kWh)		Max Demand (kW)	Charges			
Bill Ranges & Seasons	On Peak	Off Peak	On Peak	Other	Energy	Demand	Total
1/1/2019 - 2/1/2019 W	-6,263	50,125	170	$84	$2,274	$3,340	$5,698
2/1/2019 - 3/1/2019 W	-14,352	39,071	161	$84	$1,148	$3,159	$4,392
3/1/2019 - 4/1/2019 W	-24,535	28,907	167	$84	-	$3,275	$3,360
4/1/2019 - 5/1/2019 W	-47,728	18,705	175	$84	-$1,016	$3,429	$2,498
5/1/2019 - 6/1/2019 W	-58,584	12,271	180	$84	-$1,621	$3,537	$2,001
6/1/2019 - 7/1/2019 S	-45,950	4,517	177	$84	-$1,450	$4,661	$3,295
7/1/2019 - 8/1/2019 S	-49,710	14,651	192	$84	-$1,227	$5,049	$3,906
8/1/2019 - 9/1/2019 S	-32,821	22,619	204	$84	-$357	$5,363	$5,091
9/1/2019 - 10/1/2019 W	-22,080	28,681	198	$84	$82	$3,898	$4,064
10/1/2019 - 11/1/2019 W	-18,404	37,275	196	$84	$785	$3,849	$4,718
11/1/2019 - 12/1/2019 W	-7,269	29,161	192	$84	$1,084	$3,768	$4,936
12/1/2019 - 1/1/2020 W	-3,200	43,437	172	$84	$2,117	$3,383	$5,585
Totals:	-330,896	329,420	-	$1,012	$1,818	$46,713	$49,543

New Rate Schedule Option 2: PNM - 3B

Time Periods	Energy Use (kWh)		Max Demand (kW)	Charges			
Bill Ranges & Seasons	On Peak	Off Peak	On Peak	Other	Energy	Demand	Total
1/1/2019 - 2/1/2019 W	-6,263	50,125	170	$84	$2,274	$3,340	$5,698
2/1/2019 - 3/1/2019 W	-14,352	39,071	161	$84	$1,148	$3,159	$4,392
3/1/2019 - 4/1/2019 W	-24,535	28,907	167	$84	-$68	$3,275	$3,292
4/1/2019 - 5/1/2019 W	-47,728	18,705	175	$84	-$2,143	$3,429	$1,370
5/1/2019 - 6/1/2019 W	-58,584	12,271	180	$84	-$3,204	$3,537	$418
6/1/2019 - 7/1/2019 S	-45,950	4,517	177	$84	-$3,054	$4,661	$1,691
7/1/2019 - 8/1/2019 S	-49,710	14,651	192	$84	-$2,781	$5,049	$2,352
8/1/2019 - 9/1/2019 S	-32,821	22,619	204	$84	-$1,142	$5,363	$4,305
9/1/2019 - 10/1/2019 W	-22,080	28,681	198	$84	$82	$3,898	$4,064
10/1/2019 - 11/1/2019 W	-18,404	37,275	196	$84	$785	$3,849	$4,718
11/1/2019 - 12/1/2019 W	-7,269	29,161	192	$84	$1,084	$3,768	$4,936
12/1/2019 - 1/1/2020 W	-3,200	43,437	172	$84	$2,117	$3,383	$5,585
Totals:	-330,896	329,420	-	$1,012	-$52	$46,713	$47,673

Annual Electricity Savings: $57,996

2.2 Cash Purchase

Inputs and Key Financial Metrics

Total Project Costs	$1,300,000	25-Year NPV	($468,463)	Discount Rate	5%
10-Year IRR	-12.64%	Payback Period	22 Years	Electricity Escalation Rate	2%
20-Year IRR	-0.82%	25-Year ROI	16.7%	Federal Income Tax Rate	0%
25-Year IRR	1.17%	PV Degradation Rate	0.5%	State Income Tax Rate	0%

Years	Project Costs	O&M / Equipment Replacement	Electric Bill Savings	Change in State Tax Liability	Change in Federal Tax Liability	Total Cash Flow	Cumulative Cash Flow
Upfront	-$1,300,000	-	-	-	-	-$1,300,000	-$1,300,000
1	-	-$4,736	$57,996	-	-	$53,260	-$1,246,740
2	-	-$4,878	$58,861	-	-	$53,983	-$1,192,757
3	-	-$5,024	$59,736	-	-	$54,712	-$1,138,045
4	-	-$5,175	$60,623	-	-	$55,448	-$1,082,597
5	-	-$5,330	$61,522	-	-	$56,191	-$1,026,406
6	-	-$5,490	$62,432	-	-	$56,942	-$969,464
7	-	-$5,655	$63,354	-	-	$57,699	-$911,765
8	-	-$5,825	$64,288	-	-	$58,463	-$853,302
9	-	-$5,999	$65,234	-	-	$59,235	-$794,067
10	-	-$6,179	$66,192	-	-	$60,013	-$734,055
11	-	-$30,045	$67,162	-	-	$37,118	-$696,937
12	-	-$6,556	$68,145	-	-	$61,589	-$635,348
13	-	-$6,752	$69,140	-	-	$62,388	-$572,960
14	-	-$6,955	$70,148	-	-	$63,193	-$509,767
15	-	-$7,164	$71,168	-	-	$64,005	-$445,762
16	-	-$7,379	$72,201	-	-	$64,823	-$380,939
17	-	-$7,600	$73,247	-	-	$65,647	-$315,292
18	-	-$7,828	$74,306	-	-	$66,478	-$248,813
19	-	-$8,063	$75,378	-	-	$67,316	-$181,498
20	-	-$8,305	$76,463	-	-	$68,159	-$113,339
21	-	-$32,234	$77,562	-	-	$45,328	-$68,011
22	-	-$8,810	$78,673	-	-	$69,863	$1,852
23	-	-$9,075	$79,799	-	-	$70,724	$72,576
24	-	-$9,347	$80,937	-	-	$71,590	$144,167
25	-	-$9,627	$82,090	-	-	$72,462	$216,629
Totals:	-$1,300,000	-$220,031	$1,736,660	-	-	$216,629	-