**SOUTHERN INDIANA GAS AND ELECTRIC COMPANY**
**d/b/a VECTREN ENERGY DELIVERY OF INDIANA, INC.**
**(VECTREN SOUTH)**

**IURC CAUSE NO. 45086**



# DIRECT TESTIMONY
# OF
# WAYNE D. GAMES
# VICE-PRESIDENT POWER SUPPLY

# ON

# DESCRIPTION AND BENEFITS OF SOLAR PROJECT, ESTIMATED COST OF SOLAR PROJECT, AND SUPPORT FOR CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY

**SPONSORING PETITIONER'S EXHIBIT NO. 1 (PUBLIC)**
**ATTACHMENTS WDG-1 THROUGH WDG-5**

**DIRECT TESTIMONY OF WAYNE D. GAMES**

## I. INTRODUCTION

**Q. Please state your name and business address.**

A. My name is Wayne D. Games. My business address is One Vectren Square, Evansville, Indiana 47708.

**Q. What position do you hold with Petitioner, Southern Indiana Gas and Electric Company d/b/a Vectren Energy Delivery of Indiana, Inc. ("Vectren South" or the "Company")?**

A. I am Vice President – Power Supply.

**Q. Please describe your educational background.**

A. I received a Bachelor of Arts in Industrial Technology from Ohio Northern University in 1980 and a Master of Arts in Management from Antioch University in 2002.

**Q. Pleases describe your professional experience.**

A. I have over twenty-five years of varied experience in the utility industry. I started my career with The Dayton Power & Light Co. in 1991 where I held supervisory, manager, and regional manager titles on the energy delivery side of the business. Upon joining Vectren in 2000, I served as Director of Construction and Service and Regional Manager in the Ohio service area. In 2003, I moved to Evansville, Indiana, and accepted responsibility as Director of Vectren South's AB Brown generating station. I was promoted to Vice President of Power Supply in April of 2011.

**Q. What are your present duties and responsibilities as Vectren South's Vice President of Power Supply?**

A. I am responsible for the overall budgeting, operation, maintenance, and personnel decisions for the power generation fleet of Vectren South. In addition, I have responsibility for ensuring that the demand of our customers is met at the lowest reasonable cost through the production and purchase of electric energy, including fuel purchases, necessary to meet the needs of our jurisdictional customers. I am responsible for completing these functions while ensuring compliance with the

environmental requirements of all applicable regulatory or governmental agencies. As part of overseeing Vectren South's generation assets, I have also been involved in providing cost inputs to the modeling associated with the Integrated Resource Plan ("IRP") process, and have reviewed the modeling results and the risk evaluation set forth therein.

**Q. Have you previously testified before the Indiana Utility Regulatory Commission ("Commission")?**

A. Yes. I regularly testify in the Company's fuel adjustment clause ("FAC") proceedings and in the related subdockets in Cause No. 38708. I also testified in support of Vectren South's proposal to install pollution control equipment on its coal-fired generation facilities in Cause No. 44446 and in support of Vectren South's proposal to construct solar facilities in Cause No. 44909. I also am testifying in Cause No. 45052 in support of Vectren South's proposal to construct a new combined cycle gas turbine on available property at its Brown Generating station.

**Q. What is the purpose of your testimony in this proceeding?**

A. The purpose of my testimony is to describe and provide support for Vectren South's constructing, owning and operating a solar energy project (the "Solar Project") totaling approximately 50 megawatts of alternating current ("MWac") within its service territory. I describe Vectren South's decision to pursue the Solar Project. I provide an overview of the benefits of adding solar resources generally, as well as the benefits of adding the Solar Project specifically to Vectren South's existing portfolio of generation assets. Additionally, I describe the contractors involved in constructing the Solar Project and estimated cost of the Solar Project and how those costs were developed. Finally, I provide support for Vectren South's request for the Commission to issue to the Company a certificate of public convenience and necessity ("CPCN") for the construction of the Solar Project.

**Q. Are you sponsoring any attachments in this proceeding?**

A. Yes. I am sponsoring:

- Petitioner's Exhibit No. 1, **Attachment WDG-1**: Solar Project site map;

- Petitioner's Exhibit No. 1, **Attachment WDG-2**: Description of First Solar Series 6 Thin Film Solar Modules;
- Petitioner's Exhibit No. 1, **Attachment WDG-3 (Confidential)**: Cost estimates of Solar Project;
- Petitioner's Exhibit No. 1, **Attachment WDG-4**: Public version of Vectren South's 2016 Integrated Resources Plan ("2016 IRP"); and
- Petitioner's Exhibit No. 1, **Attachment WDG-5**: Construction schedule with key milestones.

**Q. Were these attachments prepared by you or under your direction?**

A. Yes.

**Q. Are any other Vectren South witnesses providing direct testimony in this proceeding?**

A. Yes. The following witnesses also are testifying on behalf of Vectren South in this proceeding:

- Mathew R. Brinkman P.E., Solar Business Unit Manager for Burns & McDonnell's Energy Group, supports the reasonableness of the estimated cost of the Solar Project including a cost comparison to similar projects;
- Thomas L. Bailey, Director of Industrial Sales & Economic Development for Vectren Utility Holdings, Inc. ("VUHI"), explains why the addition of renewable energy to a utility's resources has become increasingly important to Vectren South's existing and potential large customers; and
- J. Cas Swiz, Director, Rates and Regulatory Analysis of VUHI, explains the proposed ratemaking and accounting treatment for the Solar Project and the proposed use of the Clean Energy Cost Adjustment ("CECA"), which the Commission approved in Cause No. 44909.

## II. BACKGROUND REGARDING THE SOLAR PROJECT

**Q. Please provide a brief overview of the Solar Project as proposed by Vectren South.**

A. Vectren South proposes to construct a solar generating facility totaling approximately 50 MWac. The Solar Project will be located on approximately 300 acres of land near the eastern edge of Spencer County, Indiana that will be leased from local property owners. The Solar Project will include: 150,000 solar modules mounted on a single axis tracker that tracks the sun, an interconnection site substation and approximately 560 linear feet of 161 kV generation tie line and related equipment.

**Q. Why are you describing the capacity of the Solar Project in terms of MWac?**

A. Capacity from solar photovoltaic ("PV") systems can be measured by either the alternating current ("AC") or direct current ("DC") capacity. Solar PV panels produce DC power which needs to be converted to AC power for distribution on the utility grid system, as well as for use in electric appliances in homes and businesses. The AC rating of a solar PV system is typically lower than the DC rating to maximize the capacity of the inverter, which converts the DC current produced by the PV modules to AC current. Because the solar irradiance only meets the peak design condition during a small percentage of hours annually, the DC array is oversized to allow the inverter to operate at full capacity for a greater portion of the year, thereby providing more value for the capital expenditure. Because the AC rating better corresponds to traditional power plant ratings, all energy and capacity ratings (MW, MWh, kW, kWh used) in this testimony are stated in AC power, unless otherwise noted.

**Q. What is the DC capacity of the proposed Solar Project?**

A. The DC capacity of the Solar Project will be 64 MWdc.

**Q. Please describe Petitioner's Exhibit No. 1, Attachment WDG-1.**

A. Petitioner's Exhibit No. 1, Attachment WDG-1 is map showing the location of the proposed Solar Project.

**Q. How did the Solar Project originate?**

A. Orion Renewable Energy Group, LLC ("Orion") originated the Solar Project independently. Orion has developed nearly 4,700 MW of renewable energy projects worldwide. In mid-2017, Orion leased 300 acres of farmland in Spencer County and began acquiring certain assets and rights necessary to construct the 50 MWac solar

generating facility on the property. On September 19, 2017, the Spencer County Council agreed to designate the property as an Economic Revitalization Area.

**Q. How did Vectren South become involved in the Solar Project?**

A. Orion approached Vectren South to assess its interest in either entering into a power purchase agreement for energy produced at the site or potentially partnering in the project. Vectren South had identified the addition of solar resources to its portfolio as a component of the resource diversification strategy supported by IRP risk modeling. Accordingly, prior to being approached by Orion, Vectren South was independently considering the construction of a large-scale solar facility and already has two small scale solar projects underway.

Vectren South, therefore, recognized that Orion's construction of the facility within its service territory presented a unique opportunity to add solar assets to its portfolio and began discussions with Orion regarding the project. On December 21, 2017, Vectren South and OSER, LLC (a subsidiary of Orion created for the purpose of developing the Solar Project) entered into an Asset Purchase Agreement setting forth terms under which Vectren South would acquire from Orion the assets and associated rights to complete the development of the Solar Project. The Asset Purchase Agreement is contingent on the Commission's approval of the relief requested in this proceeding.

**Q. What particular assets and rights would Vectren South acquire from Orion under the Asset Purchase Agreement?**

A. Primarily, Vectren South will acquire the rights to leases, subleases, surface use agreements and licenses for multiple properties composing the 300 acres of land on which the Solar Project will be constructed. Orion has entered into 50-year agreements for multiple parcels of land composing the 300 acres. Under the Asset Purchase Agreement, Vectren South also would obtain rights to permits Orion had been issued, as well as the benefits of the pre-construction work Orion completed to ensure the site could be used for installation of the Solar Project. In addition, Orion secured local tax benefits for the Solar Project through the designation of the area as an Economic Revitalization Area, which also will benefit Vectren South.

**Q. Please explain further why the work done by Orion presented such a unique opportunity to add solar assets to Vectren South's portfolio.**

A. A 50 MWac solar facility requires a substantial amount of acreage and close proximity to a substation with the capacity to accept and distribute the energy produced. Accordingly, there are a limited number of on-system opportunities for Vectren South to develop such a facility on its own.

**Q. What other factors caused Vectren South to enter into the Asset Purchase Agreement?**

A. As I mentioned above, the biggest factor Vectren South considered was the cost to customers of electric energy generated by a solar project. While favorable environmental attributes of solar energy are highly attractive and solar resources provide better capacity than wind, cost remains a key consideration. Here, Vectren South is able to add the Solar Project to its portfolio, before tax benefits are reduced, at an average cost of approximately 7 cents per kWh over 30-years. This price compares favorably to the cost per kWh for other large scale solar projects undertaken in Indiana, as further discussed by Vectren South witness Mathew R. Brinkman P.E. Further, given location, the Solar Project is not burdened by grid infrastructure costs or the abnormal risk of congestion issues.

**Q. What other steps had Orion undertaken to facilitate the construction of the project?**

A. Orion identified First Solar Electric, LLC ("First Solar") as the optimal choice to provide solar modules for the project because First Solar was able to lock down the price of modules in advance of the imminent solar tariffs. Accordingly, Vectren South began negotiations with First Solar for the purchase of modules last year in anticipation of the tariffs. On December 21, 2017, Vectren South entered into a Module Sale Agreement with First Solar under which First Solar agreed to sell modules to Vectren South at a fixed price of [redacted] cents per Watt direct current ("Wdc").

**Q. Please describe further the benefit of the Module Sale Agreement.**

A. As further discussed by witness Brinkman, during the time the Module Sale Agreement was negotiated, there was significant pricing uncertainty in the solar market.

Specifically, the U.S. International Trade Commission was considering imposing a tariff of $0.40/Wdc on imported polycrystalline modules and a floor price on all polycrystalline modules of $0.78/Wdc. In January 2018, President Trump imposed a tariff of 30% on polycrystalline PV modules. The modules Vectren South is purchasing are thin film modules and are not directly impacted by the tariffs. However, module price increases by First Solar's polycrystalline competitors due to the 30% solar module tariff could increase demand for First Solar thin film modules and drive price increases. The Module Sale Agreement with First Solar insulated Vectren South and customers from price increases due to market demand resulting from the tariff increases.

**Q. What steps did Vectren South take next?**

A, First Solar would not commit to selling modules at the price agreed to in the Module Sales Agreement without Vectren South agreeing to negotiate with First Solar for it to be the engineering, procurement and construction ("EPC") contractor. On March 2, 2018, Vectren South entered into an Engineering, Procurement and Construction ("EPC") Agreement with First Solar (the "EPC Agreement"). The EPC Agreement incorporated the price of solar modules and other terms from the Module Sale Agreement. In addition, the EPC Agreement sets forth terms under which First Solar will design, engineer, procure, install, construct, test and commission the Solar Project. As with the other agreements, the effectiveness of the EPC Agreement is contingent on the Commission's approval of the relief requested in this proceeding.

**Q. What are the benefits to Vectren South of entering into the EPC Agreement with First Solar?**

A. First Solar has substantial experience in the construction and operation of solar facilities. In addition, entering into the EPC Agreement enabled Vectren South to obtain modules at the favorable price agreed upon in the Module Sale Agreement. Witness Brinkman further discusses in his testimony that the price quotes for services and equipment obtained through First Solar are favorable. Finally, First Solar is providing a 25-year module warranty to Vectren South. First Solar is the only thin film module manufacturer with the financial strength to stand behind such a warranty.

**Q. Please testify further regarding the experience of First Solar.**

A. First Solar has developed, financed, engineered, constructed and currently operates many of the world's largest grid-connected PV power plants. With over 17GW of modules sold, First Solar has a demonstrated history of financial stability and manufacturing success. First Solar has extensive expertise into how state-of-the-art PV power plants are developed, financed, designed, constructed and operated.

## III. COMPONENTS OF THE SOLAR PROJECT

**Q. What are the major components of the Solar Project?**

A. The major components of the Solar Project include the actual solar modules, ground mounted racking systems on which the panels are mounted, the inverter which transforms DC current into AC current to be used to serve customers, a site substation, transformers, approximately 560 linear feet of 161 kV generation tie-line, and communication systems. The Solar Project also includes fencing for security and access roads to maneuver within the site for inspections and maintenance, as well as a security system.

**Q. What are the primary considerations when choosing a solar system?**

A. The primary considerations when choosing a solar system are the types of modules and the type of racking system to be used. Other components, such as the site substation and generation tie-line, are fairly standard across solar projects.

**Q. What type of modules did Vectren South choose to install?**

A. Vectren South has selected First Solar's Series 6 PV thin film modules. Thin film solar modules are made with solar cells that have light absorbing layers about 350 times smaller than that of a standard silicon panel. Because of their narrow design and the efficient semi-conductor built into their cells, thin film solar cells are the lightest PV cell available that also are sufficiently durable. First Solar's Series 6 PV thin film modules generate up to 8% more energy than conventional solar modules. A fact sheet regarding First Solar's Series 6 PV thin film modules is attached hereto as Petitioner's Exhibit No. 1, Attachment WDG-2.

**Q. How many modules will the Solar Project include?**

A. The Solar Project will include 150,000 thin film modules. Each module is approximately 2 meters in height and 1.3 meters in width.

**Q. What are the considerations when selecting the racking systems on which the modules are mounted?**

A. Modules either can be secured in racks that are fixed or on racks with motors that have the ability to tilt panels to track with the sun for maximum output. Tracking systems can be single axis pivoting panels that pivot in one direction only or dual axis pivoting panels that tilt in two different directions. Vectren South has chosen to install a single axis racking system.

**Q. What are the benefits of single axis tracking?**

A. Single axis tracking offers the ability to track the sun and achieve about 13% additional output for each module. For a system as large as the Solar Project, this increased output can be significant. Vectren South decided not to install a dual axis tracking system because a dual axis tracking system is more expensive to install on a per MWh system output basis. In addition, a dual axis tracking system requires more inspection and maintenance expense. Single axis tracking systems have a higher reliability than dual axis tracking systems and a longer life-span. Vectren South, therefore, determined that a single axis tracking system provides the best value for its investment for this particular project.

**Q. What is the purpose of the inverters?**

A. Inverters are necessary to convert DC power produced by a solar panel into AC power. Electricity must be AC to be delivered to the electric grid. Inverters can be installed as a string of inverters or a central inverter with combiner boxes. String inverters are connected to rows of panels where they receive DC current, convert it to AC current and send it to the distribution system. A central inverter receives DC current from several combiner boxes connected to rows of panels and converts DC current from the entire solar array to AC current and sends the electricity to the site substation. Vectren South has chosen a central inverter as there are fewer component connections, less space requirements and lower future maintenance cost.

**Q. Please describe further the purpose of the site substation.**

A. The site substation collects AC electricity from the inverter and delivers it to generator step up transformers. The transformers will take the voltage of AC current gathered at the site substation up to 161 kV, which is the suitable transmission voltage level.

**Q. Will the site substation be interconnected with the transmission grid?**

A. No. Electricity collected at the site substation will be delivered to the Hoosier Energy Rural Electric Cooperative ("Hoosier Energy") substation, which is located across the street from the Solar Project property as depicted on Petitioner's Exhibit No. 1, Attachment WDG-1. The fact that the Hoosier Energy substation is adjacent to the property is another factor that made the Solar Project attractive. Vectren South's system is connected directly to this substation.

**Q. Has Vectren South submitted the proposed Solar Project to the Midcontinent System Operator ("MISO") interconnection queue?**

A. Yes. Vectren South has submitted the proposed Solar Project to MISO's interconnection queue and received approval to interconnect up to 70 MWac generated by the Solar Project into the MISO transmission system. MISO has indicated that there will be no required transmission upgrades based on the location of the project.

**Q. What is the expected life of the Solar Project?**

A. Vectren South believes the expected life of the Solar Projects is approximately 30 years. First Solar has agreed to give Vectren South a 25-year warranty on the modules. However, Vectren South believes the Solar Project could continue to operate and provide cost effective energy beyond the 30-year expected life. Accordingly, the leases on property that Vectren South would acquire from Orion under the Asset Purchase Agreement extend for 50 years.

**Q. Will future expansion of the Solar Project be possible?**

A. Expansion of the Solar Project is possible, but not likely. While the Solar Project could technically be expanded to 70 MWac, there is not enough acreage to increase the size of the project.

**Q. Will the Solar Project include a battery storage facility?**

A. At the present time, a battery storage facility is not part of the Solar Project. However, Vectren South believes a battery storage facility could be incorporated into the Solar Project at a future time if installing such a facility becomes cost effective.

## IV. ESTIMATED COST OF THE SOLAR PROJECT

**Q. Has Vectren South developed a cost estimate for the Solar Project?**

A. Yes. Vectren South estimates the total cost of the Solar Project will be approximately $76.1 million. Approximately $[redacted] million of the cost is directly attributable to the cost of the modules. An additional $[redacted] million is attributable to materials and services provided by First Solar pursuant to the EPC Agreement, including costs of inverters, trackers and constructing the site substation. The module and EPC costs are supported and described further by Petitioner's witness Brinkman. An additional $[redacted] million of the total cost is attributable to project development efforts undertaken by Orion, such as obtaining the right to land leases and permitting under the Asset Purchase Agreement. In addition, $[redacted] million is budgeted for interconnection to the MISO transmission system and making any necessary upgrades to the Hoosier Energy substation to accommodate the Solar Project. An additional $[redacted] million is budgeted for miscellaneous "owner's costs" that Vectren South will incur and $[redacted] million is included in the estimate for contingencies. I have attached a breakdown of these costs as Petitioner's Exhibit No. 1, Attachment WDG-3 (Confidential).

**Q. Please describe in greater detail the costs attributable to project development that are shown on Petitioner's Exhibit No. 1, Attachment WDG-3 (Confidential).**

A. The $[redacted] million represents amounts owed to Orion assuming the Solar Project is approved by the Commission. Of that amount, $[redacted] million relates to the assets and rights acquired under the Asset Purchase Agreement and [redacted] is attributable to certain pre-construction engineering costs Orion incurred.

**Q. What costs are included in the amount that has been budgeted for miscellaneous "owner's costs"?**

A. These costs include the cost of: obtaining title insurance; EPC contractor oversight performed by the Owner's Engineer, Burns & McDonnell; legal services; sales taxes; and other miscellaneous services.

**Q. Please provide further detail with respect to the contingency Vectren South has included in the estimated cost of the Solar Project.**

A. The contingency amount represents approximately [redacted]% of the total cost of the Solar Project. However, a portion of this contingency is dedicated to certain aspects of the Solar Project. For instance, the contingency is expected to cover the cost of installing a security system and an on-site operations and maintenance building. In addition, the contingency amount includes funds that might be necessary to cover any unexpected expenses discovered during construction or the interconnect phase of the Solar Project, including the potential imposition of steel and aluminum tariffs.

**Q. How were the cost estimates set forth in Petitioner's Exhibit No. 1, Attachment WDG-3 (Confidential) developed?**

A. The majority of the costs are provided for under the EPC Agreement or Asset Purchase Agreement with Orion. In total, approximately [redacted]% of the project cost is fixed pursuant to the terms of those agreements.

**Q. Is the cost reasonable in comparison to similar projects that have been undertaken?**

A. Yes. Petitioner's witness Brinkman discusses the reasonableness of each component of the cost of the project incorporated into the EPC Agreement, including the cost of the modules. Witness Brinkman notes that the amount Vectren South is paying First Solar under the EPC Agreement is well below the modeled EPC cost for a single axis tracking solar system constructed with union labor in Indiana per the "U.S. Solar Photovoltaic System Cost Benchmark: Q1 2017." In addition, prior to entering into the Agreement with Orion, Vectren South confirmed that the total estimated cost of the project per kWh is significantly lower than the cost of comparable solar projects that have been approved by the Commission, including those undertaken by Duke Energy (approved in Cause No. 44734) and Indiana & Michigan Power Company (approved in Cause No. 44511).

**Q. In your opinion, do the cost estimates set forth in Petitioner's Exhibit No. 1, Attachment WDG-3 (Confidential) constitute the best estimate of the cost of constructing the Solar Project?**

A. Yes. As described above, a large majority of the cost of the Solar Project are fixed by either the Asset Purchase Agreement or EPC Agreement and there is very little contingency built into the project cost.

**Q. What kind of operating and maintenance ("O&M") expense is Vectren South anticipating once the Solar Project is used and useful and in service?**

A. Maintenance activities required for the Solar Project include: remote performance monitoring; resolving any outage or system performance concerns; replacement of panels as needed due to breakage or performance loss; routine maintenance of the inverters and power transformers; repair of electrical connections; property lease costs; insurance costs; audit fees; and routine vegetative management, including mowing and vegetation control. The *pro forma* O&M costs of the Solar Project are $[redacted] annually.

**Q. How do Vectren South's *pro forma* O&M expenses compare to similar projects?**

A. Vectren South's *pro forma* O&M costs equate to approximately $[redacted] per kWdc per year. According to the "U.S. Solar Photovoltaic System Cost Benchmark: Q1 2017" attached to the testimony of Petitioner's witness Brinkman, the average O&M cost of utility scale single axis solar generation systems was $18.5 per kWdc per year in 2017 – or $1,184,000 per year for a 64 MWdc solar facility.

## V. IMPORTANCE OF ADDING SOLAR RESOURCES IN 2019

**Q. What are the benefits of adding solar resources generally?**

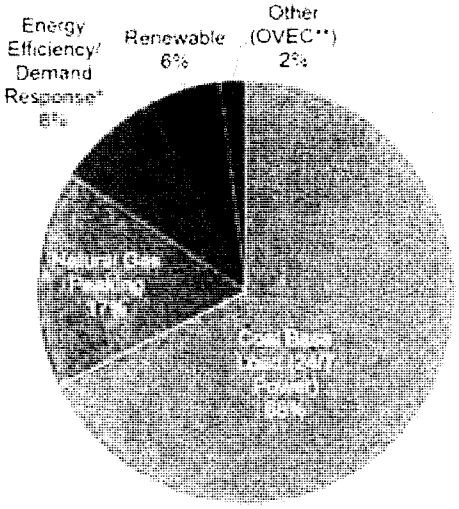
A. Solar resources are an important part of the future of the electric industry and solar energy has emerged as an efficient source of renewable energy. As such, electric utilities are actively building and investing in solar infrastructure, and expanding solar energy options for customers. Vectren South's customers are increasingly interested in the use of more renewable resources to meet their energy needs. Solar energy helps

Vectren South and southwestern Indiana move towards a cleaner generation portfolio. A diversified portfolio also helps to protect customers from risks in the marketplace such as increases in fuel costs. As solar energy has become more viable and customers are more interested in it as a resource, now is the right time for Vectren South to move forward with a Solar Project.

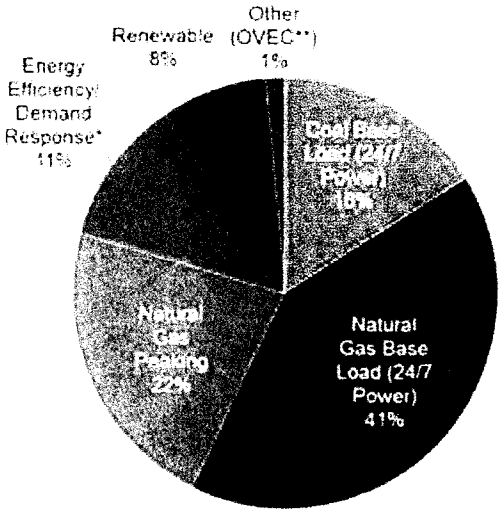
**Q. Please provide an overview of Vectren South's existing generation resources.**

A. Vectren South's current generation mix consists of approximately 1,360 MWs of installed capacity. This capacity consists of approximately 1,000 MW of coal-fired generation, 245 MW of gas-fired generation (peaking units), 3 MW of landfill gas generation, purchased power agreements ("PPAs") totaling 80 MW from wind, and a 1.5% ownership share of Ohio Valley Electric Corporation ("OVEC"), which equates to 32 MW. The table below from Vectren South's 2016 IRP illustrates the 2015 Portfolio Resource Mix, as well as the 2036 Preferred Portfolio Resource Mix:

**2015 Portfolio Resource Mix (MWs)**




**2036 Preferred Portfolio Resource Mix (MWs)**




*Cumulative Demand Response & Net Energy Efficiency
**Vectren's 1.5% ownership of Ohio Valley Electric Corporation (OVEC) coal units. Per contractual obligations, all portfolios include OVEC

**Q. Is construction of the Solar Project consistent with achieving the Preferred Portfolio Resource mix set forth in the 2016 IRP?**

A. Yes. Construction of the Solar Project is an important step towards diversifying Vectren South's generation assets even though coal will continue to be the primary fuel resource through 2023. Vectren South owns and operates five coal-fired units that provide approximately 1,000 MW of baseload generation capacity. The baseload capacity supplied by Vectren South's coal units is summarized below:

| Unit | Installed Capacity | Start Date | Age in 2023 |
|---|---|---|---|
| Culley 2 | 90 MW | 1966 | 57 |
| Culley 3 | 270 MW | 1973 | 50 |
| Warrick 4 | 150 MW | 1970 | 53 |
| Brown 1 | 245 MW | 1979 | 44 |
| Brown 2 | 245 MW | 1986 | 37 |

However, the Culley 2 unit will be 57 years old in 2023 and is expected to be retired at that time. Brown Units 1 and 2 also are expected to be retired in 2023. Vectren South has agreed to retain its involvement in Warrick 4, which it co-owns with ALCOA, through 2023. However, beyond that point it does not make sense to continue to invest in a unit that could be subject to shut down at such time as ALCOA decides it has no continuing need for that capacity. As the coal units retire, Vectren South has the opportunity to ensure diversity going forward via a mix of gas, coal, renewables and energy efficiency.

**Q. Please describe further the renewable resources Vectren South currently has in its generation portfolio.**

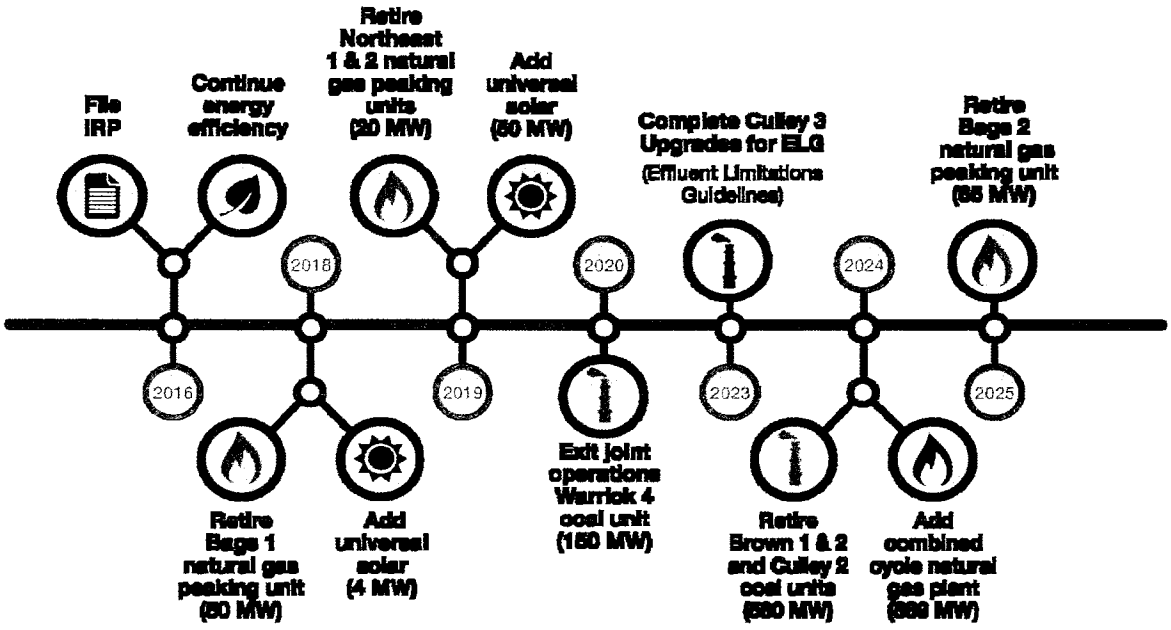
A. As shown in the 2015 Portfolio Resource Mix, Vectren South currently has a limited offering of renewable generation resources. Most of the renewable energy included in Vectren South's portfolio is not Company-owned, rather it is procured through PPAs. Specifically, Vectren South has entered into PPAs under which it purchases 80 MW of wind energy from Fowler Ridge and Benton County. Vectren South also operates the 3 MW Blackfoot Clean Energy Facility in Winslow, Indiana, which consists of two internal combustion landfill methane gas fired units. In addition, Vectren South is constructing two small solar arrays (4 MWs) on our system in accordance with the Commission's Order in Cause No. 44909. The Solar Project is also timely given the impending loss of tax incentives for solar projects.

**Q. Is there a need for Vectren South to add more renewable resources at this time?**

A. In my opinion, yes. Vectren South believes there is value in a balanced portfolio as a way to reduce risk by having a balanced set of generation resources available to serve customer load (gas, coal, energy efficiency, wind, solar, etc.) The benefits of a balanced energy mix cannot be understated. The best way to plan in this environment is to provide a diverse portfolio, which provides a natural hedge against unforeseen changes in regulations, technologies and markets. Moreover, as witness Bailey indicates in his testimony a number of corporations have publicly announced renewable energy goals. These policies create an expectation that electric utilities will create more diverse generation portfolios to assist corporations with their renewable goals.

**Q. Is pursuit of the Solar Projects consistent with Vectren South's 2016 IRP?**

A. Yes. The Preferred Portfolio Plan in Vectren South's 2016 IRP is that renewables and ongoing Energy Efficiency will account for approximately 20% of total capacity by 2036. To accomplish this goal, the 2016 IRP indicates that "Vectren plans to add 50 MW of solar in 2019, which corresponds with clean energy tax incentives for solar power plants." The request for a CPCN in this proceeding is the next step of implementing the solar projects outlined in the Preferred Portfolio Plan of the 2016 IRP planning process, which is designed to diversify the energy mix of the Vectren South generation portfolio. Below is the timeline set forth in Vectren South's 2016 IRP for moving toward the Preferred Portfolio Plan:




**Q. Please describe Petitioner's Exhibit No. 1, Attachment WDG-4.**

A. Petitioner's Exhibit No. 1, Attachment WDG-4 is a copy of Vectren South's 2016 IRP.

**Q. Please describe further the preference set forth in the 2016 IRP that the addition of "50 MW of solar in 2019, . . . correspond . . . with clean energy tax incentives."**

A. The Energy Policy Act of 2005 created a 30% income tax credit for residential and commercial solar energy systems placed in service between January 1, 2006 and December 31, 2007. The in-service date has been extended several times since then, most recently in 2015 in the Omnibus Appropriations Act (P.L. 114-113). Currently, 2019 is the last year to commence construction and receive the full 30% benefit (it tapers down from there). The income tax credits ultimately provide for a reduction in a utility's overall tax liability for investments in solar technology. Any ITC value Vectren South receives from its investment in solar properties will benefit customers by reducing the revenue requirement over the depreciable life of the solar property in accordance with federal tax laws.

**Q. Aside from the income tax credits and corresponding reduction in the Company's revenue requirement, are there additional benefits to customers that can be**

**achieved by constructing the Solar Project at this time?**

A. Solar Renewable Energy Certificates ("SRECs") are available for every MWh of solar electricity created. The value of a SREC is determined by the market, subject to supply and demand constraints. Vectren South will own the SRECs associated with the energy produced by the Solar Project. Vectren South will sell the SRECs through the open market until such time as they are needed for an environmental or regulatory requirement. Net proceeds from the sale of the SRECs will be credited to customers to offset the revenue requirements as described in greater detail by witness Swiz. If in the future, Vectren South should become subject to a renewable portfolio standard or other renewable energy regulatory requirements, then Vectren South will retain the SRECs to count towards Vectren South's environmental or regulatory requirement.

**Q. In your opinion, would it be difficult to pursue a similar project in the future if Vectren South were to not take advantage of this opportunity?**

A. Yes. As I mentioned previously, there are limited on-system opportunities to develop a solar project of this scale. Moreover, prior to being presented with the opportunity to undertake the Solar Project, Vectren South had not identified a project of a similar scale competitive with the cost per kWh of the Solar Project. In my opinion, it makes sense for Vectren South to seize this opportunity for the benefit of its customers.

## VI. CONSTRUCTION SCHEDULE

**Q. When does Vectren South anticipate commencing construction of the Solar Project?**

A. In order to maximize the tax credits described above, the project must commence before the end of 2019. Once Vectren South receives Commission approval to move forward, Vectren South anticipates giving First Solar notice to proceed on the project substation. Vectren South's goal is for this work to begin no later than April 1, 2019. Engineering, permitting and procurement work are also expected to begin in 2019, with the balance of construction work to begin in the second quarter of 2020.

**Q. When does Vectren South expect the Solar Project to be completed?**

A. Vectren South anticipates the Solar Project will be substantially complete by the end of August 2020 and the facility will go on-line in the fourth quarter of 2020.

**Q. Please describe Petitioner's Exhibit No. 1, Attachment WDG-5.**

A. Petitioner's Exhibit No. 1, Attachment WDG-5 is a construction schedule with key milestones.

## VII. OTHER STATUTORY CONSIDERATIONS

**Q. Is the Solar Project a "clean energy project" under Indiana law?**

A. Yes. Indiana Code § 8-1-8.8-2 defines a "clean energy project" as including "projects to develop alternative energy sources, including renewable energy projects." In addition, "solar energy" is specifically listed as one of the clean energy resources in Indiana Code § 8-1-37-4(a)(1) through Indiana Code § 8-1-37-4(a)(16), thus making it a "renewable energy resource" under Indiana Code § 8-1-8.8-10. The proposed Solar Project also promotes a "robust and diverse portfolio of energy production or generating capacity, including . . . the use of renewable energy resources" which are imperative "if Indiana is to continue to be successful in attracting new businesses and jobs." Indiana Code § 8-1-8.8-1.

**Q. Did Vectren South consider demand side management ("DSM") as a resource in its 2016 IRP?**

A. Yes. Vectren South considered DSM as a resource in its 2016 IRP. Vectren South considers DSM to be part of a balanced utility resource plan.

**Q. In your opinion, are DSM initiatives a viable alternative to completing the Solar Project?**

A. No. The 2016 IRP demonstrates that DSM will be an important part of Vectren South's resource options in the future. However, the IRP also recognizes that the addition of renewable resources, and in particular solar generation resources, are necessary to meet the needs of the system in the future and to diversify Petitioner's generation portfolio.

**Q. Please describe the strategy Vectren South will employ to manage the Solar Project and facilitate ongoing review of the Solar Project.**

A. Vectren South has requested ongoing review of its construction of the proposed Solar Project pursuant to Indiana's CPCN law. Vectren South plans to provide a written report at the end of each year until the projects are completed. The written report will include information on the status of construction and construction costs incurred over the previous 12 months. Vectren South will notify the Commission within 60 days of the project's in-service date. After these initial filings, Vectren South will provide informational updates in its ongoing rider filings. The information to be included in the ongoing rider filings is as follows: (i) generation output of the solar generation system (with monthly detail); (ii) the actual revenue requirement during the twelve (12) months covered by the report ("reporting period"); (iii) the cost per kWh of electricity generated by Solar Project during the reporting period; (iv) the total SRECs proceeds (in U.S. dollars) associated with solar generation at the Solar Project; (v) the average annual billing impact on all customer classes.

**Q. In your opinion, is the Solar Project reasonable and necessary and in the public interest?**

A. Yes. Vectren South believes that investing in solar energy resources is reasonable and appropriate at this time and will benefit Indiana and Vectren South's customers. The Solar Project serves to diversify the Company's generation portfolio, provides additional solar generation located in Indiana, encourages economic development and meets our customers' increasing desire to have renewable energy options available to serve their needs. Vectren South respectfully requests that the Commission approve Vectren South's proposed Solar Project and requested rate relief.

## VIII. CONCLUSION

**Q. Does this conclude your direct testimony?**

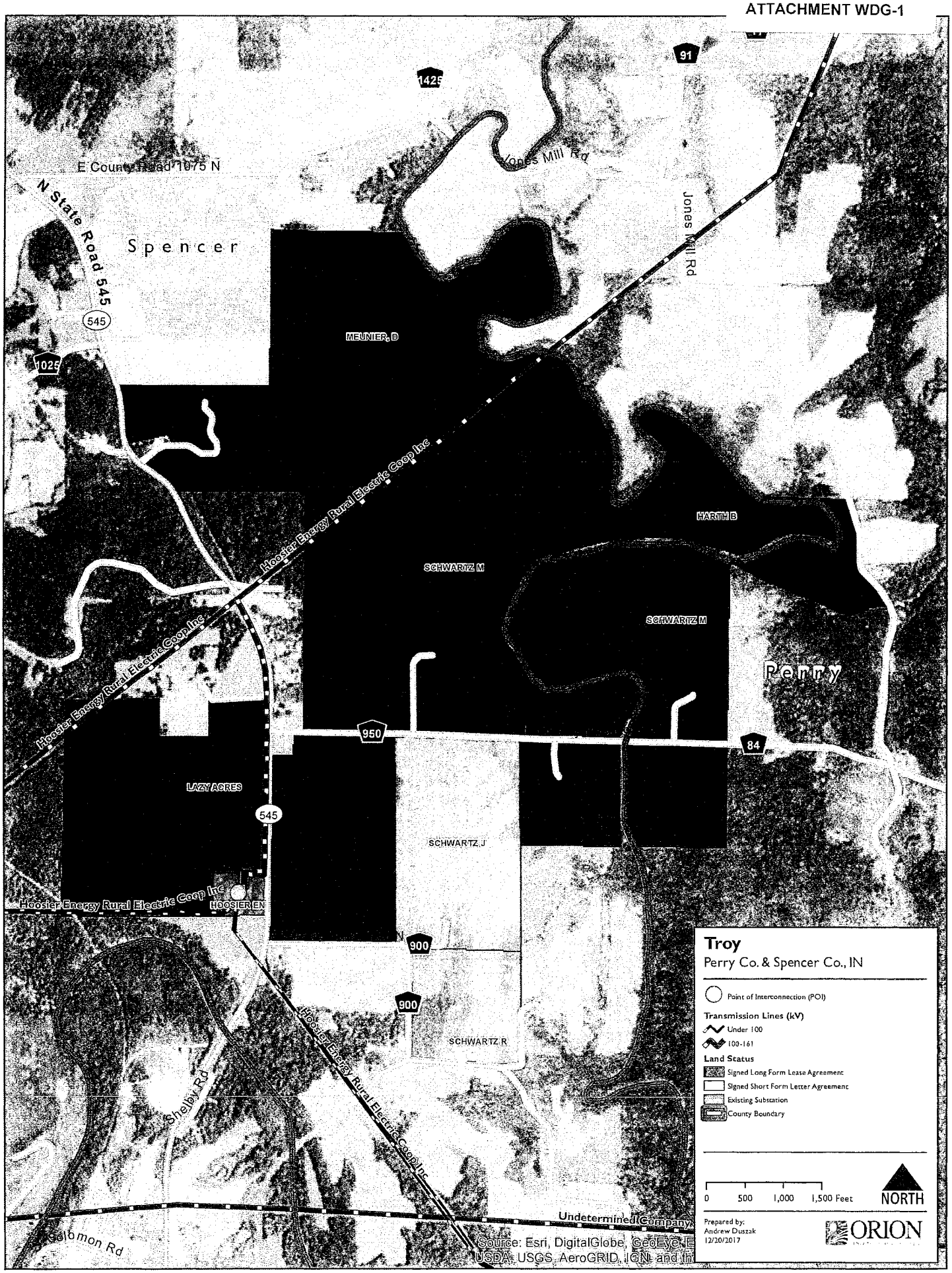
A. Yes, at the present time.

## VERIFICATION

I, Wayne D. Games, Vice President – Power Supply for Southern Indiana Gas and Electric Company d/b/a Vectren Energy Delivery of Indiana, Inc., under the penalties of perjury, affirm that the answers in the foregoing Direct Testimony are true to the best of my knowledge, information and belief.

Wayne D. Games
Vice President – Power Supply

PETITIONER'S EXH. NO. 1
ATTACHMENT WDG-1

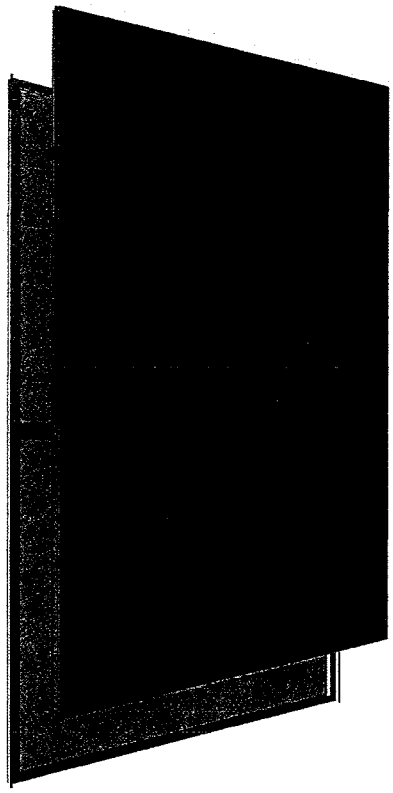


First Solar.

# First Solar Series 6™

NEXT GENERATION THIN FILM SOLAR TECHNOLOGY

MODULE DATASHEET

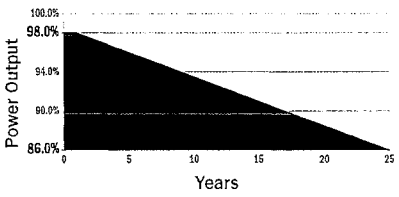


## 420-445 Watts
## 17%+ Efficiency

### INDUSTRY-LEADING MODULE WARRANTY[1]

**98%** WARRANTY START POINT

**0.5%** WARRANTED ANNUAL DEGRADATION RATE




- 25-Year Linear Performance Warranty
- 10-Year Limited Product Warranty

### HIGH-POWER PV MODULES

First Solar Series 6™ photovoltaic (PV) module sets a new industry benchmark for reliable energy production, optimized design and environmental performance. Series 6 modules are optimized for every stage of your application, significantly reducing balance of system, shipping, and operating costs.

### MORE ENERGY PER MODULE

- More watts per connection and per lift (420+ watts) than 72-cell silicon modules (<400 watts)
- With superior temperature coefficient, spectral response and shading behavior, Series 6 modules generate up to 8% more energy than conventional crystalline silicon solar modules
- Anti-reflective coated glass enhances energy production

### INNOVATIVE MODULE DESIGN

- Under-mount frame allows for simple and fast installation
- Dual junction box optimizes module-to-module connections
- Under-mount frame provides the cleaning and snow-shedding benefits of a frameless module, protects edges against breakage and enables horizontal stacking

### PROVEN LONG-TERM RELIABILITY

- Manufactured using methods and process adapted from Series 4 modules – the most tested solar modules in the industry
- Independently tested and certified for reliable performance that exceeds IEC standards in high temperature, high humidity, extreme desert and coastal applications

### BEST ENVIRONMENTAL PROFILE

- Fastest energy payback time and smallest carbon and water footprint in the industry
- Global PV collection and recycling services available through First Solar or customer-selected third-party

# FIRST SOLAR SERIES 6™

| MODEL TYPES AND RATINGS AT STANDARD TEST CONDITIONS (1000W/m², AM 1.5, 25°C)[2] | | | | | | | |
|---|---|---|---|---|---|---|---|
| NOMINAL VALUES | | FS-6420<br>FS-6420A | FS-6425<br>FS-6425A | FS-6430<br>FS-6430A | FS-6435<br>FS-6435A | FS-6440<br>FS-6440A | FS-6445<br>FS-6445A |
| Nominal Power[3] (-0/+5%) | $P_{MAX}$ (W) | 420.0 | 425.0 | 430.0 | 435.0 | 440.0 | 445.0 |
| Efficiency (%) | % | 17.0 | 17.2 | 17.4 | 17.6 | 17.8 | 18.0 |
| Voltage at $P_{MAX}$ | $V_{MAX}$ (V) | 180.4 | 181.5 | 182.6 | 183.6 | 184.7 | 185.7 |
| Current at $P_{MAX}$ | $I_{MAX}$ (A) | 2.33 | 2.34 | 2.36 | 2.37 | 2.38 | 2.40 |
| Open Circuit Voltage | $V_{OC}$ (V) | 218.5 | 218.9 | 219.2 | 219.6 | 220.0 | 220.4 |
| Short Circuit Current | $I_{SC}$ (A) | 2.54 | 2.54 | 2.54 | 2.55 | 2.55 | 2.56 |
| Maximum System Voltage | $V_{SYS}$ (V) | 1500[5] | | | | | |
| Limiting Reverse Current | $I_R$ (A) | 6.0 | | | | | |
| Maximum Series Fuse | $I_{CF}$ (A) | 6.0 | | | | | |
| **RATINGS AT NOMINAL OPERATING CELL TEMPERATURE OF 45°C (800W/m², 20°C air temperature, AM 1.5, 1m/s wind speed)[2]** | | | | | | | |
| Nominal Power | $P_{MAX}$ (W) | 317.2 | 320.9 | 324.7 | 328.5 | 332.4 | 336.0 |
| Voltage at $P_{MAX}$ | $V_{MAX}$ (V) | 168.7 | 169.8 | 170.9 | 172.0 | 173.1 | 174.1 |
| Current at $P_{MAX}$ | $I_{MAX}$ (A) | 1.88 | 1.89 | 1.90 | 1.91 | 1.92 | 1.93 |
| Open Circuit Voltage | $V_{OC}$ (V) | 206.3 | 206.6 | 207.0 | 207.3 | 207.7 | 208.0 |
| Short Circuit Current | $I_{SC}$ (A) | 2.04 | 2.05 | 2.05 | 2.06 | 2.06 | 2.06 |

| TEMPERATURE CHARACTERISTICS | | |
|---|---|---|
| Module Operating Temperature Range | (°C) | -40 to +85 |
| Temperature Coefficient of $P_{MAX}$ | $T_K$ ($P_{MAX}$) | -0.32%/°C [Temperature Range: 25°C to 75°C] |
| Temperature Coefficient of $V_{OC}$ | $T_K$ ($V_{OC}$) | -0.28%/°C |
| Temperature Coefficient of $I_{SC}$ | $T_K$ ($I_{SC}$) | +0.04%/°C |

## CERTIFICATIONS AND TESTS[1]

IEC

61215 & 61730 1500V[5], CE
61701 Salt Mist Corrosion
60068-2-68 Dust and Sand Resistance

UL

UL 1703 1500V Listed[5]

REGIONAL CERTIFICATIONS

CSI Eligible
FSEC
MCS
CEC Australia
JET
SII
InMetro

EXTENDED DURABILITY TESTS

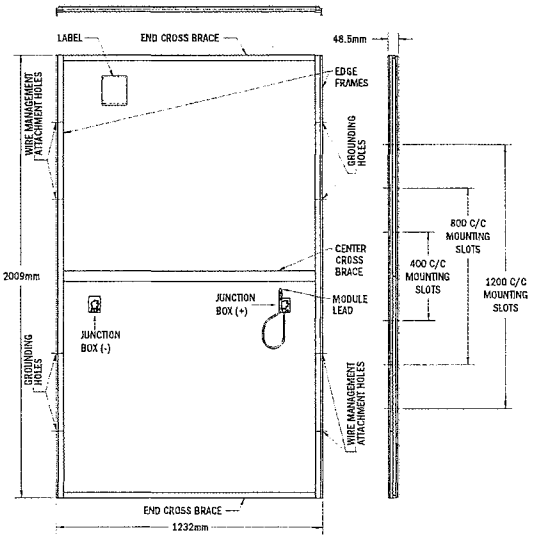
Long-Term Sequential
Thresher Test
PID Resistant

QUALITY & EHS

ISO 9001:2008 & 14001:2004
OHSAS 18001:2007

| MECHANICAL DESCRIPTION | |
|---|---|
| Length | 2009mm |
| Width | 1232mm |
| Thickness | 48.5mm |
| Area | 2.47m² |
| Module Weight | 35kg |
| Leadwire[6] | 2.5mm², 720mm (+) & Bulkhead (-) |
| Connectors | MC4-EVO 2 |
| Bypass Diode | N/A |
| Cell Type | Thin film CdTe semiconductor, up to 264 cells |
| Frame Material | Anodized Aluminum |
| Front Glass | 2.8mm heat strengthened<br>Series 6A™ includes anti-reflective coating |
| Back Glass | 2.2mm heat strengthened |
| Encapsulation | Laminate material with edge seal |
| Frame to Glass Adhesive | Silicone |
| Wind Load[7] | 2400Pa |
| Snow Load[7] | 5400Pa |

## MECHANICAL DRAWING




Install in portrait only

| PACKAGING INFORMATION | | | |
|---|---|---|---|
| Modules Per Pallet | 26 | Pallet Dimensions (L x W x H) | 2200 x 1300 x 1150mm (86 x 51 x 45in) |
| Pallet Weight | 1025kg | Pallets per 40' Container | 18 |

1 Limited power output and product warranties subject to warranty terms and conditions
2 All ratings ±10%, unless specified otherwise. Specifications are subject to change
3 Measurement uncertainty applies
4 Testing Certifications/Listings pending
5 IEC 61730-1: 2016 Class II | ULC 1703 1000V listed
6 Leadwire length from junction box exit to connector mating surface
7 See User Guide

PETITIONER'S EXH. NO. 1
ATTACHMENT WDG-3

## Cost Estimates of Solar Project
## Petitioner's Exhibit No. 1, Attachment WDG-3 (Public)

| Item | | Estimate | Notes |
|---|---|---|---|
| 150,000 Series 6 Thin Film Modules | | [redacted] | Cost supported in testimony of Mathew Brinkman |
| Engineering, Procurement and Construction | | | Cost supported in testimony of Mathew Brinkman |
| | Subtotal | | |
| Project Development | | | Cost related to acquring rights to proroject from Orion Renewable Power Resources, LLC |
| Interconnection | | | Cost of interconnection to the transmission system and upgrades to the Hoosier Energy substation |
| Owner costs | | | Title insurance, Owner's Engineer Costs, sales taxes, etc. |
| Contingency | | | |
| | Subtotal | | |
| **Total Estimated Project Cost** | | | |

**The materials comprising Petitioner's Exhibit 1, Attachment WDG-4 are voluminous and therefore, are being separately filed.**

PETITIONER'S EXH. NO. 1
ATTACHMENT WDG-5

# Construction Schedule