DIRECT TESTIMONY OF JAMES S. NORTHRUP DIRECTOR, WHOLESALE AND RENEWABLES ANALYTICS DUKE ENERGY BUSINESS SERVICES LLC ON BEHALF OF DUKE ENERGY INDIANA, INC. CAUSE NO. 44578 BEFORE THE INDIANA UTILITY REGULATORY COMMISSION

I. INTRODUCTION

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is James S. Northrup and my business address is 400 South Tryon Street, Charlotte, North Carolina 28202.

Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A. I am employed as Director, Wholesale and Renewables Analytics by Duke Energy Business Services LLC. Duke Energy Business Services LLC is a service company affiliate of Duke Energy Indiana, Inc. ("Duke Energy Indiana" or "Company"). Duke Energy Indiana is a wholly owned, indirect subsidiary of Duke Energy Corporation.

Q. WHAT ARE YOUR RESPONSIBILITIES AS DIRECTOR, WHOLESALE AND RENEWABLES ANALYTICS?

A. As Director, Wholesale & Renewables Analytics, I am responsible for developing specific strategies for Duke Energy Corp.'s operating utilities, including commercial support for Requests For Proposals ("RFPs") for renewable and supply side resources and major project/initiative business case analysis.

Q. PLEASE DESCRIBE YOUR EDUCATIONAL AND PROFESSIONAL BACKGROUND.

A. I am a registered professional engineer in the state of North Carolina, having received a Bachelor of Science in Civil Engineering from North Carolina State University and a Master's Degree in Business Administration from Queens University. I began my career at Duke Power Company in 1979 and have held a variety of responsibilities across Duke Energy in the areas of electric system distribution engineering, customer marketing, Demand-Side Management Program design and implementation, generation business planning, generation expansion planning, energy risk management, and Integrated Resource Planning. After coordinating the development of Demand-Side Customer Programs, I joined the Generation System Planning Group in 1994 and coordinated the development of the Integrated Resource Plan ("IRP") filings for state regulatory agencies. I was promoted to Manager, Generation Business Support in the Power Generation Group in 2000 to lead the business case development and asset strategy for fossil/hydro generation. In 2003, I was promoted to Director, System and Power Planning Group to guide major investments for generation assets and develop expansion plans to maintain system reliability. In 2006, I was promoted to Director, Regulated Economic Analysis where I worked in Integrated Resource Planning, new generation investments, and maintaining system reliability. In July 2012, I was promoted to my current position as Director, Wholesale and Renewables Analytics.

Q. HAVE YOU PREVIOUSLY TESTIFIED BEFORE THE INDIANA UTILITY REGULATORY COMMISSION?

A. No.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. The purpose of my Testimony in this proceeding is to: (1) describe the Company's issuance of a solar request for proposals ("RFP") to secure the most cost-effective solar resources available in the market; (2) describe the four (4) solar proposals selected from the RFP totaling twenty (20) MWs alternating current ("AC") and their associated proposed contracts; (3) summarize the RFP economic valuation methodology utilized to select the winning solar proposals; (4) demonstrate the economic value of the solar projects for Indiana customers; and (5) describe the benefits of new solar generation to the Indiana generation portfolio.

Q. ARE YOU SPONSORING ANY EXHIBITS IN THIS PROCEEDING?

A. Yes, Petitioner's Exhibit A-2 and Confidential Exhibits A-1, A-3, A-4, A-5, A-6, A-7, A-8, and A-9.

Q. PLEASE IDENTIFY THE FOUR (4) SOLAR PROJECTS THAT YOU ARE PROPOSING FOR THIS COMMISSION TO CONSIDER.

A. The four (4) winning proposals from the Solar RFP totaling twenty (20) MWs AC are:

PROJECT NAME	DEVELOPER	LOCATION
• Sullivan Solar LLC	Juwi Solar	Sullivan County
• McDonald Solar, LLC	Solexus Development	Vigo County
• Pastime Farm, LLC	Solexus Development	Clay County
• Geres Energy LLC	Inovateus Solar	Howard County

All four (4) projects are five (5) MWs AC solar resources in size with the PPAs for twenty (20) year contract duration.

Q. ARE THERE ANY OTHER WITNESSES SPONSORING TESTIMONY IN THIS PROCEEDING?

A. Yes. Ms. Christine E. Smith, Product and Services Manager, will discuss the request to have the flexibility to purchase Renewable Energy Credits ("RECs") from the solar Power Purchase Agreements ("PPAs") on behalf of the Duke Energy Indiana GoGreen program at prevailing market prices. Ms. Suzanne E. Sieferman, Manager Rates and Regulatory Strategy, will discuss Duke Energy Indiana's request for the proposed recovery of the retail jurisdictional portion of the purchased power costs under the PPAs from retail customers in conjunction with Duke Energy Indiana's Fuel Cost Adjustment Standard Contract Rider No. 60 ("Rider 60" or "FAC") proceeding for the twenty (20) year terms of these PPAs.

II. SOLAR RFP ECONOMIC EVALUATION PROCESS

Q. WHY DID DUKE ENERGY INDIANA DECIDE TO ISSUE A SOLAR RFP?

A. Duke Energy Indiana issued a solar RFP to assist in the selection of cost effective solar resources to expand and diversify the Company's generation portfolio with emission-free renewable solar energy. Adding new solar generation will allow the company to gain experience in contracting and operating utility scale solar facilities on its distribution facilities and increase customer awareness of the opportunity for "home grown" renewable energy to meet a portion of its energy consumption needs. Additionally, securing solar resources enables the Company to comply with the August 28, 2013, Agreement between Duke Energy Indiana and the parties Sierra Club, Valley Watch, Inc., Save the Valley, Inc., and Citizens Action Coalition of Indiana, Inc., to resolve the

issues for the Edwardsport Station Air Permit Settlement. Using an open market RFP solicitation provided an opportunity to secure a reasonable amount of the most cost effective solar resource alternatives that the market could provide.

Q. PLEASE PROVIDE AN OVERVIEW OF THE DUKE ENERGY INDIANA SOLAR RFP.

A. Duke Energy Indiana issued an RFP on February 3, 2014, to request proposals for energy, capacity and Renewable Energy Credits ("RECs") from new or existing solar generating facilities. Projects were requested to have minimum sizes of one (1) MW AC with maximum sizes not to exceed five (5) MW AC with contract duration terms of twenty (20) years. Proposals were required to (1) include pricing on a $/mwh basis, (2) demonstrate project site control, and (3) demonstrate sufficient relevant experience and expertise to successfully develop, finance, construct, and operate the project. There was a preference for projects located in Duke Energy Indiana's service territory and no project could currently be under contract to Duke Energy Indiana. The overall objective of the RFP was to secure the most cost effective solar resources in the specified size range that the market could provide.

Q. PLEASE PROVIDE A SUMMARY OF THE BIDS RECEIVED IN RESPONSE TO THE RFP.

A. The response to the solar RFP was favorable with the Company receiving proposals from twenty-five (25) different counterparties totaling forty-nine (49) bid responses amounting to 193 MWs AC of proposed solar resource capacity. Petitioner's Confidential Exhibit A-1 summarizes the complete list of RFP responses received.

Q. PROVIDE AN OVERVIEW OF THE ECONOMIC ANALYSIS PERFORMED ON THE RFP RESPONSES TO DETERMINE WHICH PROJECTS WERE SELECTED FOR FURTHER ANALYSIS.

A. Under my supervision, all proposals were economically evaluated to determine which proposals provided the best value to Duke Energy Indiana customers.

The economic analysis process was designed to consider both the potential benefits and costs associated with each proposal to capture variations in generation profiles and PPA payments resulting from different solar equipment technology, site characteristics, and equipment configurations. The economic analysis produced a levelized "net project cost" per megawatt-hour (MWH) value for each project by comparing (or subtracting) the project's benefits and costs for the twenty (20) year contract period. The levelized "net project cost" per megawatt-hour value provided the basis for ranking projects from high to low allowing the highest value proposals to be selected.

Project benefits were determined by calculating the value of energy and capacity produced by each project using the estimated solar energy production profile applied to avoided capacity and energy costs. Because future energy and capacity costs are avoided by undertaking the project, these avoided costs represent a project benefit to customers. Similarly, project costs are the expected PPA payments during the contract life based on the annual MWH production of the solar resource.

Energy benefits were estimated using the avoided energy costs produced from Integrated Resource Planning ("IRP") production simulation models. These models

produce estimated avoided energy costs by simulating the hourly dispatch of available generation resources to meet Duke Energy Indiana customer loads. These avoided costs estimates are applied to the specific solar generation profiles to determine the expected total energy benefits over the solar project contract life.

Capacity benefits were estimated using the expected equivalent annual capacity value of the solar project multiplied by the annualized cost of a combustion turbine developed from the most recent IRP. The expected equivalent annual capacity value was determined using the methodology specified by the Midwest Independent System Operator ("MISO") from its Resource Adequacy Business Practice Manual for new intermittent resources such as solar. Specifically, the hourly net output in MWs for hours 1500 – 1700 EST from June, July, and August are used to estimate the equivalent annual capacity value for intermittent solar capacity resources.

Petitioner's Exhibit A-2 provides a summary diagram of the RFP Economic Ranking Flowchart analysis process.

Q. PLEASE SUMMARIZE THE SELECTION OF PROJECTS FOR FURTHER INTERCONNECTION COST AND FINAL ECONOMIC ANALYSIS.

A. To minimize the barriers of entry to bidders (both from a cost and timeliness perspective) and minimize impacts on Duke Energy Indiana's engineering interconnection resource specialists, RFP bidders were not required to complete the transmission/distribution interconnection process to the electrical grid prior to submitting their proposals. As a result, the initial economic analysis ranking did not include the potential costs for interconnection facilities. Rather, the Company elected to develop a short list of the

highest economically ranked projects that would then undergo interconnection cost assessment and final economic evaluations including all costs for final selection. The short list included sixty (60) MWs of the sixteen (16) highest economically ranked proposals to cover a wide range of possible interconnection cost estimates. Petitioner's Confidential Exhibit A-3 provides a summary of the sixteen (16) selected proposals for short list inclusion. This short list of the highest economically ranked projects was forwarded to Duke Energy Indiana engineering specialists for site specific evaluation and interconnection cost analysis.

Q. PLEASE SUMMARIZE THE TRANSMISSION/DISTRIBUTION INTERCONNECTION ANALYSIS OF THE SHORT LISTED BIDS.

A. Duke Energy Indiana engineering resource specialists performed an interconnection cost analysis for the short listed projects so that these costs could be incorporated in the final project selection analysis. The first step in the analysis was to confirm that all projects were in the Duke Energy Indiana service territory to allow interconnection to the Company's electrical facilities. After confirmation, site assessment considered the amount of installed solar capacity, distance from the distribution substation, the peak, minimum and average circuit loadings at multiple points along the circuit, and the wire conductor sizes and configurations between the site and the rest of the circuit. These site specific characteristics were used to determine the appropriate electrical system interconnection equipment and potential network upgrades necessary for continued reliable operation of the electrical grid with the addition of the proposed solar facility.

Q. WERE ANY PROPOSALS ELIMINATED FROM THE SHORT LIST AS A RESULT OF THE INTERCONNECTION ANALYSIS?

A. Yes. The interconnection analysis resulted in the elimination of three (3) proposals due to the inability or extreme difficulty (such as extensive distances from distribution facilities capable of receiving the solar generation) in connecting to Duke Energy Indiana distribution facilities.

Q. WERE THE RESULTS OF THE INTERCONNECTION ANALYSIS COSTS SHARED WITH THE BIDDERS?

A. Yes. The bidders were notified of the estimated interconnection cost and asked to provide refreshed PPA proposals with their best and final pricing (including the estimated interconnection costs). Project interconnection costs for each project were stated in the RFP to be the responsibility of the respondent and had to be included in the final refreshed proposals.

Q. PLEASE DESCRIBE THE RESULTS OF THE REFRESHED PROPOSALS' ECONOMIC ANALYSIS AND FINAL PROJECT SELECTIONS.

A. The refreshed proposals were again economically ranked from highest to lowest value to determine which proposals would go forward for detailed contract negotiations. The final results of the refreshed economic ranking are summarized on Petitioner's Confidential Exhibit A-4. As shown on Petitioner's Confidential Exhibit A-4 the four (4) highest ranked projects, McDonald Solar LLC, Pastime Farm LLC, Geres Energy LLC, and Sullivan Solar LLC were selected for detailed contract negotiations. These projects were all five (5) MWs in size. The selection of twenty (20) MWs of solar proposals

satisfies the Edwardsport Air Permit Settlement Agreement requirements and allows Duke Energy Indiana to gain significant experience in operating large scale solar facilities on its distribution facilities throughout its service territory.

Q. WHAT IS THE ESTIMATED COST OF THE PURCHASED POWER AGREEMENTS AND HOW MUCH SOLAR GENERATION WILL THEY SUPPLY?

A. The estimated total cost of the four (4) PPAs will be **<CONFIDENTIAL>** [redacted] [redacted] **<CONFIDENTIAL>** over the twenty (20) year contract life. The projects are estimated to provide approximately a total of 38,500 MWH of solar generation in the first full year of operation.

Q. WHAT IS THE STATUS OF CONTRACT NEGOTIATIONS FOR THE SELECTED SOLAR PROJECTS?

A. All negotiations have been completed and contracts have been executed. Major contract provisions include: (1) a condition precedent stipulating that Commission approval is required; (2) established minimum operating performance standards and performance security; (3) specified due diligence periods to complete Interconnection Agreements; and (4) certain responsibilities associated with being a Behind the Meter Generation ("BTMG") market participant. Petitioner's Confidential Exhibits A-6 through A-9 are final copies of the executed Agreements.

III. PPA IMPLICATIONS TO INDIANA

Q. PLEASE EXPLAIN THE ECONOMIC ANALYSIS AND POSSIBLE IMPACTS OF THE SOLAR PPA CONTRACTS.

A. The Duke Energy Indiana 2013 Integrated Resource Plan ("2013 IRP") updated with the Spring 2014 load forecast provided the basis for the economic analysis. Production costing runs were performed with and without each solar project's generation profile in order to calculate each project's avoided energy costs. Both the IRP Reference Scenario including potential CO_2 costs for greenhouse gas legislation modeling and no CO_2 costs for IRP Low Regulation Scenario were used to produce the avoided energy costs. The scenarios are described more fully in the Company's 2013 IRP.

The solar contract PPA payments were compared to the avoided production cost plus avoided capacity cost to determine the economics of the four combined solar projects. Avoided capacity costs used in the analysis represented the annualized cost in $/kw of a new natural gas-fired Combustion Turbine (CT) from the IRP multiplied by the equivalent annual capacity value of the combined solar projects. The expected equivalent annual capacity value was determined using the MISO methodology for intermittent resources previously discussed. The equivalent annual capacity value for the twenty (20) MWs of nameplate solar contracts using the MISO methodology resulted in assigning approximately fourteen (14) MWs for the combined solar contracts, or seventy percent (70%) of nameplate capacity.

Q. WHAT WERE THE RESULTS OF THE ANALYSIS?

A. Over the twenty (20) year term of the solar PPAs, the avoided costs in both the "With CO_2" and "Without CO_2" cases were higher than the PPA payments. Under the analysis, "Without CO_2", the present value of the savings from the solar projects was approximately **<CONFIDENTIAL>** [redacted] **<CONFIDENTIAL>**. Under the

"With CO_2" analysis, the present value of the savings was approximately <CONFIDENTIAL> [redacted] <CONFIDENTIAL>. In other words, the solar PPAs are economical for customers as compared to not having the PPAs included in the generation resource portfolio. This analysis is conservative because it does not take into account the value of the RECs that are included in the solar PPA contracts. Petitioner's Confidential Exhibit A-5 shows a graphical representation of the year-by-year comparison of the avoided cost versus the PPA payments for both scenarios ("With" and "Without CO_2").

Q. PLEASE DESCRIBE THE EXPECTED VALUE OF THE RECS.

A. A REC is the tradable commodity unit that represents the generation of one MWh of renewable or environmentally-friendly generation. RECs are traded in the open market and are a widely used and accepted industry standard. The value of these RECs was not included in the economic analysis in an effort to be conservative. A review of quoted solar REC prices for adjacent state solar RECs for the past three (3) years are in the <CONFIDENTIAL> [redacted] <CONFIDENTIAL> range. Duke Energy Indiana proposes that the retail portion of any value received from the sale of these RECs flow through to the benefit of retail customers through the fuel clause, as discussed in more detail in Ms. Suzanne E. Sieferman's Testimony.

Q. WHAT ARE THE BENEFITS OF THE SOLAR PPAS TO DUKE ENERGY INDIANA AND ITS CUSTOMERS?

A. The solar PPAs provide a number of benefits to Duke Energy Indiana and its customers. First, these projects provide Duke Energy Indiana customers with "home grown" sources

of clean, sustainable renewable energy without emissions at long term stable prices. Indiana customers will be able to purchase locally sourced green power renewable RECs for its GoGreen program. Finally, and most importantly, it is economical for customers, as demonstrated by the economic analysis discussed earlier.

IV. CONCLUSION

Q. IN YOUR OPINION, ARE THE FOUR (4) SOLAR PPAS BEING PROPOSED FOR THE COMMISSION'S CONSIDERATION REASONABLE AND NECESSARY?

A. Yes. Securing these four (4) solar PPA projects provides Duke Energy Indiana customers the opportunity to participate in the development and consumption of economically clean solar energy produced locally. Duke Energy Indiana reviewed forty-nine (49) proposed projects through an open market RFP solicitation and the four (4) PPAs selected represent the most cost-effective solar projects available in the marketplace.

Q. WERE PETITIONER'S EXHIBIT A-2 AND CONFIDENTIAL EXHIBITS A-1, A-3, A-4, A-5, A-6, A-7, A-8, AND A-9 PREPARED BY YOU OR AT YOUR DIRECTION?

A. Yes.

Q. DOES THIS CONCLUDE YOUR PREPARED DIRECT TESTIMONY AT THIS TIME?

A. Yes.

VERIFICATION

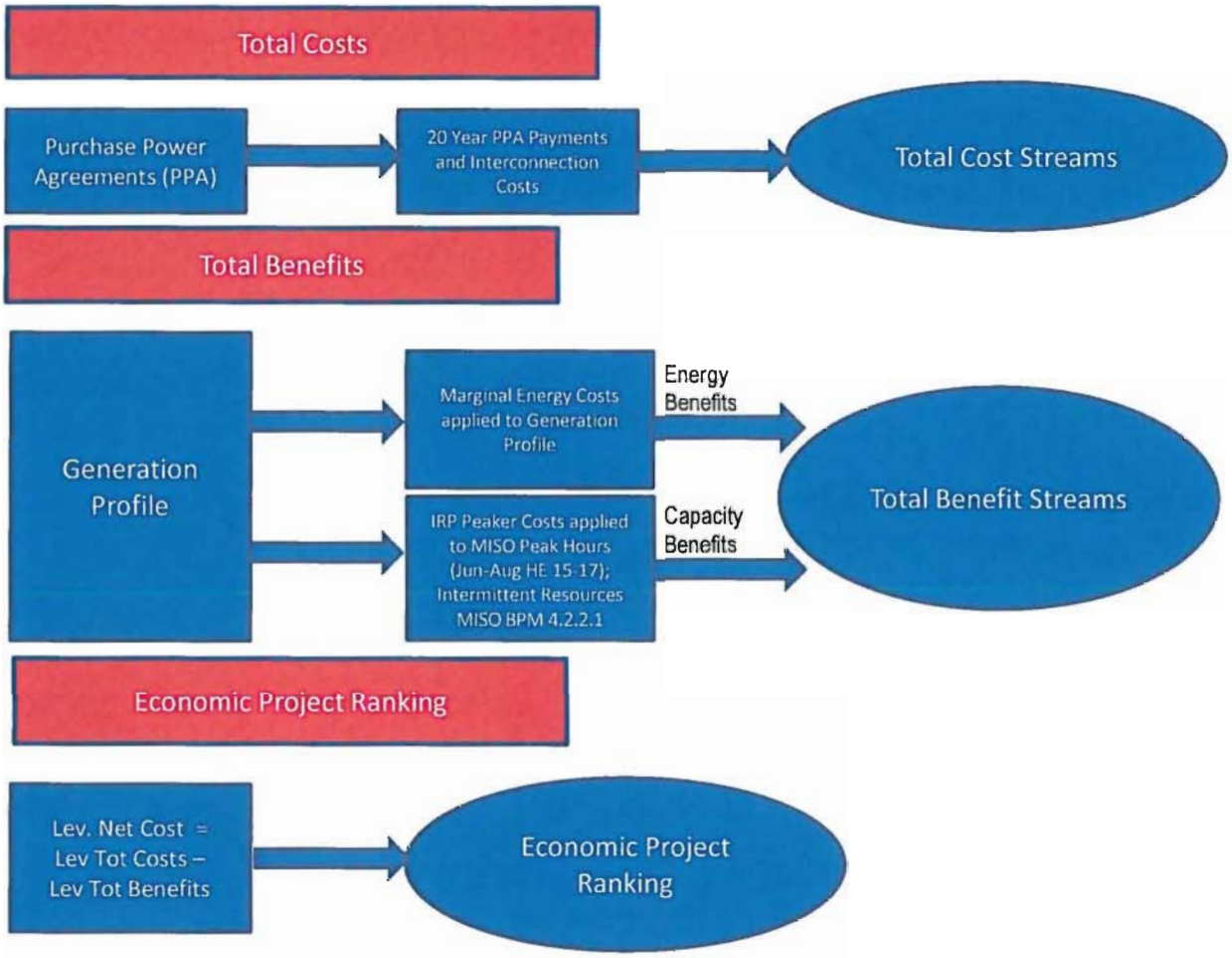
I hereby verify under the penalties of perjury that the foregoing representations are true to the best of my knowledge, information and belief.

Signed: _____ Dated: 2-19-15

James S. Northrup

PETITIONER'S EXHIBIT A-1
IS CONFIDENTIAL

Petitioner's Exhibit A-2: RFP Economic Ranking Flowchart



PETITIONER'S EXHIBIT A-3
IS CONFIDENTIAL

PETITIONER'S EXHIBIT A-4
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PETITIONER'S EXHIBIT A-5
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