STATE OF ILLINOIS

ILLINOIS COMMERCE COMMISSION

Rock Island Clean Line LLC	**)**	
	)	
Petition for an Order granting Rock Island	**)**	
Clean Line a Certificate of Public Convenience	**)**	
and Necessity pursuant to Section 8-406 of the	**)**	**Docket No. 12-____**
Public Utilities Act as a Transmission Public	**)**	
Utility and to Construct, Operate and Maintain	**)**	
an Electric Transmission Line and Authorizing	**)**	
and Directing Rock Island Clean Line pursuant	**)**	
To Section 8-503 of the Public Utilities Act to	**)**	
Construct an Electric Transmission Line	**)**	

DIRECT TESTIMONY OF

LEONARD JANUZIK

ON BEHALF OF

ROCK ISLAND CLEAN LINE LLC

ROCK ISLAND EXHIBIT 6.0

OCTOBER 10, 2012

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Certain capitalized terms in this testimony have the meaning set forth in the Glossary included as **Attachment A** to the Direct Testimony of Michael Skelly, Rock Island Exhibit 1.0.

I. WITNESS INTRODUCTION

Q. Please state your name, present position and business address.

A. My name is Leonard Januzik. I am Senior Director and Midwest Regional Manager of Quanta Technology, LLC ("Quanta Technology"), a wholly owned subsidiary of Quanta Services. My business address is 4020 Westchase Blvd., Raleigh, North Carolina.

Q. What is the business of Quanta Technology and Quanta Services?

A. Quanta Services is a leading provider of specialized contracting services, delivering solutions for the electric power, natural gas and pipeline and telecommunication industries. The company provides a comprehensive range of services, including the design, installation, maintenance and repair of virtually every type of infrastructure.

Quanta Technology is an independent consulting arm of Quanta Services, whose mission is to provide business and technical expertise to energy utilities and the energy industry and to assist in deploying holistic and practical solutions resulting in improved performance. Services include: visioning, strategic planning and capital budgeting, delivery infrastructure planning and engineering, enterprise process and technology innovation, system operations and design, regulatory support, power system automation and protection, sustainable energy resources planning and management, and energy efficiency and demand management.

Q. What are your duties and responsibilities as Senior Director and Midwest Regional Manager of Quanta Technology?

A. As Senior Director, I am responsible for serving as the primary interface to the client and developing proposals in response to client needs that present a technical strategy to achieve those goals. I am responsible for coordinating project schedules and needs across other areas of Quanta Services and with other entities that are a party to the project and for assembling a technical team that has the necessary skill sets to meet the objectives.

Those skill sets include technical, economic, and regulatory expertise in the following areas:

- **Transmission Planning** such as power flow and contingency analysis, short circuit, and voltage and transient stability analysis;
- **Economic Analysis** as it pertains to unit operation, constraints, and the value of transmission projects;
- **Interconnection Studies** that determine the additions necessary to connect new generation resources to the electric system;
- **System Reliability** that examines generation system adequacy in terms of the ability to serve load and the ability to move power between systems;
- **Regulatory Reviews** of documentation and mock audits to prepare entities for periodic reviews of compliance with North American Electric Reliability Corporation ("NERC") standards; and
- **Project Management of** large capital projects with significant public impact.

Q. Please describe your education and professional background.

A. I have a Bachelor's Degree in Electrical Engineering from the Illinois Institute of Technology and have worked in the power industry for 40 years. I have served in various related areas at Commonwealth Edison Company ("ComEd"), including resource planning, transmission planning, strategic analysis and staff assistant to the Vice President of Engineering for almost 25 years. I served as the Director of Engineering and Operations at the Mid-American Interconnected Network ("MAIN") Coordination Center (one of the NERC Regional Reliability Councils) from 1985 until 2004, a portion of which I served while employed at ComEd.

I have directed numerous study efforts in the power system reliability area at MAIN over a period of 19 years, including probabilistic studies to determine acceptable levels of generating capacity (MAIN Guide #6 Generation Reliability Studies) and transmission transfer studies to determine how much help (power imports) from interconnections can be expected for a given transmission configuration. These latter studies include the annual Summer and Winter Operating Studies and Future Systems Study Group studies.

II. PURPOSE AND COVERAGE OF TESTIMONY

Q. What is the purpose of your direct testimony?

A. I am testifying in support of the request of Rock Island Clean Line LLC ("Rock Island") to be issued a Certificate of Public Convenience and Necessity pursuant to Section 8-406 of the Illinois Public Utilities Act ("PUA") to operate as a public utility in the State of Illinois and to construct, operate and maintain the Rock Island Clean Line transmission project ("Rock Island Project" or the "Project") and for an order pursuant to Section 8-

503 of the PUA authorizing and directing Rock Island to construct the Rock Island Project. Specifically, I will describe studies that were performed by Quanta Technology to determine the impacts on the reliability and adequacy of electric service in Northern Illinois and the state of Illinois as the result of installation of the Rock Island Project and the wind generating facilities to be located in northwest Iowa and nearby areas ("the Resource Area") whose output will be delivered to Illinois by the Rock Island Project.

Q. Were the studies performed by you or under your direct supervision?

A. Yes. I worked closely with experts in my company to develop the data sets and to analyze the results. I had day-to-day interaction with and oversight of the studies being performed, and I provided direct input from inception to completion.

Q. In addition to your prepared testimony, which is identified as Rock Island Exhibit 6.0, are you presenting any other exhibits?

A. Yes, I am also presenting Rock Island Exhibits 6.1 through 6.6, which were prepared by me or under my supervision and direction.

III. <u>OVERVIEW OF STUDIES AND METHODOLOGIES</u>

Q. What was the overall purpose of the studies that were performed by Quanta Technologies?

A. The overall purpose of the studies was to determine what, if any, impact on the reliability and adequacy of electric service in Northern Illinois and the state of Illinois would result from the installation of the Rock Island Project and the wind generating facilities to be located in the Resource Area whose output would be transported to Illinois by the Rock Island Project. We analyzed this question by evaluating the impacts of the Project using

standard industry measures for judging power system reliability as described in the remainder of this testimony.

Q. Please provide an overview of the types of studies that were performed.

A. Quanta Technology performed two basic types of studies in order to determine what, if any, reliability benefits will be conveyed to the state's electric grid, or portions of the grid within the state, due to the installation of the Rock Island Project and the generation assets located within the Resource Area. Those studies were: 1) a Loss of Load Expectation ("LOLE") study, and 2) a transfer capability study. The LOLE study is a probabilistic analysis that is used to determine the likelihood of not being able to serve the total electrical demand of a given system during the year. The transfer capability study is a deterministic analysis to evaluate the amount of additional power that can be imported into an area as a result of transmission system configuration changes, such as the installation of the Rock Island Project.

Q. Are the LOLE study, the transfer capability study, and the methodologies you used for them generally accepted in the industry as traditional measures of reliability?

A. Yes. Transmission transfer capability studies have been, and continue to be, one of the primary measures of transmission system reliability, and they are utilized in virtually all regional transmission studies and in annual reporting to NERC for input into its national reliability assessments. Similarly, LOLE studies have been conducted for several decades in the determination of proper capacity reserve levels and remain an important component in the transmission expansion planning process for the Regional Transmission Organizations ("RTOs").

A. Description of LOLE Studies

Q. Please describe the methodology behind the LOLE studies.

A. An LOLE study measures the adequacy of a region's generating capability to reliably serve its demand, measured in terms of how often that demand is at risk of exceeding the available generating capacity.

The Loss of Load Probability ("LOLP") within a given time period is calculated by convolving two probability distributions of available capacity and of peak load within that time period. Loss of load occurs whenever the load is greater than the generation capacity available to serve that load.

If the Loss of Load Probability for a given day is viewed as the expected number of days per year that capacity will be insufficient, the sum of these values can be interpreted as the LOLE for the year. For the last several decades a value of 0.1 day per year (equivalent to one day in ten years) has been viewed by the utility industry as a satisfactory balance between the social costs of outages and the economic costs of unutilized capacity.

Q. Please describe the calculation of the probability distribution of generating capacity.

A. In its simplest form, the probability distribution of generating capacity is calculated as follows: each unit is assumed to be in one of two states, fully available or completely offline. The probability of being offline is denoted by the Forced Outage Rate ("FOR"). If a system has two units, one of 100 MW and one of 50 MW, and each unit has an FOR of 0.05, the probability of having zero MW in service (150 MW offline) is 0.05 x 0.05 = 0.0025. The probability of having 50 MW in-service is 0.05 x 0.95 = 0.0475; the probability of having 100 MW in service is also 0.0475. The probability of having 150

MW in service is 0.95 x 0.95 = 0.9025. This process can be repeated until all units in the system are considered and is shown in more detail in Rock Island Exhibit 6.1.

As a computational shortcut, it is common to round all unit capacities to multiples of a "step size," such as 10 or 25 MW, so the number of states remains manageable.

This approach can be extended to consider partial outage states for some or all units. However, partial outage data is not published in the NERC Generating Availability Data System ("GADS", described later in my testimony) reports. A statistic called "Equivalent Forced Outage Rate," which increases the Forced Outage Rate to account for partial outages, is published and was used for this study, except for combustion turbines as discussed below. A further adjustment can be made to recognize that some unit types with high operating costs are not operated except at peak periods, and it is the probability of outage during these periods that is of significance. The resulting statistic is called "Equivalent Forced Outage Rate demand" (EFORd). EFORd was used for combustion turbines in this study. Details of these adjustments to the Forced Outage Rate are available within Institute of Electrical and Electronics Engineers Standard 762-2006, "IEEE Standard Definitions for Use in Reporting Electric Generating Unit Reliability, Availability, and Productivity", Appendix F, "Performance Indexes and Equations".

The distribution of generating capacity is generally assumed constant for a given week, but it changes from week to week because maintenance outages are generally scheduled weekly. A second cause of changes is the installation or retirement of units during the year.

Q. Please describe the calculation of the probability distribution of load.

A. Load is assumed to be normally distributed around an "expected" value. The standard deviation of the load, in percent, is referred to as the Load Forecast Uncertainty ("LFU"). LFU is due to many factors including economic factors, changes to energy efficiency and demand response, and weather uncertainty; the majority (60%) is due to weather. LFU is discussed in more detail later in my testimony.

Q. Please explain how the required reserve margin to attain a target LOLE is calculated.

A. Reserve margin is the percentage by which the available generating capacity exceeds the load. If the predicted load is increased by a specified percentage, the reserve margin will decrease. If this adjusted load is used in an LOLE calculation, holding the mix of generating capacity constant, a higher LOLE value will be calculated. The relationship between reserve margin and LOLE is approximately logarithmic, and the results can be interpolated to determine the reserve margin required to attain the above-mentioned target of 0.1 day per year.

Q. Please describe the input data used for the LOLE studies.

A. The unit input data for the LOLE studies consisted of four major components:

1) The population of generating units in the area to be analyzed (all of Illinois or only Northern Illinois (NI - the ComEd transmission sub-region of the PJM Interconnection, LLC (PJM) RTO)), depending on the scenario. Wind farms, consisting of large numbers of small wind turbines (less than 3 MW apiece), whose output is delivered to a single point of interconnection to the transmission system, were aggregated as a single unit. Combined cycle plants, consisting of one or more combustion turbines and a steam unit supplied by a heat recovery boiler, were also aggregated into a single unit. Other types of

generating units were modeled individually. The total MW capacity of each class of units is shown, by Balancing Area, in Rock Island Exhibit 6.2.

2) Representative maintenance schedules for each of the above units.
   a) Most conventional units have annual two-to-four week maintenance outages; these are generally conducted in the Fall, Winter, and Spring when electrical demand is lower and replacement power is more readily available. Normally, maintenance outages at a particular site do not overlap due to manpower constraints. This convention was adhered to in the data for the LOLE study.
   b) Wind turbines are maintained individually and most of the plant capacity remains in-service, so no scheduled maintenance was represented for the single, aggregated wind plant.
3) Forced outage data from the NERC GADS survey of generating unit performance. Forced outage rates used in the study are technology and size specific. Units are classified into the following groups, most of which are further broken down by nameplate MW capacity:
   a) Steam
      i) Coal
      ii) Oil
      iii) Gas
   b) Nuclear
      i) Boiling water reactors
      ii) Pressurized water reactors
   c) Combustion Turbine

i) Industrial (heavy duty)

ii) Aero-derivative

d) Combined Cycle (combustion turbine plus steam turbine, gas fired)

e) Hydro

The population of units and the maintenance schedules were provided from Rock Island witness Gary Moland's production cost model. Also, as mentioned above, NERC GADS data was used for unit forced outage rates.

4) Projected hourly load data, also provided by Mr. Moland from his production cost model inputs, was condensed to the daily peaks for the study area. All 366 days, including weekends and holidays, were considered.

In addition to the above study data, two systemic assumptions are made that are used in the LOLE study.

1) LFU: Experience indicates that the standard deviation of load beyond the period for which reliable weather forecasts can be obtained is approximately three percent, due to weather being other than the "average" or "normal" for the season of the year. The standard deviation for load in the planning horizon for new generating capacity, roughly five years, is approximately five percent, due to both weather variations and economic variations and changing energy efficiency, demand response and other factors.

2) "Wind capacity equivalent": This is a multiplier applied to the nameplate capacity of wind plants, representing the probable fraction of the capacity available at the daily peak. PJM's Manual 21[1] outlines the calculation procedure to determine capacity value of a

[1] PJM Manual 21 "Rules and Procedures for Determination of Generating Capability *(Green Book)*", available at: http://pjm.com/~/media/documents/manuals/m21.ashx.

wind resource based on historical operating data or, in the absence of operating data (from existing plants or meteorological towers) using PJM's class average for missing operational data.

An hourly energy profile for the generation in the Resource Area, adjusted for electrical losses at the two DC converter stations and during transmission over the line, was provided by Rock Island witness Mr. David Berry. Using this energy profile and PJM's capacity value methodology as previously described, I calculated the wind capacity equivalent value to be 35% for the wind turbines in the Resource Area affiliated with the Rock Island Project; this amounts to a capacity allocation of 1,240 MW. A similar exercise was conducted to calculate the wind capacity equivalent value for the wind generation in the model across Illinois, which resulted in a 20% wind capacity equivalent value.

PJM's default capacity value for an immature wind resource is 13%. Therefore, the calculation used herein is more indicative of a mature and efficient resource based on the data provided by Mr. Berry, which was sourced from the National Renewable Energy Laboratory's Eastern Wind Integration and Transmission Study.

Q. What cases were developed for the LOLE studies?

A. Two fundamental base cases were developed for this analysis. The first was a case that includes the entire state of Illinois and the second case was for just NI. The intent was to show the impact on the entire state first, and then second, on the area of the state where the Rock Island Project terminates. The latter case also separates the portion of the state that is a part of PJM from the portion that is part of the Midwest Independent Transmission System Operator, Inc. ("MISO").

Three different scenarios were examined for each of the above two cases. Those scenarios were: 1) no Load Forecast Uncertainty, 2) 3% Load Forecast Uncertainty and, finally, 3) 5% Load Forecast Uncertainty. In general, the 3% case represents uncertainty when weather is expected to be the primary uncertainty factor affecting load, usually in studies with a shorter time horizon. The 5% forecast uncertainty has been used to consider total forecast error which includes other factors such as the economy or technological changes in generator design. This is usually considered for studies with longer time horizons.

B. Description of Transfer Capability Studies

Q. Please describe the methodology behind the transfer capability studies.

A. As is common industry practice, the transfer capability studies were conducted using Siemens Power Technology International's software entitled Managing and Utilizing System Transmission ("PSS®MUST") whereby a linear transfer analysis is employed in order to determine the First Contingency Incremental Transfer Capability ("FCITC") between a designated point-of-receipt, or source, to a designated point-of-delivery, or sink. FCITC is a measure of how much power can be transferred from one portion of the network to another such that no transmission facility outage results in an overload of another transmission facility. This methodology was used to determine the impact that the Rock Island Project would have on the ability to transfer power from the MISO RTO and the PJM RTO into NI as well as in aggregate into the entire state of Illinois.

A transfer capability study measures the ability to transfer power from one part of the transmission system to another. A transfer from one region to another is simulated by creating a surplus of capacity in the sending region, the source, and a capacity deficit in

the receiving region, the sink. The surplus in the source region is created by increasing the generation output in the source system. The deficit is created by decreasing the generation output in the sink region. The increases within the sending region are allocated proportionately among all in-service units up to their individual maximum capacities; likewise decreases in the receiving region are proportionate among in-service units down to their minimum generation limits while remaining in-service. Units are not committed (turned on) nor de-committed (turned off) in this analysis. For this study, the power was transferred from the point-of-interconnection of the Rock Island Project – the Collins substation in ComEd – where half of the power was modeled as transferred to eastern PJM (that is, the portions of PJM outside of NI, referred to as PJM-East or PJM_E) and the rest was modeled to sink within NI. The amount of power transferred from the Project was 1,240 MW which, as described in §III.A above, was calculated to be the "wind capacity equivalent" of the wind generation in the Resource Area. This transfer created the "Dispatch of Rock Island" for the case with the Rock Island Project.

A <u>transfer limit</u> is reached when the reliability of the network is compromised. The increase in transfer from the base level to the transfer limit is called the <u>First Contingency Incremental Transfer Capability</u> or FCITC. A <u>contingency</u> is the loss of a single transmission line or transformer within the existing electrical network, otherwise known as N-1. Hence the FCITC limit is the smallest transfer of capacity that causes some network element to become overloaded for the contingent outage of another element. For this study, the FCITC was determined by simulating transfers from MISO and PJM_E into NI or into Illinois after consideration of the Dispatch of Rock Island as described above.

The results of these FCITC calculations provide an indication of how transmission loading would change according to assumed end users of the Rock Island capacity and the resulting change in the ability to transfer power into all or part of Illinois.

In addition to the incremental change in FCITC due to the addition of the Rock Island Project, there is also an additional amount of import capability made available due to the addition of the Project, which is represented by the increase in transmission capability to serve Illinois load net of the amount of that capacity used by wind generating plants in the Resource Area to serve summer peak demand. This additional import capability is referred to in the transfer capability studies as the HVDC Incremental Imports. The sum of the FCITC increase and the HVDC Incremental Imports due to the addition of the Rock Island Project equals the total increase in transfer capability due to the Rock Island Project.

Q. What exactly does a transfer capability study measure in terms of the reliability of the region studied?

A. Transfer capability studies, such as the import capability studies which were performed for the Rock Island Project, provide an indication of how much transmission capacity may be available to support the load in a given region of the network from external resources. The greater the increases in FCITC and total transfer capability, the more transmission capability there is to import power into the receiving region should there be a capacity shortfall due to fuel interruption, regulatory compliance, abnormal capacity outages, or other factors that might require power imports to meet demand. Sufficient

import capability is also required to enable reserve sharing by providing access to external resources and so as to reduce capacity reserve margin requirements.

Q. Please describe the input data used for the transfer capability studies.

A. Power flow base cases provided by PJM were used in the transfer capability study. Summer peak and shoulder (Fall/Spring) demand cases representing the 2015 operating year, which were developed in the PJM Regional Transmission Expansion Plan ("RTEP") cycle of 2011, were obtained from PJM. The PJM power flow base cases depict the interconnected transmission system, generation, and loads of the Eastern Interconnection of the US power grid at a particular point in time with a focus on the detail of the PJM region. These cases were not modified from the form in which they were obtained from PJM. These cases were used to determine the impact that the Rock Island Project would have on import capability into NI from the rest of PJM, into NI from MISO and into NI from a combination of both PJM and MISO. Additionally, the impact on imports into all of Illinois was also analyzed in a similar fashion.

A summary of key data and assumptions for the Transfer Capability Analysis is included in Rock Island Exhibit 6.6.

The objective of the transfer capability study was to provide an estimate of the impact of the power injection at the Illinois terminus of the Rock Island Project on power transfers into Illinois. In light of this objective, confirmed and queued transmission service requests of other entities, proposed generation interconnection projects of other entities, multi-segment contingencies (such as outages on common towers or common rights-of-way), and reliability margins were not included in the assessments. Exclusion

of these factors would not impact the results since the study is only focused on the relative effect of the Rock Island Project**.**

Q. Are PJM power flow cases, such as the ones you used, commonly used in transfer capability studies and other studies of this type?

A. Yes. It is common industry practice to use transmission base cases, produced by the RTO or independent transmission system operator in which impacts are being studied, for any type of reliability study. The PJM base cases are developed from the most recent Eastern Interconnection Reliability Assessment Group ("ERAG")[2] models and are then revised by PJM transmission planning to include all the current system parameters and assumptions.[3]

Q. Is the validity of the transfer capability studies and of the results impacted by the use of a base case that represents the year 2015 when the expected in-service date of the Project is 2016 or 2017?

A. PJM publishes powerflow base cases for credentialed users on the PJM website. The base cases that were available on their site at the time that this study was commissioned were developed in 2011 and represented the 2015 simulation year. In my experience, this will provide a reasonable representation of the reliability impacts of the Project even if it does not go into service until 2016 or 2017. It should also be noted that the results presented for Rock Island are in the form of a difference calculation between a base case and a sensitivity case (the "Dispatch of Rock Island" case).

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[2] ERAG is a modeling group within Reliability First (a Regional Entity of NERC) that performs reliability studies and aggregates utility system models for use in these studies. For additional information on ERAG, see: https://www.rfirst.org/reliability/easterninterconnectionreliabilityassessmentgroup/Pages/default.aspx.

[3] PJM's Manual 14B "PJM Region Transmission Planning Process" at page 22; available at: http://pjm.com/~/media/documents/manuals/m14b.ashx.

IV. RESULTS AND CONCLUSIONS OF THE STUDIES

A. LOLE Studies

Q. What were the results of the LOLE studies you performed?

A. Because the new capacity being brought to the Illinois market is highly reliable (having a low EFOR), the reserve margin required to attain a target LOLE of 0.1 day per year decreases. Conversely, loads in excess of those currently projected can be supplied by the available generation as shown in Rock Island Exhibit 6.3 and Rock Island Exhibit 6.4. The LOLE study results clearly indicate an increase to the system reserve margin at both the State of Illinois and NI sub-regional levels as a result of the installation of the Rock Island Project. Throughout the sensitivities analyzed, the cases with the addition of the Rock Island Project show an order of magnitude decrease in LOLE when compared to the cases without the project.

This improvement can also be viewed in terms of additional load that can be served because of the Rock Island Project. Across the board, the addition of the Rock Island Project allows service to new load of approximately 1,100 MW to 1,200 MW (based on the assumed LFU) which also speaks to the reliability benefits of the Project.

B. Transfer Capability Studies

Q. What were the results of the transfer capability studies you performed?

A. The results of the transfer capability analysis indicate FCITC to be increased by about 1,015 MW for imports into NI and about 1,180 MW for imports into the entire state of Illinois as shown in Rock Island Exhibit 6.5. The results also indicate the increase in total transfer capability into NI to be 1,525 MW and into the entire state of Illinois to be 1,690 MW, as also shown in Rock Island Exhibit 6.5.

As described above in §III.B, in addition to the Project's impact to imports from existing MISO and PJM_E ties, there is additional import capability available from the Project's unused capacity – the "HVDC Incremental Imports." The amount of the HVDC Incremental Imports is 510 MW. This is the result of an increase of 1,750 MW in transmission capability to serve Illinois load due to the installation of the Rock Island HVDC line, a utilization of 1,240 MW of that transfer capability by wind plants in the Resource Area to serve the summer peak demand (as previously described and calculated during the LOLE study), and an assumed sinking of this new resource divided equally (50/50) between NI and the rest of PJM. The 1,750 MW increase in transmission capability is developed as follows: The total transmission capacity of the Rock Island project is 3,500 MW. The electric grid is operated to account for system contingencies. The most severe single contingency (N-1) for the Rock Island Project is the loss of a single pole of the Rock Island Project – which would result in a 50% reduction in the Project's transmission capability. The amount of the HVDC Incremental Imports is the excess HVDC capability above that which is used by wind plants in the Resource Area during the summer peak period (1,750 MW – 1,240 MW = 510 MW). The calculated increases in total transfer capability, therefore, are 1,015 MW + 510 MW = 1,525 MW for NI and 1,180 MW + 510 MW = 1,690 MW for Illinois as shown in Rock Island Exhibit 6.5.

In summary, the results of the transfer capability analysis show improvement to reliability in Northern Illinois and to the State of Illinois consistent with regional practices in calculating and evaluating FCITC results. The transfer capability studies indicate that, for the peak scenario as modeled using conservative PJM dispatch

assumptions, there is a significant increase in incremental import capability at both the state of Illinois level and the NI sub-regional level as a result of the installation of the Rock Island Project. The increases for imports into NI and Illinois are approximately 1,525 MW and 1,690 MW, respectively. For comparative purposes, the State of Illinois would have additional import transfer capability, over and above the margins that already exist before the Rock Island Project is installed, that is greater than the largest generating units in the state.

Q. Based on the results of your studies, what is your conclusion as to whether installation of the Rock Island Project and the wind generating facilities that will be connected to it in the Resource Area will increase the reliability and adequacy of electric service in NI and in the State of Illinois?

A. Based on the results of our LOLE and transfer capability studies, as summarized in Rock Island Exhibits 6.3, 6.4 and 6.5, there is a significant increase in the reliability and adequacy of electric service in the State of Illinois and in the Northern Illinois region of PJM as the result of installation of the Rock Island Project and the wind generating facilities that will be connected to it.

Q. Does this conclude your prepared direct testimony?

A. Yes, it does.

Developing the Distribution of Generating Capacity Thru Convolution

Example 1

A system has two units, one of 100 MW and one of 50 MW and each has an FOR of 0.05.

- The probability of having zero MW in service (150 MW offline) is 0.05 x 0.05 = 0.0025
- The probability of having 50 MW in-service is 0.05 x 0.95 = 0.0475
- The probability of having 100 MW in service is 0.95 x 0.05 = 0.0475
- The probability of having 150 MW in service is 0.95 x 0.95 = 0.9025

Example 2

Add a third unit, also of 50 MW but with an FOR of 0.10

- The probability of having zero MW in service is 0.05 x 0.05 x 0.10 = 0.00025
- The probability of having 50 MW in-service is 0.05 x 0.05 x 0.90+0.95 x 0.05 x 0.10 = 0.00070
- The probability of having 100 MW in service is 0.95 x 0.05 x 0.90+0.05 x 0.95 x 0.10 = 0.04750
- The probability of having 150 MW in service is 0.95 x 0.95 x 0.10+0.05 x 0.95 x 0.90 = 0.13300
- The probability of having 200 MW in service is 0.95 x 0.95 x 0.90 = 0.81225

Example 3

A system has two units, one of 100 MW and one of 50 MW and each has an FOR of 0.05. The 100 MW unit also has a 5% probability of being derated to 50 MW.

- The probability of having zero MW in service is 0.05 x 0.05 = 0.0025
- The probability of having 50 MW in-service is 0.05 x 0.05 + 0.95 x 0.05 = 0.0500
- The probability of having 100 MW in service is 0.95 x 0.05 +0.05 x 0.90 = 0.0925
- The probability of having 150 MW in service is 0.95 x 0.90 = 0.8550

LOLE Generating Capacity

Summary of Generating Capacity Assumed In LOLE Study (MW)										
BA	PWR	BWR	COAL	OIL	COMB	HYDRO	WIND	IC	CT	TOTAL
AMIL	-	1,043	7,821	156	1,131	8	20	6	2,354	12,539
AMMO	-	-	-	-	-	-	-	-	859	859
CWE	4,730	5,824	5,587	-	2,614	-	1,160	11	8,457	28,383
CWLP	-	-	572	-	-	-	-	-	177	749
EEI	-	-	-	-	-	-	-	-	254	254
SIPC	-	-	-	-	-	-	-	-	160	160
TOTAL	4,730	6,867	13,980	156	3,745	8	1,180	17	12,261	42,944

Notes:

Technology Types:

PWR = Pressurized Water (Nuclear) Reactor Generation
BWR = Boiling Water (Nuclear) Reactor Generation
COAL = All types of Coal Steam Generation
OIL = All types of OIL Steam Generation
COMB = Combined Cycle Generation (All)
HYDRO = Water Powered Generation (All)
WIND = Wind Powered Generation
IC = Internal Combustion Generation (All)
CT = Combustion Turbine Generation (All)

Balancing Area (BA) Names:

AMIL = Ameren Illinois
AMMO = Ameren Missouri
CWE = Commonwealth Edison
CWLP = City Water Light and Power – Springfield, IL
EEI = Joppa Power Plant
SIPC = Southern Illinois Power Cooperative

LOLE Comparison -- Illinois

	LOLE Comparison - Illinois					
	Without Rock Island HVDC			With Rock Island HVDC		
		LFU			LFU	
	0%	3%	5%	0%	3%	5%
Capacity Value Considered (MWs)	42,941	42,941	42,941	44,166	44,166	44,166
Peak Load Level	35,782	35,782	35,782	35,782	35,782	35,782
Actual Reserve Margin	20.01%	20.01%	20.01%	23.43%	23.43%	23.43%
Required Reserve Margin to attain .1 day per year	10.58%	13.16%	16.69%	10.28%	12.90%	16.45%
Actual LOLE - per year	0.00020	0.00249	0.02664	0.000009	0.00019	0.00404
Add'l Load within .1 day per year that can be served (%)	8.42%	5.94%	2.73%	11.97%	9.37%	6.03%
Add'l Load within .1 day per year that can be served (MW)	3013	2125	977	4283	3353	2158

Advantage of Rock Island (MWs) >>>>>	1270	1227	1181

LOLE Comparison – Northern Illinois

	LOLE Comparison - Northern Illinois					
	Without Rock Island HVDC			With Rock Island HVDC		
		LFU			LFU	
	0%	3%	5%	0%	3%	5%
Capacity Value Considered (MWs)	28,379	28,379	28,379	29,604	29,604	29,604
Peak Load Level	25,493	25,493	25,493	25,493	25,493	25,493
Actual Reserve Margin	11.32%	11.32%	11.32%	16.13%	16.13%	16.13%
Required Reserve Margin to attain .1 day per year	12.04%	14.26%	17.49%	11.50%	13.78%	17.05%
Actual LOLE - per year	0.14844	0.33382	0.75059	0.01057	0.03565	0.13585
Add'l Load within .1 day per year that can be served (%)	-0.80%	-2.73%	-5.40%	4.20%	2.12%	-0.74%
Add'l Load within .1 day per year that can be served (MW)	-227	-775	-1532	1243	628	-219

Advantage of Rock Island (MWs) >>>>>	1470	1402	1313

Transfer Capability Study Results

All values in MW	NI			Illinois		
	Without Rock Island	With Rock Island	Change	Without Rock Island	With Rock Island	Change
FCITC	2095	3110	1015	2435	3615	1180
HVDC Incremental imports	0	550	510	0	510	510
Increased Transfer Capability due to Rock Island			1525			1690

Notes:

- Rock Island imports are split 50% to NI and 50% to PJM_E ("PJM_E" is the portion of PJM outside Northern Illinois).
- Incremental HVDC imports could come from additional wind in the Resource Area or western MISO generation utilizing the Rock Island Project to access Illinois.
- First Contingency Incremental Transfer Capability (FCITC) is sourced from MISO and PJM_E

Key Data and Assumptions for Transfer Capability Studies

Key Data and Assumptions for Transfer Capability Studies		
Time Period		2015 PJM RTEP Summer Peak
Peak Load	Illinois NI	36,667 MW 25,237 MW
Source Areas		PJM_E MISO
Sink Areas		Illinois NI
Base Imports	Illinois NI	880 MW 440 MW
Dispatch of Rock Island		50% to NI 50% to PJM_E
Rock Island Injection		1240 MW at Collins Terminal
Contingencies		Outages of all transmission elements taken one at a time (N-1) for transmission facilities in IL, IN, IA, MO, OH, & MN

Notes:

- AMIL is the Illinois portion of Ameren.
- PJM_E is the portion of PJM outside of Illinois