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Witness: J. Neil Copeland
Sponsoring Party: Grain Belt Express Clean Line LLC
Type of Exhibit: Direct Testimony
Case No.: EA-2016-0358
Date of Testimony: August 30, 2016

MISSOURI PUBLIC SERVICE COMMISSION

CASE NO. EA-2016-0358

DIRECT TESTIMONY OF

J. NEIL COPELAND

ON BEHALF OF

GRAIN BELT EXPRESS CLEAN LINE LLC

August 30, 2016

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I. INTRODUCTION

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

A. My name is Neil Copeland. I am a Managing Director in the Power Supply Group at GDS Associates, Inc. ("GDS"). My business address is 1850 Parkway Place, Suite 800, Marietta, GA 30067.

Q. Please describe your education and professional background.

A. I received a Bachelor's degree in Mechanical Engineering and a Bachelor's degree in Nuclear Engineering from the Georgia Institute of Technology ("Georgia Tech"). I am also a licensed professional engineer in the Commonwealth of Virginia.

I am currently employed by GDS, an engineering and consulting firm providing services to the utility industry. Prior to joining GDS, I was employed at the firms of Black and Veatch, R.W. Beck (now Leidos), Navigant Consulting, and ABB/Ventyx. I have sixteen years of experience in preparing energy and capacity price forecasts, providing detailed assessments of energy market fundamentals, analyzing transmission investments, providing nodal congestion and curtailment analysis, developing integrated resource plans, managing data gathering and price forecasting databases, and performing asset valuations for power plants. I have supported project development and financing for construction of new generation, acquisition, divestiture, refinancing, and bankruptcy proceedings. I have completed numerous consulting engagements for diverse clients, including regulatory agencies, project developers, load-serving entities, generation companies, private equity investors and investment banks. I also have extensive experience with the use of commercial price forecasting tools such as the ABB/Ventyx MarketPower and PROMOD IV software. A current copy of my CV is attached as **Schedule JNC-1**.

I have provided analyses in many markets across the United States and Canada. The analyses examine the current and future market structure, and market supply and demand in these areas. All aspects were included in these studies, including, but not limited to, transmission analysis and upgrades, congestion and curtailment, new entrants into the market, retirements, fuel consumption, emissions controls and technology, and any potential Environmental Protection Agency ("EPA") requirements that may affect the forecast. Types of projects and locations are listed below:

Combined cycle, peaking, coal, renewable, and transmission projects located in specific states within Independent System Operator ("ISO") of New England (ME, MA, RI, NH, CT); New York ISO (Zone C, F, G, J, K); PJM Interconnection (IL, PA, NJ, MD, VA); Midcontinent ISO ("MISO") (IL, IA, MI, KY, IN); Southwest Power Pool ("SPP") (TX, KS, NE); Electric Reliability Council of Texas (TX); the U.S. Southeast (GA, NC, SC, FL); Western Electricity Coordinating Council (AZ, NM, CO, WA, MT); and the Canadian provinces of Ontario, Alberta, and New Brunswick.

Q. Please describe your background in performing transmission economic analysis.

A. I have extensive experience in analyzing transmission projects, including transmission opportunities to reduce congestion, to provide generator access to distant markets, and to provide market opportunities. Specific examples of my work in transmission analysis include the following projects:

- ITC Lake Erie Connector, a direct current transmission line to bring power from Ontario to PJM;
- Maine Renewable Energy Initiative, a joint renewable energy and transmission project to deliver wind energy from Maine to southern New England;
- Northern Pass Transmission, a new direct current line to bring additional hydropower from Quebec to New England; and
- Neptune Regional Transmission System, a direct current transmission cable connecting New Jersey in PJM to Long Island in the New York ISO

Q. What is the purpose of your direct testimony?

A. The purpose of my testimony is to describe the assumptions, methodology, and results of the analysis I conducted to measure the economic and environmental impacts of operation of the Grain Belt Express transmission project ("Grain Belt Express Project" or "Project") being proposed by Grain Belt Express Clean Line LLC ("Grain Belt Express" or "Company"). My testimony will present this PROMOD Analysis, which describes the economic and environmental benefits of the Project under seven assumption scenarios or "futures." It will also demonstrate that the Project will result in lower overall demand costs for energy in Missouri and throughout the region, lower energy production costs, and reduce overall emissions of pollutants.

Q. Please summarize your testimony.

A. The PROMOD Analysis showed that the Grain Belt Express Project will benefit Missouri and the Eastern Interconnection in three key metrics described below.

- *The Project will lower adjusted production cost (APC) for Missouri.* The APC is a metric used by most Regional Transmission Operators ("RTO's") to estimate the cost for load serving entities to supply power to their end-use customers. APC accounts for not only generator production costs (fuel, variable operating & maintenance, and emissions) to serve demand in a region, but also any economic purchases and sales of electricity in the wholesale market.
- *The Project will lower demand cost for Missouri.* Demand cost is the total cost for a load-serving entity or region to purchase energy to supply electric demand. This value represents the hourly electrical demand (in MWh) at each bus multiplied by the hourly locational marginal price ("LMP", in $/MWh) at that bus, and then summed over all Missouri busses for all hours in the study year.
- *The Project will lower emissions in the Eastern Interconnection.* The renewable energy delivered by the Project will reduce emissions in the Eastern Interconnection by displacing thermal generation which emits sulfur dioxide ("SO_2"), nitrogen oxides ("NO_X"), and carbon dioxide ("CO_2")

In addition, I will discuss certain modifications to this analysis compared to the similar analysis presented in the Company's previous application in Case No. EA-2014-0307 ("2014 Case") to the Missouri Public Service Commission ("Commission" or "PSC") in the testimonies of Grain Belt Express witnesses Gary Moland and Robert Cleveland. These modifications were the result of discussions and meetings with PSC Staff to address issues they raised in the 2014 Case.

Q. In addition to your prepared direct testimony are you sponsoring any other exhibits?

A. Yes, I am also sponsoring Grain Belt Express **Schedules JNC-1** and **JNC-2**, which were prepared by me. The conclusions of the PROMOD Analysis are contained in Schedule **JNC-2**.

II. ECONOMIC MARKET STUDY

a. Study Methodology, Scenarios, and Data Assumptions

Q. Please provide an overview of the energy markets of which Missouri is a part.

A. The majority of electrical demand in the state is served by utilities within the MISO and SPP RTOs. The primary responsibility of SPP and MISO is the continuous monitoring and control of the reliable operation of the transmission grid in their service territory. Reliability is maintained by managing electricity supply and demand balance through the direct and indirect control of generating assets owned by power producers and by adjusting import and export transactions. Power producers are paid for their operation through competitively traded power markets managed by SPP and MISO and, to the extent they qualify, tariffs for ancillary services. SPP and MISO are also responsible for monitoring the wholesale market to assure that the market is operating competitively and that no market manipulation occurs.

The SPP and MISO energy markets operate much like any commodity market, with buyers and sellers establishing a price by matching supply and demand. Generating resources in SPP and MISO that are not involved in bilateral transactions are required to submit energy offers into the day-ahead energy market. SPP and MISO use the energy price offers to perform a day-ahead, least-cost security constrained unit commitment and hourly security constrained economic dispatch ("SCED") analysis of their respective systems, from which projected loads and energy exports for the following day are modeled to be served at the lowest possible bid cost of generation (plus imports), while maintaining adequate transmission system reliability and operating reserves.

From the day-ahead dispatch, a price is calculated for each node on the electric grid, from which prices are further computed by SPP and MISO for aggregations of nodes such as load zones, hubs, and interfaces. Transmission congestion can cause prices to diverge between nodes (and therefore also between zones, hubs, and interfaces) based on the cost impact of dispatching generating units out of merit in order to relieve congestion. Generators are paid the nodal LMP price and load pays the zonal price (a load-weighted average of nodal LMPs within a defined load zone). Generating resources, load, imports, and exports that participate in the day-ahead market are also required to participate in the real-time energy (also referred to as the real-time balancing) market the following day. The real-time energy market reflects prices that develop when actual market operations vary from day-ahead expectations. Real-time LMPs are set based on the real-time SCED. Generators (and imports) are paid and load (and exports) are charged in the real-time market based on their deviations from the day-ahead schedule.

Q. What are LMPs?

A. "LMP" stands for locational marginal pricing and represents the incremental cost of energy at a specific electrical bus (or collection of buses, often referred to as a "hub") at a given point in time. LMPs are calculated by SPP and MISO every five minutes in the real-time energy market. These prices are used in financial settlements to determine the cost to buy and sell energy on the open wholesale market. LMPs include the cost of the next increment of energy needed to meet system-wide demand, the cost of transmission congestion impacts on a specific bus location, and the cost of electrical losses associated with a specific bus location with respect to a pre-determined reference point.

Q. Why are the wholesale markets of SPP, MISO and other regions relevant to electric customers in Missouri?

A. Numerous Missouri utilities, including Ameren, Kansas City Power & Light, and municipal utilities participate in the MISO and SPP markets, and therefore analysis of these markets is relevant to these utilities' cost to serve their customers. When utilities generate power at a power plant they own (or with which they have a power purchase agreement), the utilities are paid the LMP through a settlement process with MISO or SPP. When utilities serve their load, they pay the LMP at the relevant load zone. Prices in the market influence the cost to utilities to serve their customers, which ultimately influences the cost-based rates charged by utilities to their customers as determined in rate cases.

Q. Please summarize the PROMOD Analysis regarding the impacts of constructing and operating the Grain Belt Express Project and the interconnected wind facilities which the Project will deliver.

A. GDS used the PROMOD production cost modeling software package to perform simulations of future energy markets for a representative study year (2022) to assess the economic impact of the Project on Missouri. The year 2022 was chosen because it is the first full year the Project is scheduled to be in operation. In order to develop a robust view of impacts and benefits, simulations were performed across several possible future market scenarios both with and without the Project.

Q. Please describe the PROMOD software model used in the PROMOD Analysis.

A. PROMOD is proprietary modeling software which incorporates extensive details of generating unit operating characteristics, transmission grid topology and characteristics, and market system operations to support economic-based decisions affecting the electric industry including transmission planning. The simulations encompass RTO energy markets and transmission grids throughout the eastern United States, including SPP, PJM, MISO, New York ISO, and the U.S. Southeast. PROMOD is an integrated electric generation and transmission market simulation tool. PROMOD performs hourly chronological commitment and dispatch of generating resources that minimizes system operating costs while simultaneously adhering to a variety of constraints, including operating limits of generation sources, transmission element limits, fuel and environmental costs, operating reserve requirements, and customer demand and supply/demand balance. PROMOD can be used to forecast hourly energy prices at a nodal granularity (LMPs), unit generation output, fuel consumption, emissions output, transmission flows, and congestion costs based on the input market conditions specified by the user. PROMOD is a tool commonly used by RTOs, including PJM, MISO and SPP, to perform cost-benefit analyses for new transmission facilities.

Q. Please describe the study methodology used in the PROMOD Analysis for evaluating the economic and environmental benefits of the Project.

A. The study methodology used to assess the economic benefits of the Project was performed through the following four steps

1) *Assumptions and scenario development* –Assumption scenarios are selected to provide several plausible futures under which to evaluate the economic and environmental benefits of the Project. A scenario-based approach is critical to ensure that economic results are robust across a variety of future conditions. For each scenario, specific assumptions are developed for modeling inputs, such as future demand growth, future fuel prices, new wind generation, and other key assumptions based on research and past modeling experience.

2) *Base Case simulations* – A full set of simulations is performed for the study year across multiple scenarios without the Grain Belt Express Project included.

3) *Grain Belt Express Project simulations* – A second set of simulations is performed for the study year across multiple scenarios that include the Project along with the new wind generation expected to supply energy to be delivered over the Project. Hourly energy profiles for the wind generation in western Kansas were provided by Grain Belt Express witness David Berry. The economic feasibility of the Project and the new wind generation resources that will utilize it are directly intertwined such that one cannot be reasonably modeled without the other. The Project serves no purpose without the new wind resources and the new wind resources would not be developed without the transmission access afforded by the Project. Quality assurance checks are carried out with a focus on the operation of the Project to ensure that the modeled line flow, electrical loss rates, and other results align with design parameters.

4) *Cost-Benefit Analysis* – The Project simulations are compared to the corresponding Base Case simulations for each scenario to assess the impact of the Project on system operations, costs, and emissions. By changing no other variables than the presence of the Project and its connected wind generation, the resulting economic and environmental impacts are wholly driven by the Grain Belt Express Project. This new wind generation delivered by the Project offsets production costs (fuel and emission costs) from conventional generation, and the low variable cost of the new wind generation also reduces LMPs in Missouri, lowering demand cost under RTO settlement processes.

Q. What future energy market scenarios were considered in the economic analysis?

A. Since the 2016 MISO Transmission Expansion Plan is not completed, I used the MISO Transmission Expansion Plan 2015 ("MTEP15") as the starting point for the analysis. MTEP15 included the five futures described below. Additional information about each MTEP15 future is available in the MTEP15 report.[1]

- Business as Usual - The Business as Usual ("BAU") future captures all current policies and trends in place at the time of the futures development and assumes they continue, unchanged, throughout the duration of the study period. All existing, enforceable EPA regulations governing electric power generation, transmission and distribution (referred to as "NAICS 2211" by the EPA) are modeled. Demand and energy growth rates are modeled at a level equivalent

[1] *MISO Transmission Expansion Plan 2015*, p110 (available at):
https://www.misoenergy.org/Library/Repository/Study/MTEP/MTEP15/MTEP15%20Full%20Report.pdf

to the 50/50 forecasts submitted into MISO's Module E Capacity Tracking tool which is used by MISO to determine where new capacity resources are being developed to meet system resource adequacy needs. All current state-level Renewable Portfolio Standard ("RPS") and Energy Efficiency Resource Standard ("EERS") mandates are modeled. To capture the expected effects of the EPA's Mercury and Air Toxics Standards ("MATS") regulations on the coal fleet, 12.6 GW of coal unit retirements are modeled.

- Limited Growth - The Limited Growth ("LG") future is designed to capture the effects of the economy turning back toward recession-like levels. All current state-level RPS and EERS mandates are modeled. All existing, enforceable EPA regulations governing electric power generation, transmission and distribution (NAICS 2211) are modeled. To capture the expected effects of the MATS regulations on the coal fleet, 12.6 GW of coal power is retired.
- High Growth - The High Growth ("HG") future is designed to capture the effects of pre-recession level economic growth as well as an increase in renewable energy over the entire footprint. All current state-level RPS and EERS mandates are modeled. All existing, enforceable EPA regulations governing electric power generation, transmission and distribution (NAICS 2211) are incorporated, and 12.6 GW of coal power is retired.
- Generation Shift - The Generation Shift ("GS") future focuses on several key items that combine to result in a substantial shift in the main sources of energy in the MISO footprint: MISO assumes each non-coal and non-nuclear thermal generator will be retired in the year it reaches 50 years of age; hydro units will

retire in the year they reach 100 years of age; additional coal unit retirements are assumed; a $10/ton carbon cost is included; and a 20 percent footprint-wide renewable energy standard is assumed. These assumptions would result in system-wide energy sales derived from coal generation falling to 40 percent by the end of a 20-year study period. Finally, demand and energy growth rates are modeled at a mid-level and EERS goals and mandates are considered.

- Public Policy - The Public Policy (PP) future captures the effects of increased carbon regulations and an even greater move toward clean energy production and efficient use of resources. These assumptions would result in total energy sales derived from coal falling to 25 percent as a result of the combined effects of a cost on carbon emissions, coal unit retirements, and a 30 percent MISO-wide renewable mandate. Demand and energy growth rates are modeled at a mid-level, and EERS goals and mandates are considered.

These scenarios were developed and approved by MISO in MTEP15 prior to the current Clean Air Act Section 111(d) rule (i.e. the "Clean Power Plan") that the EPA has recently finalized. The biggest driver of coal retirements in the BAU, HG and LG scenarios is the EPA MATS. In the GS scenario, coal retirements are driven by the EPA MATS rule plus another 7 GW to aid in achieving the desired goal of reducing the amount of energy derived from coal to 40 percent by the end of the 20-year study period. MISO also considers additional retirements of generators in the GS future due strictly to their age. In the PP scenario, MISO considers EPA MATS plus other pending regulations such as Cooling Water Intake Structures and Coal Combustion Residuals.

Q. What other data assumptions were used in the economic analysis?

A. I made a few adjustments to the MTEP15 model and generation database before performing the simulations. These include the following:

- I utilized the preliminary MISO MTEP17 futures for gas prices, the most recent forecast published by MISO.
- I updated generation in Missouri to include heat rate and capacity information from a recent rate case by Ameren Missouri.[2] This data was specific to Ameren units, but was also used as proxy data to update similar units in Missouri and surrounding areas.
- I modeled additional, new transmission projects that are planned to be in service by 2022 but which were not included in the MTEP15 power flow models. These projects included:
    - a 345kV line from Duff-Coleman-Rockport in Indiana. The Duff-Coleman-Rockport 345 kV line was included in the base power flow model because this project is currently being competitively bid[3] and is anticipated to be in-service prior to the Grain Belt Express Project.
    - a 765 kV line from the point-of-interconnection of the Grain Belt Express Project with PJM (i.e. Sullivan) to the New Reynolds 765 kV substation in northwest Indiana. This project was included in the power flow model because it is a network upgrade that was identified by PJM for the Grain

[2] *Case No. ER-2012-0166, Direct Testimony of Mark J. Peters on Behalf of Ameren Missouri,* Schedule MJP-E1 (available at): https://www.efis.psc.mo.gov/mpsc/commoncomponents/viewdocument.asp?DocId=935666433

[3] *"MISO Issues RFP for First Competitive Transmission Project",* (available at): https://www.misoenergy.org/AboutUs/MediaCenter/PressReleases/Pages/MISOIssuesRFPforFirstCompetitiveTransmissionProject.aspx

Belt Express Project as discussed in the direct testimony of Grain Belt Express witness Dr. Wayne Galli.

- I incorporated several modifications to generator input assumptions in response to recommendations by PSC Staff.

Q. What modifications were made to the input assumptions of the PROMOD Analysis to incorporate recommendations from PSC Staff?

A. Leading up to filing of this case, I have discussed the input assumptions and methodology for this analysis with Staff on several occasions. I met with Staff on June 16, 2016 to discuss issues regarding the previous analysis conducted on behalf of Grain Belt Express in the 2014 Case, which are reflected in the following:

- *Staff recommended that Grain Belt Express should further test the effect of wind variability on the PROMOD analysis.* In response, the Grain Belt Express Analysis bounded the range of impacts on the production cost metrics due to the variability of wind by looking at more variable, as well as less variable wind profiles in two additional scenarios. In both additional scenarios the quantity of energy delivered to Missouri by the Project remained the same as the BAU scenario.
- *Staff recommended that the latest information related to the status of Ameren's Meramec power plant should be incorporated.* The latest Ameren Integrated Resource Plan describes a retirement plan for Meramec units three and four which suggests retirement by 2022. Thus these units have been retired in the PROMOD Analysis.
- *Staff recommended that heat rates for combined cycle, and gas and oil fired turbines should be non-linear and reflect the varying efficiency of different capacity states.* In response, the PROMOD Analysis uses non-linear heat rate curves for Ameren Missouri

units as found in their 2012 rate case to accurately reflect the production efficiencies gained with higher capacity states. I used these same, non-linear heat rate curves as representative for other power plants in Missouri.

- *Staff recommended that Grain Belt Express' projections for fuel prices reflect the latest projections.* In response, as previously discussed, the PROMOD Analysis utilized fuel price forecasts based on the latest MTEP17 futures. [4]
- *Staff recommended that demand side management (DSM), energy efficiency (EE), and increased distributed solar should be taken into account in the Missouri demand projections.* The load forecasts used for this study are based on MISO's MTEP15 load projections, which include the effects of increased DSM, EE, and BTM solar.

Q. Who else uses PROMOD to study the electricity market?

A. MISO, SPP, and PJM all use PROMOD in their transmission planning efforts. In addition, many of the utilities and power marketing entities transacting business within these RTO's use PROMOD as well.

Q. What metrics were developed in the PROMOD Analysis and what do they tell us about the Project?

A. PROMOD simulations provide several key metrics that were used to assess the economic benefits of the Grain Belt Express Project and the new wind generation it supports. These metrics include:

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[4] *MTEP17 Futures Development Workshop,* MISO, February 23, 2016, (available at): https://www.misoenergy.org/Library/Repository/Meeting%20Material/Stakeholder/Workshops%20and%20Special%20Meetings/2016/MTEP17%20Futures%20Development%20Workshops/20160223/20160223%20MTEP17%20Futures%20Development%20Workshop%20Presentation.pdf

- Adjusted Production Cost ($) – The total variable cost of generation plus the cost of energy purchases minus revenue from off-system sales (exports). This metric captures the ability for Missouri to recognize revenue from outside sales, as well as the costs associated with market purchases. It is a proxy for the cost to serve wholesale load within the State of Missouri.
- Demand Cost ($) – The hourly electrical demand (MWh) at each bus multiplied by the hourly LMP ($/MWh) at that bus summed over all Missouri buses for all hours. This represents the total cost for utilities to purchase wholesale energy to supply total Missouri annual demand under RTO settlement rules.
- Emissions Production (tons) – Total volume of emissions produced by generation units for sulfur dioxide ("SO2"), nitrogen oxide ("NOx"), and carbon dioxide ("CO2").

b. Modifications and additions to the 2014 Case analyses

Q. In what ways is the PROMOD Analysis different from the analysis that was conducted for the 2014 Case by Mr. Moland and Mr. Cleveland?

A. Aside from the updated assumptions in the PROMOD Analysis which I previously described, my PROMOD Analysis differed from the analysis in the 2014 Case in two additional ways:

  - I have modeled the recent transmission service contract between the Missouri Joint Municipal Electric Utility Commission ("MJMEUC") and Grain Belt Express.
  - I have modeled a representation of the ability for the Missouri converter station to both inject energy into and withdraw energy from Missouri, given the bi-

directional nature of HVDC as discussed in the direct testimony of Grain Belt Express witness Dr. Galli.

Q. How does the PROMOD analysis incorporate the contract between MJMEUC and Grain Belt Express?

A. MJMEUC and Grain Belt Express have entered into an agreement whereby MJMEUC will purchase 200 MW of transmission service on the Grain Belt Express Project between Kansas and Missouri. The PROMOD Analysis accounts for the transmission service contract by modeling the ability of MJMEUC to source low-cost power from Kansas wind farms, which is delivered to Missouri from the Grain Belt Express Project. This low-cost source of power affects the APC metric by reducing the cost of generation to serve load in Missouri. For modeling Grain Belt Express' delivered wind power in the APC metric, I used the levelized cost of energy estimate from Section IV.b in Mr. David Berry's direct testimony. Specifically, I used the "first mover" levelized cost for the 200 MW of the MJMEUC contract, and the "normal rate" levelized cost for the remaining 300 MW of delivered power to Missouri.

Q. Does the bi-directionality of the Missouri converter station impact the PROMOD analysis?

A. Yes. The Missouri converter station will allow up to 500 MW of MISO to PJM service. In accordance with the MJMEUC agreement, up to 50 MW of MISO to PJM service is reserved for MJMEUC customers. However, the remaining 450 MW is available for other MISO customers to sell excess power into PJM using the Grain Belt Express Project. This capability provides an opportunity for Missouri utilities to sell excess generation to PJM, earning excess revenue which can be used to offset other costs.

c. Results of the Economic Analysis

Q. What were the results of the PROMOD Analysis?

A. Please refer to **Schedule JNC-2** for adjusted production cost, demand cost, locational marginal prices, and emissions production.

Q. Please summarize the results of the PROMOD Analysis of the Grain Belt Express Project and interconnected wind generation.

A. In each of the scenarios simulated, reductions in adjusted production cost, average generator LMPs, and emissions production were observed with the Grain Belt project. Demand cost and average load LMP reductions were observed in all but one scenario. The demand cost and average load LMPs increased slightly (0.05% and 0.04%, respectively) in the High Growth scenario.

Q. Are the impacts of the Grain Belt Express Project and the interconnected wind facilities from the simulated year 2022 also representative of the impacts to be expected in other future years?

A. Yes. The five scenarios of input assumptions from MTEP15 cover a wide range of potential changes to the electric grid. The wide range of inputs assures that the analysis is robust in many different future scenarios, even if these scenarios do not materialize until after 2022.

III. DATA PROVIDED TO GRAIN BELT EXPRESS WITNESS ED PFEIFFER

Q. Please describe the data and data sources that you provided to Grain Belt Express witness Edward C. Pfeiffer for his reliability analyses.

A. Mr. Pfeiffer performed Loss of Load Expectation ("LOLE") analyses to determine the incremental reliability benefit to Missouri with the inclusion of the Grain Belt Express

Project. For this work, I provided Mr. Pfeiffer a forecasted hourly load profile for all of Missouri in the year 2022. I used the same load forecast as in my BAU scenario. The source of this load forecast is the MTEP15 load forecast. In order to provide Mr. Pfeiffer a single profile for the state of Missouri, I summed all of the Missouri load buses in PROMOD to yield a single, statewide load figure for each hour.

In addition, I provided Mr. Pfeiffer a list of generation units and certain operating characteristics of these units. Included in this list are all units in Missouri, as well as other units serving Missouri load which are listed, in aggregate by utility, in Table 3-1 of Mr. Pfeiffer's LOLE Report (Schedule ECP-1). For each generation unit, I provided Mr. Pfeiffer with certain operating characteristics, including, on a unit-specific basis: maximum nameplate capacity, forced outage rate, and average maintenance outage duration. The source of this data is the MTEP15 PROMOD database.

Q. Does this conclude your prepared direct testimony?

A. Yes, it does.

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

In the Matter of the Application of Grain Belt Express Clean Line LLC for a Certificate of Convenience and Necessity Authorizing it to Construct, Own, Control, Manage, Operate and Maintain a High Voltage, Direct Current Transmission Line and an Associated Converter Station Providing an Interconnection on the Maywood-Montgomery 345 kV Transmission Line	)))))))	Case No. EA-2016-0358

AFFIDAVIT OF J. NEIL COPELAND

STATE OF Georgia)
) ss
COUNTY OF Cobb)

J. Neil Copeland, being first duly sworn on his oath, states:

1. My name is J Neil Copeland. I am a Managing Director in the Power Supply Group at GDS Associates, Inc.

2. Attached hereto and made a part hereof for all purposes is my Direct Testimony on behalf of Grain Belt Express Clean Line LLC consisting of 21 pages, having been prepared in written form for introduction into evidence in the above-captioned docket.

3. I have knowledge of the matters set forth therein. I hereby swear and affirm that my answers contained in the attached testimony to the questions therein propounded, including any attachments thereto, are true and accurate to the best of my knowledge, information and belief.

J N Copeland
J. Neil Copeland

Subscribed and sworn before me this 25th day of August, 2016.

Faye H. Culpepper
Notary Public

My commission expires: March 3, 2018

FAYE H. CULPEPPER NOTARY PUBLIC GEORGIA EXPIRES MARCH 3, 2018 COBB COUNTY

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J. NEIL COPELAND, P.E.

Managing Director

EDUCATION

Bachelor of Mechanical and Nuclear Engineering, Georgia Institute of Technology (Georgia Tech), Atlanta, GA, 1994

SUMMARY

Mr. Copeland brings more than 16 years of experience in testimony, preparing energy and capacity price forecasts, providing detailed assessments of market fundamentals, analyzing transmission investment, providing nodal congestion and curtailment analysis, developing integrated resource plans, managing data gathering and price forecasting databases, and performing asset valuations for various power plants. Mr. Copeland has supported project development and financing for construction of new generation, acquisition, divestiture, refinancing, and bankruptcy proceedings. Mr. Copeland has completed numerous consulting engagements for diverse stakeholders, including regulatory agencies, project developers, load-serving entities, generating companies, private equity and investment banks. Mr. Copeland also has extensive experience with the use of commercial price forecasting tools such as the ABB/Ventyx *MarketPower* and *PROMOD IV* software.

EXPERIENCE

- Provided gross margin analysis and long term power price forecasts for power plants located in many areas of the United States and Canada. The analyses examine the current and future market structure and market demand in these areas. All aspects were included in these studies, including, but not limited to, transmission analysis and upgrades, new entrants into the market, retirements, fuel consumption, emissions controls and technology, and any potential EPA requirements that may affect the forecast. Types of projects and locations are listed below:
  - Combined cycle, peaking, and coal power plants located in WECC (AZ, NM, CO, CA, WA, MT), ERCOT (TX), SPP (TX), Southern (GA), Carolinas (SC, NC), NYISO (Zone C, F, G, J, K), ISONE (ME, MA, RI, NH), PJM (IL, PA, NJ, MD, VA), MISO (IL, IA, MI, KY, IN), Ontario, and New Brunswick.
- Provided forecast and gross margin projections for the development and financing of wind projects in multiple areas of the United States. The forecasts included energy, capacity, and renewable energy credit (REC) prices, as well as the subsequent gross margins based on these prices. In addition, scenarios were produced for high and low carbon pricing, high and low fuel costs, and high and low capital costs for generic resources entering the system.
  - Wind plants located in ERCOT (TX), SPP (TX, KS), ISONE (NH, ME), PJM (IL, MD), MISO (MN, IL)
- Provided short term (1-5 year) security constrained economic dispatch (SCED) analysis for the potential purchase, sale, refinancing or operational analysis of power plants within the United States. The SCED analysis examined the future market structure and market demand in the respective markets, including major backbone transmission additions that could affect the operation of the assets. Projections of market energy prices, unit production, curtailment, and key congestion facilities for the project node were provided, as well as revenue projections, performance projections, and projected gross margins.

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  - Thermal and wind plants located in WECC (CA), ERCOT (TX), SPP (TX, KS, NE), NYISO (Zone J), PJM (IL, PA, NJ, MD, VA, OH), MISO (IL, IA, KY) and Alberta.

- Other notable experience also includes a position as a Senior Reactor Operator at the Georgia Tech steady state 5 MW nuclear research reactor, nuclear non-proliferation work inside North Korea, an engineer for the manufacturing of the reactor cores used by the US Navy, and sales for an IT start-up company.

Previous Employment

Black & Veatch Management Consulting, LLC, 2011 – April 2016
Managing Director

R. W. Beck, Inc., 2008 - 2011
Manager, Power Markets

Navigant Consulting, 2007 – 2008
Managing Consultant

ABB/New Energy Associates, 2001 – 2007
Manager and Lead Consultant

Missouri Adjusted Production Cost ($mm)
in 2022

	Business As Usual	Limited Growth	High Growth	Generation Shift	Public Policy
Without Grain Belt	1,951	1,469	2,432	2,499	5,274
With Grain Belt	1,911	1,453	2,369	2,424	5,051
Savings	*40*	*16*	*63*	*76*	*223*

Wind Volatility Sensitivity

	Business As Usual	*Savings*
Without Grain Belt	1,951	
High Wind Volatility	1,911	*40*
Med Wind Volatility	1,911	*40*
Low Wind Volatility	1,911	*40*

Missouri Demand Cost ($mm)
in 2022

	Business As Usual	Limited Growth	High Growth	Generation Shift	Public Policy
Without Grain Belt	3,333	2,649	5,593	4,295	7,516
With Grain Belt	3,321	2,614	5,596	4,250	7,513
Savings	*12*	*35*	*(3)*	*45*	*2*

Wind Volatility Sensitivity

	Business As Usual	*Savings*
Without Grain Belt	3,333	
High Wind Volatility	3,320	*13*
Med Wind Volatility	3,321	*12*
Low Wind Volatility	3,320	*14*

Missouri Average LMPs ($/MWh)
in 2022

MO Generation Hub LMP		Business As Usual	Limited Growth	High Growth	Generation Shift	Public Policy
Without Grain Belt	On Peak Average	39.70	34.46	63.54	52.18	89.55
Without Grain Belt	Off Peak Average	32.92	27.21	49.19	42.86	80.27
Without Grain Belt	All Hours Average	36.16	30.66	56.03	47.30	84.69
With Grain Belt	On Peak Average	39.59	33.87	63.64	51.50	89.56
With Grain Belt	Off Peak Average	32.72	26.80	48.91	42.49	79.93
With Grain Belt	All Hours Average	36.00	30.16	55.92	46.79	84.51
Change in LMP	*On Peak Average*	*-0.11*	*-0.60*	*0.10*	*-0.68*	*0.01*
Change in LMP	*Off Peak Average*	*-0.20*	*-0.41*	*-0.29*	*-0.37*	*-0.35*
Change in LMP	*All Hours Average*	*-0.16*	*-0.50*	*-0.11*	*-0.51*	*-0.18*

MO Load Hub LMP		Business As Usual	Limited Growth	High Growth	Generation Shift	Public Policy
Without Grain Belt	On Peak Average	41.18	35.83	66.18	54.10	92.41
Without Grain Belt	Off Peak Average	34.06	28.21	51.31	44.33	82.53
Without Grain Belt	All Hours Average	37.46	31.84	58.39	48.99	87.23
With Grain Belt	On Peak Average	41.10	35.35	66.47	53.41	92.57
With Grain Belt	Off Peak Average	33.86	27.85	51.10	43.92	82.25
With Grain Belt		37.31	31.42	58.42	48.44	87.16
Change in LMP	*On Peak Average*	*-0.07*	*-0.48*	*0.30*	*-0.69*	*0.15*
Change in LMP	*Off Peak Average*	*-0.21*	*-0.36*	*-0.21*	*-0.41*	*-0.28*
Change in LMP	*All Hours Average*	*-0.14*	*-0.42*	*0.03*	*-0.55*	*-0.07*

Wind Volatility Sensitivity

MO Generation Hub LMP		Business As Usual	*Change in LMP*
Without Grain Belt	All Hours Average	36.16	
High Wind Volatility	All Hours Average	35.98	*-0.17*
Med Wind Volatility	All Hours Average	36.00	*-0.16*
Low Wind Volatility	All Hours Average	35.99	*-0.17*

MO Load Hub LMP		Business As Usual	*Change in LMP*
Without Grain Belt	All Hours Average	37.46	
High Wind Volatility	All Hours Average	37.30	*-0.16*
Med Wind Volatility	All Hours Average	37.31	*-0.15*
Low Wind Volatility	All Hours Average	37.30	*-0.16*

Systemwide emissions (short tons)
in 2022

		Business As Usual	Limited Growth	High Growth	Generation Shift	Public Policy
Without Grain Belt	CO_2	1,601,540,578	1,498,806,074	1,717,063,291	1,561,815,245	1,295,415,276
Without Grain Belt	NO_X	1,680,673	1,599,984	1,781,492	1,619,695	1,175,250
Without Grain Belt	SO_2	1,905,495	1,842,896	1,978,100	1,818,555	1,179,587
With Grain Belt	CO_2	1,588,558,950	1,486,083,410	1,704,904,268	1,549,463,441	1,275,936,800
With Grain Belt	NO_X	1,668,381	1,586,930	1,772,294	1,609,392	1,153,275
With Grain Belt	SO_2	1,895,357	1,832,559	1,968,639	1,808,532	1,154,281
Emissions reduction	CO_2	*12,981,628*	*12,722,664*	*12,159,022*	*12,351,804*	*19,478,476*
Emissions reduction	NO_X	*12,292*	*13,054*	*9,198*	*10,304*	*21,975*
Emissions reduction	SO_2	*10,138*	*10,337*	*9,461*	*10,023*	*25,306*

Wind Volatility Sensitivity

		Business As Usual	*Emissions reduction*
Without Grain Belt	CO_2	1,601,540,578	
High Wind Volatility	CO_2	1,588,546,756	*12,993,822*
Med Wind Volatility	CO_2	1,588,558,950	*12,981,628*
Low Wind Volatility	CO_2	1,588,579,146	*12,961,432*

		Business As Usual	*Emissions reduction*
Without Grain Belt	NO_X	1,680,673	
High Wind Volatility	NO_X	1,668,032	*12,641*
Med Wind Volatility	NO_X	1,668,381	*12,292*
Low Wind Volatility	NO_X	1,668,319	*12,355*

		Business As Usual	*Emissions reduction*
Without Grain Belt	SO_2	1,905,495	
High Wind Volatility	SO_2	1,895,350	*10,145*
Med Wind Volatility	SO_2	1,895,357	*10,138*
Low Wind Volatility	SO_2	1,895,350	*10,145*