Exhibit No.:	
Issues:	Safety Interconnection Studies
Witness:	Shawn E. Lange
Sponsoring Party:	MO PSC Staff
Type of Exhibit:	Rebuttal Testimony
Case No.:	EA-2014-0207
Date Testimony Prepared:	September 15, 2014

MISSOURI PUBLIC SERVICE COMMISSION

REGULATORY REVIEW DIVISION

REBUTTAL TESTIMONY

OF

SHAWN E. LANGE

GRAIN BELT EXPRESS CLEAN LINE LLC

CASE NO. EA-2014-0207

Jefferson City, Missouri
September 2014

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, Operate, Control, Manage, 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-2014-0207

AFFIDAVIT OF SHAWN E. LANGE

STATE OF MISSOURI)
) **ss**
COUNTY OF COLE)

Shawn E. Lange, of lawful age, on his oath states: that he has participated in the preparation of the following Rebuttal Testimony in question and answer form, consisting of 17 pages of Rebuttal Testimony to be presented in the above case, that the answers in the following Rebuttal Testimony were given by him; that he has knowledge of the matters set forth in such answers; and that such matters are true to the best of his knowledge and belief.

Shawn E. Lange
Shawn E. Lange

Subscribed and sworn to before me this 15th day of September, 2014.

Susan L. Sundermeyer
Notary Public

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REBUTTAL TESTIMONY

OF

SHAWN E. LANGE

GRAIN BELT EXPRESS CLEAN LINE LLC

CASE NO. EA-2014-0270

REBUTTAL TESTIMONY

OF

SHAWN E. LANGE

GRAIN BELT EXPRESS CLEAN LINE LLC

CASE NO. EA-2014-0270

Q. Please state your name and business address.

A. My name is Shawn E. Lange and my business address is Missouri Public Service Commission, P.O. Box 360, Jefferson City, MO 65102.

Q. What is your present position with the Missouri Public Service Commission (Commission)?

A. I am a Utility Engineering Specialist III in the Engineering Analysis Section, Tariff, Safety, Economic and Engineering Analysis Department, Regulatory Review Division.

Q. Would you please review your educational background and work experience.

A. In December of 2002, I received a Bachelor of Science Degree in Mechanical Engineering from the University of Missouri, at Rolla. I joined the Commission Staff ("Staff") in January 2005. I am a registered Engineer-in-Training in the State of Missouri. A copy of my credentials and case experience is attached as Schedule SEL-1.

Q. What is the purpose of your rebuttal testimony?

A. I discuss the safety aspects of Electric and Magnetic Fields ("EMF") and storm restoration plans, as well as the results of the Midwest Independent System Operator ("MISO") feasibility study, Southwest Power Pool ("SPP") Dynamic Stability Assessment of Grain Belt Express Clean Line HVDC Project, SPP Steady State Review, SPP System Impact Study, and Pennsylvania, New Jersey and Maryland Regional Transmission Organization

("PJM") feasibility study currently performed for the requested transmission line and converter stations for which Grain Belt Express is seeking a Certificate of Convenience and Necessity ("CCN") from this Commission ("Application").

Q. If the Commission grants Grain Belt Express a CCN for this transmission line project, is Staff recommending that the Commission impose any conditions on that CCN?

A. Yes. Staff witness Dan I. Beck is presenting all of Staff's recommended conditions in his rebuttal testimony. Some of those conditions are that certain items be completed. Others are that certain items be brought back to the Commission for Commission approval (or acceptance) prior to any condemnation of Missouri real property. Staff and other parties to this case should be given an opportunity for review and comment on these items requiring Commission approval (or acceptance).

Q. Which of Staff's recommended conditions are you sponsoring?

A. (1) Staff recommendations that the Commission order Grain Belt Express to provide for Commission acceptance, the following items:

- Completed Storm Restoration Plans for the proposed project,
- The Interconnection Agreement with SPP,
- The Interconnection Agreement with MISO, and
- The Interconnection Agreement with PJM,
- MISO Feasibility Study,
- MISO System Planning Phase Study,
- MISO Definitive Planning Phase Study,
- SPP Dynamic Stability Assessment of Grain Belt Express Clean Line HVDC Project,
- SPP Steady State Review,
- SPP System Impact Study,
- PJM Feasibility Study,
- PJM System Impact Study,
- PJM Facilities Study, and
- Any further study necessary for interconnection with any of SPP, MISO, or PJM.

and

(2) that the Commission order Grain Belt Express to comply with the appropriate NERC standards for a project of this scope and size[1], National Electric Safety Code for a project of this scope and size, 4 CSR 240-18.010, and the Overhead Power Line Safety Act section 319.075 et al.;

(3) Staff's recommendation that the Commission order Grain Belt Express to provide to the Commission completed, documentation of the Grain Belt Express plan, equipment, and engineering drawings to achieve compliance with NERC standards for a project of this scope and size, National Electric Safety Code for a project of this scope and size, 4 CSR 240-18.010, and the Overhead Power Line Safety Act section 319.075 et al.;

(4) Staff's recommendation that the Commission order Grain Belt Express to meet a short-circuit ratio of at least two, at the Kansas converter station, Missouri converter station, and the converter station near Sullivan, Indiana; and

(5) Staff's recommendation that the Commission order Grain Belt Express to provide to the Commission as completed, documentation of the Grain Belt Express plan, equipment, and engineering drawings to achieve a short-circuit ratio of at least two, for each converter station.

ELECTRIC AND MAGNETIC FIELDS ("EMF")

Q. What are Electric and Magnetic Fields?

A. Electric fields are areas around a charge that act or exert a force upon other charged objects. Magnetic fields result from the flow of current through a conducting material. The transmission of electricity inherently results in the creation of both types of fields.

Q. Has anyone studied the health effects associated with EMF?

[1] Dr. Galli Direct pp. 10 lines 3- 10

A. Yes.

Q. What is static EMF?

A. Static EMF is a result of the physical characteristics of a DC transmission line. In alternating current transmission lines, the flow of the electric charge alternates with a frequency of sixty hertz. In a DC or direct current line, the flow of the electric charge does not reverse direction and is therefore static.

Q Have any studies shown significant correlation between static EMF and negative health effects?

A. Yes. The following studies show correlation between static EMF and health effects:

- The Influence of Static Electric Field Generated Nearby High Voltage Direct Current Transmission Lines on Hormonal Activity of Experimental Animals EHE' 07 – 2nd International Conference on Electromagnetic Fields, Health and Environment Wroclaw, Poland, September 10-12, 2007[2]
- Bioinitive 2012, A Rationale for Biologically based Exposure Standards for Low-Intensity Electromagnetic Radiation

Q. At the Moberly Local Public Hearing ("LPH") a witness stated "In fact, the EPA and the World Health Organization have ruled EMF as a Class 2-B carcinogen"[3]. Did you review the World Health Organization "ruling"?

A. Yes, the World Health Organization (WHO) and International Agency on Cancer Research (IACR) have classified radiofrequency electromagnetic field as a Group 2B carcinogen.[4]

Q What is a Group 2B carcinogen?

[2] Concluded EMF levels of greater than 16kV/m stimulated the excretion of insulin and thyroid hormone while decreasing the corticosterone level.
[3] Transcript Moberly Local Public Hearing; Ms. Smith pp. 47 line 13-14
[4] http://www.iarc.fr/en/media-centre/pr/2011/pdfs/pr208_E.pdf pp. 1 accessed 8/24/2014

A. A Group 2B carcinogen is a type of agent that has "limited evidence of carcinogenicity" in humans and "evidence of carcinogenicity" in animals or vice versa.[5]

Q. What is "limited evidence of carcinogenicity"?

A. WHO defined it as: "A positive association has been observed between exposure to the agent and cancer for which a causal interpretation... is... credible, but chance, bias or confounding could not be ruled out with reasonable confidence."[6]

Q. What is "evidence of carcinogenicity"?

A. WHO defined it as: "...a causal relationship has been established between exposure to the agent and human cancer."[7]

Q. Are there any studies with contrary results?

A. Yes, there are studies that indicate the correlation between static EMF and negative long-term health effects is tenuous at best. As shown in Grain Belt Express witness Galli's direct[8] testimony, the following studies do not conclude EMF causes long-term health effects.

- International Agency for Research on Cancer, IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Vol. 80: Static and Extremely Low-Frequency (ELF) Electric and Magnetic Fields (Lyon, France, IARC Press, 2002).
- National Radiological Protection Board (NRPB), Advice on Limiting Exposure to Electromagnetic Fields (0-300 GHz), Vol. 15, No. 2 (Didcot, UK, 2004).
- World Health Organization, Environmental Health Criteria Monograph No. 232. Static Fields (Geneva, Switzerland, World Health Organization, 2006).
- International Committee on Electromagnetic Safety, IEEE Standard for Safety Levels with Respect to Human Exposure to Electromagnetic Fields 0 to 3 kHz C95.6-2002 (Piscataway, NJ, IEEE, 2002) (Reaffirmed 2007).
- Advisory Group on Non-ionizing Radiation, Static Magnetic Fields, RCE-6, Documents of the Health Protection Agency (Chilton, UK, 2008).
- International Commission on Non-ionizing Radiation Protection, Guidelines on Limits of Exposure to Static Magnetic Fields, Health Physics, 96:504-514 (2009).

[5] http://monographs.iarc.fr/ENG/Preamble/CurrentPreamble.pdf pp. 23
[6] http://monographs.iarc.fr/ENG/Preamble/CurrentPreamble.pdf pp. 19-20
[7] http://monographs.iarc.fr/ENG/Preamble/CurrentPreamble.pdf pp. 19
[8] Galli Direct pp 22 footnotes 7-12

Q. What does the WHO say about the long-term health effects of EMF?

A. The WHO has stated, "Despite many studies, the evidence for any effect remains highly controversial. However, it is clear that if electromagnetic fields do have an effect on cancer, then any increase in risk will be extremely small. The results to date contain many inconsistencies, but no large increases in risk have been found for any cancer in children or adults."[9]

Q. Does Staff have a recommendation to the Commission regarding the impact of the EMF of the proposed line and converter station in Missouri on health?

A. The possible health effects of EMF is a topic that is brought up in nearly every line certificate case. While not precedent, the Commission has granted line certificates in Case Nos. EA-2007-0319, EA-2002-0131, EA-2013-0089 and EO-2002-0351, among others. Staff recommends the Commission not reject the Application on the basis of public concerns about the impact of EMF on health.

EMERGENCY RESTORATION PLAN

Q. Did Staff inquire into issues related to unanticipated damage to the line or Missouri converter station caused by storms or other events?

A. Staff requested that Grain Belt Express provide copies of its storm restoration plan, contracts for mutual aid, and contracts for additional equipment that may be needed for storm response and other events.

Q. Has Grain Belt Express developed a storm restoration plan for the requested project?

[9] http://www.who.int/peh-emf/about/WhatisEMF/en/index1.html

A. No, Grain Belt Express does not have a storm restoration plan at this time.[10] Grain Belt Express expects to develop one after final engineering is complete.

Q. Does Grain Belt Express have mutual aid contracts[11]?

A. No, Grain Belt Express has not entered into any mutual aid contracts at this time.[12]

Q. Has Grain Belt Express entered into contracts for additional equipment to be used for responses to emergencies?

A. No, Grain Belt Express has not entered into any contracts for additional equipment needed for emergency response.[13]

Q. What is Staff's recommendation to the Commission regarding storm or other event safety?

A. Staff recommends that any Granting of a Certificate of Convenience and Necessity be conditioned on Grain Belt Express providing the Storm Response Plan to the Commission.

ADDITIONAL SAFETY ASPECTS

Q. At the LPH in Moberly a witness testified that "when the DC (Direct Current) line breaks, the line is dead before it hits the ground."[14] Do you agree with this testimony?

A. Typically when a line breaks the safety measures of the line then act to de-energize the line. So depending on how far down the line the break is and how long it took the safety measures to detect and act on the break, it is possible that the DC line will be

[10] Response to Staff Data Request 46
[11] Mutual Aid Contracts are contracts between Investor-owned utilities or municipal and cooperative utilities to mutually aid any other contractually obligated utility help restore power.
[12] Responses to Staff Data Requests 62 and 63
[13] Response to Staff Data Request 56
[14] Transcript Marceline Local Public Hearing; Mr. Niedholdt pp. 59 lines 20-21

de-energized before it hits the ground; however, Staff recommends the public never approach any type of downed power line.

Q. In addition to physical issues, are there cyber security issues?

A. Yes. Cyber security issues are dealt with by the FERC. On January 18, 2008, the FERC passed the NERC Critical Infrastructure Protection ("CIP") cyber security reliability standards.

Q. Did Staff inquire into any other areas of safety related to the project that might be concerns the Commission should address in this case?

A. Yes. Please see Staff witness Robert R. Leonberger's rebuttal testimony.

STUDIES

Q. Have interconnection-related studies been performed concerning the proposed line and converter stations?

A. Yes. Currently the following studies have been performed:

- SPP
  - Dynamic Stability Assessment of Grain Belt Express Clean Line HVDC Project
  - Steady State Review
  - System Impact Study
- MISO
  - Feasibility Study
- PJM
  - Feasibility Study

Q. Have any of the completed studies caused Staff to have concerns?

A. Yes. The Dynamic Stability assessment of the Grain Belt Express HVDC project includes the following table of short-circuit ratio in Kansas. Kansas City Power and Light Company ("KCPL") has three wind farms near Spearville, Kansas. Spearville, Kansas, is in Ford County, Kansas, where Grain Belt Express intends to start the transmission line. Any weakness of the system there can impact the wind farms of KCPL. The short-circuit

ratio is shown in Table 1[15] below (SCR in the table); the "without SC" and "with SC" indicate the results with Synchronous Condensers[16] and without.

	Without SC		With SC	
ClarkCo - 539800	Fault MVA	SCR'	Fault MVA	SCR'
2017 LL	4844.48	1.21	8406.06	2.10
2017 SP	5471.96	1.37	9034.25	2.26
2022 SP	5950.93	1.49	9514.52	2.38

1. SCR calculated for a wind capacity of 4,000 MW

Table 1 **Short Circuit Ratio at Clark County**

Q. What is a short-circuit ratio?

A. The short-circuit ratio is the ratio of the system short-circuit fault level MVA[17] to the MWs of DC power.

Q. What does a short-circuit ratio of less than two (2) indicate?

A. According to a Competitive Renewable Energy Zones reactive study of a project that would include a HVDC transmission line to transmit power generated from wind farms in western Texas to the load centers of Dallas, San Antonio, and Austin, a short-circuit ratio of less than two (2) indicates a weak interconnection point[18]. Also according to Preliminary Evaluation of the System Compatibility of a HVDC Transmission Alternative for the Beseck - East Devon Segment of the Middletown-Norwalk Transmission Project, "An SCR less than 2.0 is considered "very low" and an SCR between 2.0 and 3.0 is defined as "low" in IEEE Standard 1204-1997[2]"[19]

Q. What is the significance of a low short-circuit ratio?

[15] Dynamic Stability assessment of Grain Belt Express Clean Line HVDC project pp. 2-8
[16] DC power is asynchronous, the addition of synchronous condensers is an assumption in modeling to allow continued modeling of the bulk electric system without having final engineering complete.
[17] The physical limit of the AC bus that is connected to the DC converter station.
[18] Dynamic Stability assessment of Grain Belt Express Clean Line HVDC project pp. 2-8
[19] http://www.ct.gov/csc/lib/csc/docket_272/nh1-479183-v1-hvdc_system_compatibility_report.pdf pp, 2-3

A. The most concerning aspects of a low short-circuit ratio are:

- Voltage/power instability
- High temporary over-voltages[20]
- Low-frequency resonances
- Long restart times
- Commutation failures[21]

Generally, both AC to DC and DC to AC systems that have low short-circuit ratios tend to have a higher probability of poorer performance, and if a fault occurs respond more slowly from and to the faulted condition.

Q. Can short-circuit ratios be improved?

A. Yes. IEEE[22] and Cigre[23] have studied this issue and have guides on planning DC connections to weak AC grids. For example:

- Wind generators could reduce the active power generated.
- Static Compensators could be used to supply reactive power.

Q. Does Grain Belt Express have a plan to remedy the low short-circuit ratio in Kansas?

A. No. Grain Belt Express has stated that would be completed in the detailed engineering analysis of the converter stations, but this analysis has not been completed.[24]

Q. What are the short-circuit ratios for the converter station in Missouri and the converter station near Sullivan, Indiana?

[20] Overvoltage is an increase in the AC voltage Root Mean Square (RMS), typically to 110% - 120% of nominal, at the power frequency for duration longer than 1 minute.
[21] Commutation Failure is when the current fails to transition from valve to valve (Commutation), typically due to an AC grid disruption.
[22] 'IEEE guide for planning DC links terminating at AC locations having Low Short-Circuit capacities', IEEE Std 1204-1997.
[23] Guide for planning DC links terminating at AC locations having Low Short-Circuit capacities – Part I: AC/DC interaction phenomena', CIGRÉ working group 14.07, Report 68, June 1992.
[24] Response to Staff Data Request 145

A. The studies have not been completed to determine the short-circuit ratio values for the converter station interconnection in Missouri or the converter station interconnection near Sullivan, Indiana.

Q. Does Staff have a recommendation to the Commission regarding short-circuit ratios?

A. Staff recommends that the Commission order Grain Belt Express to meet a short-circuit ratio, of two or more, at the Kansas converter station, Missouri Converter station, and the converter station near Sullivan Indiana. Staff recommends that the Commission order Grain Belt Express to provide to the Commission as completed, documentation of the Grain Belt Express plan, equipment, and engineering drawings to achieve a short-circuit ratio of at least two, for each converter station.

Q. Does Staff have other concerns with the project as described in the Application based on the results of the completed MISO, SPP and PJM studies?

A. Yes, Staff has concerns with the results of the MISO Steady State review study.

Q. What are those concerns?

A. The location of Grain Belt Express' requested Missouri converter station currently has congestion issues. Ameren Missouri's Audrain CT plant currently has a Special Protection Scheme ("SPS")[25] such that upon high thermal level experienced by the Palmyra substation, the plant's total output would be reduced approximately thirty MWs[26]. MISO has studied and developed a series of projects to relieve existing transmission constraints and relieve congestion known as the Multi-Value Projects (MVP) Portfolio. MVPs are planned

[25] Ameren's Transmission Planning, Criteria and Guidelines; Revised March 14, 2014 pp. 7
[26] Ameren 2011 Integrated Resource Plan (IRP) Chapter 4 pp. 5

for northeastern Missouri that should address the existing congestion issue as well as other issues. A map showing these projects is shown in Schedule SEL-2-2. This MISO MVP portfolio will[27]:

- Provide benefits in excess of its costs under all scenarios studied, with its benefit to cost ratio ranging from 1.8 to 3.0;
- Maintain system reliability by resolving reliability violations on approximately 650 elements for more than 6,700 system conditions and mitigating 31 system instability conditions;
- Enable 41 million MWh of wind energy per year to meet renewable energy mandates and goals;
- Provide an average annual value of $1,279 million over the first 40 years of service, at an average annual revenue requirement of $624 million; and
- Support a variety of generation policies by using a set of energy zones which support wind, natural gas and other fuel sources.

As studied, Grain Belt Express' project induced thermal overloads in MISO. Upon including certain MISO MVPs in the modeling, all overloads were eliminated. These MVPs consisted of[28]:

- The Ottumwa to West Adair 345kV line
- The West Adair 345/161kV transformer
- The Palmyra Tap-Palmyra 345kV line
- The Quincy to Meredosia to Pawnee to Pana to Mt Zion to Kansas to Sugar Creek 345kV line(s)
- The 345/138kV transformers at Quincy, Pawnee, Pana, and Mt Zion

Q. If all overloads were eliminated, what is Staff's concern?

A. The MVPs are scheduled to come on line in segments. The following is the timeline[29]:

- The New Palmyra Tap substation will be ready by November 2016;
- The Ottumwa to West Adair 345 kV line and West Adair substation work will be ready by June 2017;
- The West Adair to Palmyra 345 kV line and West Adair 345/161 kV transformer will be ready by November 2018;

[27] MISO Multi Value Project Portfolio Results and Analyses January 10, 2012 pp. 1
[28] http://www.grainbeltexpresscleanline.com/sites/grain_belt/media/docs/Webinar-GBX_Steady_State_Results-February_2013_web.pdf pp. 32
[29] MISO Multi Value Project Portfolio Results and Analyses January 10, 2012 pp. 31-34

- The Palmyra Tap switching station to Quincy to Meredosia 345 kV line and the Quincy and Pawnee 345/138kV transformers will be ready by November 2016;
- The Ipava substation upgrades for new 345 kV connection from Meredosia will be ready by June 2017;
- The Meredosia to Ipava and Meredosia to Pawnee 345 kV lines will be ready by November 2017;
- Kansas to Sugar Creek 345 kV Line will be ready by November 2019; and
- All other components will be in service by November 2018.

Grain Belt Express is scheduled to become commercially operational in 2018[30]. The Kansas to Sugar Creek 345 kV line will be operational by November 2019 and any delay in any of the MVPs could impact Grain Belt Express and what may be deliverable to Missouri utilities or the total cost of the MVPs.

Q. Does Staff have concerns with the results of any of the other completed MISO studies?

A. Yes, please see Staff witness Michael L. Stahlman's rebuttal testimony.

Q. What concerns does Staff have based on completed SPP studies?

A. The SPP System Impact Study did not include additional planned wind within the SPP footprint area and if the special protection schemes are not acceptable, other solutions must be found[31]. These other solutions may include reducing the amount of the wind generation or building additional transmission lines.

Q. What are special protection schemes?

A. Special protection schemes, also known as special protection systems, also known as remedial action schemes, are defined by NERC as: "An automatic protection system designed to detect abnormal or predetermined system conditions, and take corrective actions other than and/or in addition to the isolation of faulted components to maintain system

[30] http://www.grainbeltexpresscleanline.com/site/page/schedule
[31] Dr. Galli Direct; Schedule AWG-4; pp. 39

reliability. Such action may include changes in demand, generation (MW and Mvar), or system configuration to maintain system stability, acceptable voltage, or power flows."[32]

Q. How would the inclusion of planned wind energy affect the SPP System Impact Study results?

A. It is unclear how or to what degree the additional wind energy would affect them.

Q. Does Staff have concerns with the results of any of the other completed SPP or PJM studies?

A. Yes, Please see Staff witnesses Michael L. Stahlman's rebuttal testimony.

Q. Given Staff's concerns with the SPP, MISO and PJM studies that have been completed, and that additional and more rigorous studies are not yet completed[33], does Staff recommend the Commission impose any condition, or conditions, to the issuance of any CCN to Grain Belt Express in this case?

A. Yes. MISO, SPP, and PJM will require additional studies, and the studies that have not yet been undertaken will be more detailed and rigorous than the studies that Grain Belt Express has presented to date. Staff recommends that the Commission order Grain Belt Express to provide all of the results of the studies that are required for interconnection with SPP, MISO, and PJM. To Staff's knowledge, those studies are:

- MISO Feasibility Study,
- MISO System Planning Phase Study,
- MISO Definitive Planning Phase Study,
- SPP Dynamic Stability Assessment of Grain Belt Express Clean Line HVDC Project,
- SPP Steady State Review,
- SPP System Impact Study,
- PJM Feasibility Study,
- PJM System Impact Study,

[32] http://www.nerc.com/docs/pc/Agenda%203.7_SPS%20Assessment%20Report_20120910.pdf pp. 2
[33] Dr. Galli Additional Direct pp 1 line 18 – pp 7 line 15

- PJM Facilities Study, and
- Any further study necessary for interconnection with any of SPP, MISO, or PJM.

Staff also recommends that the Commission order Grain Belt Express to provide for Commission approval completed documentation of the Grain Belt Express plan, equipment, and engineering drawings that comply with the appropriate NERC standards for a project of this scope and size, National Electric Safety Code for a project of this scope and size, 4CSR 240-18.010, and the Overhead Power Line Safety Act section 319.075 et al.

CONCLUSION

Q. Please summarize your testimony.

A. Staff has identified concerns that are due to the limited information available from Grain Belt Express. A storm restoration plan has not been completed, there is not a plan for action to address the weak interconnection point in Kansas, there are additional studies that need to be performed in MISO and a study in PJM is currently pending.

Q. Does Staff recommend that conditions be imposed on any authorization of Grain Belt Express' receipt of a CCN to build and operate the Project as described in the testimony of Staff witness Dan Beck?

A. Yes. Staff recommends that certain items be completed as a condition of the described CCN. Staff also recommends that certain items be brought back to the Commission for Commission approval (or acceptance) prior to any condemnation of Missouri real property. Staff and other parties to this case should be given an opportunity for review and comment on these items requiring Commission approval (or acceptance).

Q. Which of Staff's conditions are you sponsoring?

A. I am sponsoring the following Staff conditions:

(1) That the Commission order Grain Belt Express to provide for Commission acceptance, the following items:

- Completed Storm Restoration Plans for the proposed project34,
- The Interconnection Agreement with SPP,
- The Interconnection Agreement with MISO, and
- The Interconnection Agreement with PJM,
- MISO Feasibility Study,
- MISO System Planning Phase Study,
- MISO Definitive Planning Phase Study,
- SPP Dynamic Stability Assessment of Grain Belt Express Clean Line HVDC Project,
- SPP Steady State Review,
- SPP System Impact Study,
- PJM Feasibility Study,
- PJM System Impact Study,
- PJM Facilities Study, and
- Any further study necessary for interconnection with any of SPP, MISO, or PJM.

and

(2) That the Commission order Grain Belt Express to comply with the appropriate NERC standards for a project of this scope and size , National Electric Safety Code for a project of this scope and size, 4CSR 240-18.010, and the Overhead Power Line Safety Act section 319.075 et al.; and

(3) That the Commission order Grain Belt Express to provide to the Commission completed, documentation of the Grain Belt Express plan, equipment, and engineering drawings to achieve compliance with NERC standards[35] for a project of this scope and size National Electric Safety Code for a project of this scope and size, 4CSR 240-18.010, and the Overhead Power Line Safety Act section 319.075 et al.;

(4) That the Commission order Grain Belt Express to meet a short-circuit ratio, of two or more, at the Kansas converter station, Missouri converter station, and the converter station near Sullivan Indiana; and

[34] Including but not limited to the Emergency Restoration Plan provided to NERC.
[35] Dr. Galli Direct pp. 10 lines 3- 10

(5) That the Commission order Grain Belt Express to provide to the Commission as completed, documentation of the Grain Belt Express plan, equipment, and engineering drawings to achieve a short-circuit ratio of at least two, for each converter station.

Q. Does this conclude your rebuttal testimony?

A. Yes, it does.

SHAWN E. LANGE

PRESENT POSITION:

I am a Utility Engineering Specialist III in the Engineering Analysis Section, Energy Unit, Utility Operations Department, Regulatory Review Division.

EDUCATIONAL BACKGROUND AND WORK EXPERIENCE:

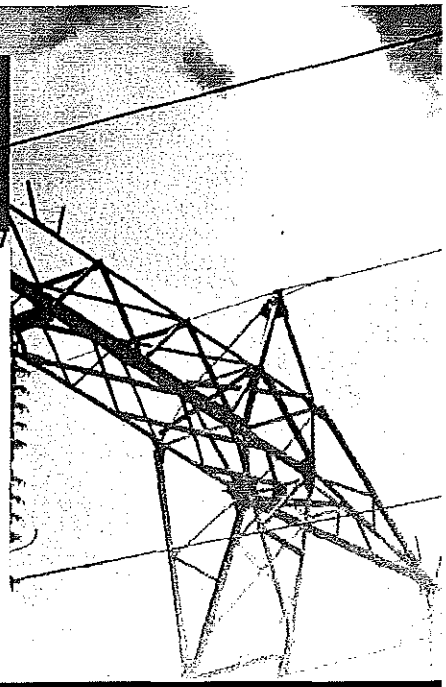
In December 2002, I received a Bachelor of Science Degree in Mechanical Engineering from the University of Missouri, at Rolla now known as the Missouri University of Science and Technology. I joined the Commission Staff in January 2005. I am a registered Engineer-in-Training in the State of Missouri. I have spoke at NCDC's workshop on alternative climate normals.

TESTIMONY FILED:

Case Number	Utility	Testimony	Issue
ER-2005-0436	Aquila Inc.	Direct	Weather Normalization
		Rebuttal	Weather Normalization
		Surrebuttal	Weather Normalization
ER-2006-0314	Kansas City Power & Light Company	Direct	Weather Normalization
		Rebuttal	Weather Normalization
ER-2006-0315	Empire District Electric Company	Direct	Weather Normalization
		Surrebuttal	Weather Normalization
ER-2007-0002	Union Electric Company d/b/a AmerenUE	Direct	Weather Normalization
ER-2007-0004	Aquila Inc.	Direct	Weather Normalization
ER-2007-0291	Kansas City Power & Light Company	Staff Report	Weather Normalization
		Rebuttal	Weather Normalization
ER-2008-0093	Empire District Electric Company	Staff Report	Weather Normalization
ER-2008-0318	Union Electric Company d/b/a AmerenUE	Staff Report	Weather Normalization
ER-2009-0089	Kansas City Power & Light Company	Staff Report	Net System Input
ER-2009-0090	KCP&L Greater Missouri Operations Company	Staff Report	Net System Input

Case Number	Utility	Testimony	Issue
ER-2010-0036	Union Electric Company d/b/a AmerenUE	Staff Report	Net System Input
ER-2010-0130	Empire District Electric Company	Staff Report	Variable Fuel Costs
		Surrebuttal	Variable Fuel Costs
ER-2010-0355	Kansas City Power & Light Company	Staff Report	Variable Fuel Costs
ER-2010-0356	KCP&L Greater Missouri Operations Company	Staff Report	Engineering Review-Sibley 3 SCR
ER-2011-0004	Empire District Electric Company	Staff Report	Variable Fuel Costs
ER-2011-0028	Union Electric Company d/b/a Ameren Missouri	Staff Report	Net System Input
ER-2012-0166	Union Electric Company d/b/a Ameren Missouri	Staff Report	Weather Normalization
		Surrebuttal	Weather Normalization Maryland Heights In-Service
ER-2012-0174	Kansas City Power & Light Company	Staff Report	Weather Normalization Net System Input Variable Fuel Costs
		Surrebuttal	Weather Normalization
ER-2012-0175	KCP&L Greater Missouri Operations Company	Staff Report	Weather Normalization Net System Input
		Surrebuttal	Weather Normalization
ER-2012-0345	Empire District Electric Company	Rebuttal	Interim Rates
		Staff Report	Weather Normalization
EC-2014-0223	Complaint of Noranda Aluminum	Rebuttal	Weather Normalization

MVPs Create Jobs, Benefits for States



MISO's Multi-Value Projects portfolio, or MVPs, will create thousands of jobs. Estimates include the following:

- Creation of 17,000 - 39,800 direct (construction) jobs
- Between 28,400 and 74,000 total jobs will be created. This includes construction, supplier and other downstream opportunities.

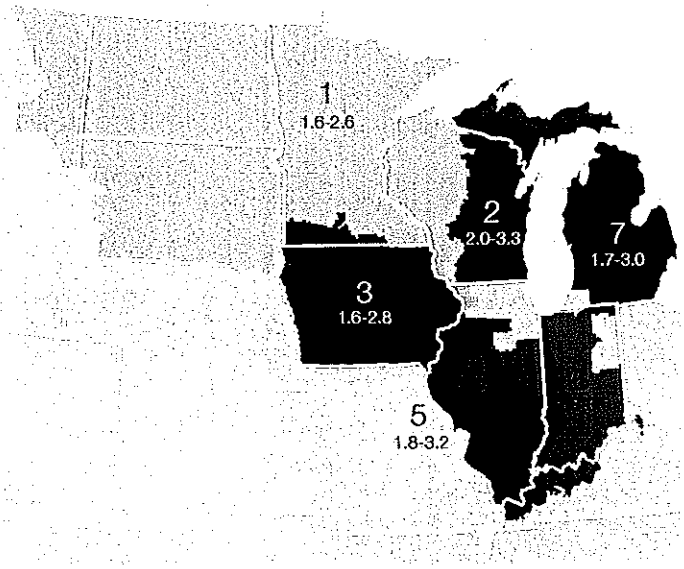
MVPs Save States Money

As a result of MVPs, consumers will see economic benefits ranging from 1.8 to 3.0 times the costs. These benefits include:

- $12.4 billion to $40.9 billion from enabling low-cost generation to displace higher-cost generation
- $28 million to $87 million from more efficient dispatch of operating reserves
- $111 million to $396 million from reductions in energy wasted on transmission losses, reducing future generation investment required to serve those losses
- $1,354 million to $2,503 million in benefits through supporting a regional wind integration methodology
- $1,023 million to $5,093 million from reduced future Planning Reserve Margin Requirements, which reduces installation of future generation to meet this requirement.
- $226 million to $794 million in avoided costs for reliability projects that would otherwise need to be constructed.

Did you know?

- Transmission planning ensures greater reliability throughout MISO, identifying areas of congestion and recommending transmission upgrades.
- MISO matches the appropriate cost allocation method with each project's driver and business case to ensure project costs are spread commensurate with benefits.
- Multi-Value Projects provide benefits beyond just meeting local energy and reliability needs.



Benefit/Cost Ratio Ranges
Local Resource Zones

Regional Benefits

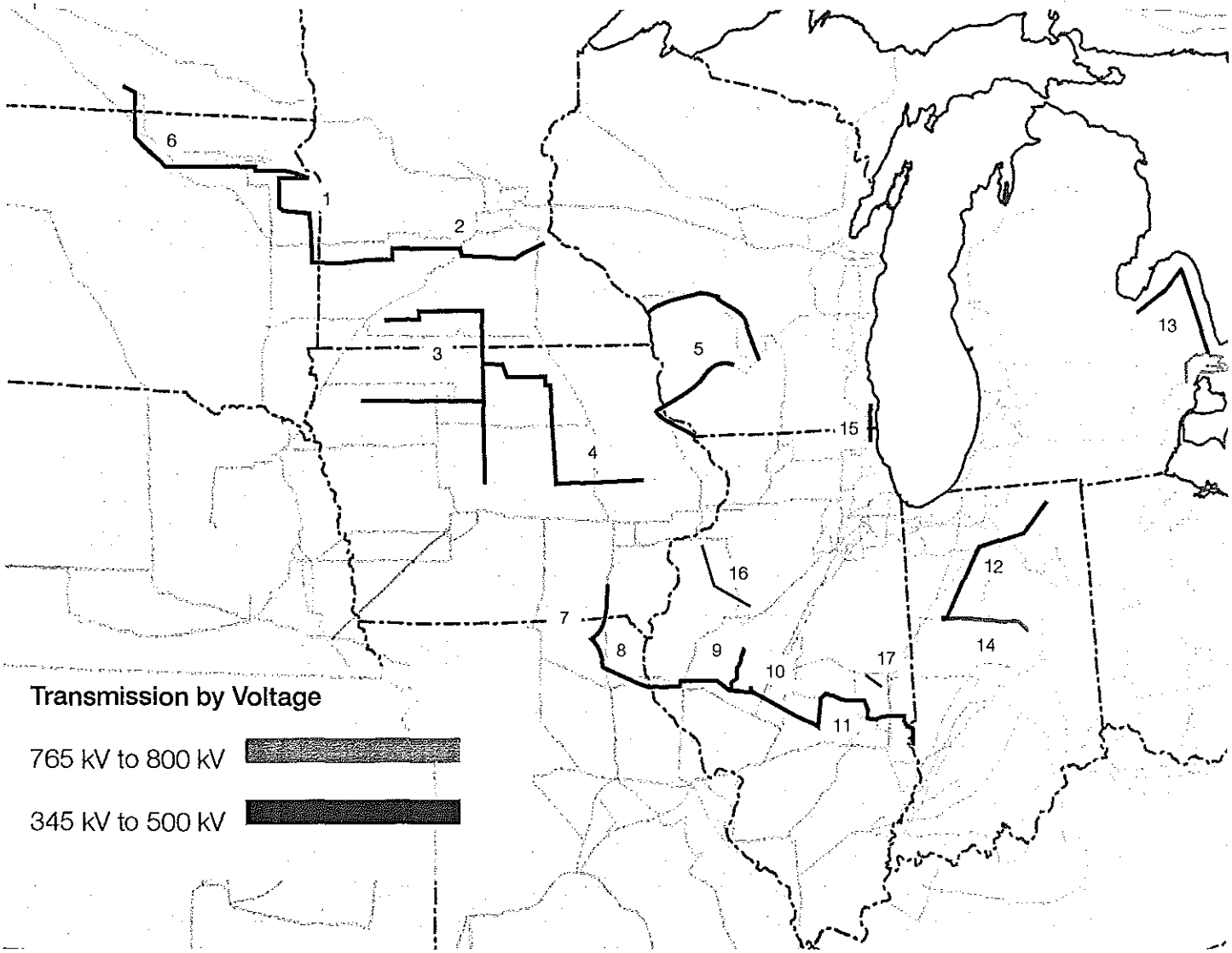
MISO projects the 2011 MVP portfolio will realize the following benefits for the entire MISO footprint:

- Average residential customer's return on investment: $23 annual return on an $11 per year investment.
- Projected benefits: $15.6 billion - $49.3 billion*
- Proposed capital cost: $5.2 billion*

MISO Zones & Planning

The MVP portfolio will deliver reliability, public policy and economic benefits across the system. MISO's energy zones are designed to optimize wind generation placement and to minimize distance to other fuel sources such as natural gas. When connected to the overall grid by the MVP projects, the zones will enable access to low-cost energy for the entire MISO footprint.

* 2011 present value dollars



2011 Multi-Value Project Portfolio

Project Name	State(s)	Voltage
1. Big Stone – Brookings	SD	345 kV
2. Brookings – SE Twin Cities	SD/MN	345 kV
3. Lakefield Jct.-Winnebago – Winco – Burt area & Sheldon – Burt area – Webster	MN/IA	345 kV
4. Winco – Lime Creek – Emery -Blackhawk – Hazleton	IA	345 kV
5. N. LaCrosse-N. Madison-Cardinal & Dubuque Co.-Spring Green-Cardinal	WI	345 kV
6. Ellendale – Big Stone	ND/SD	345 kV
7. Adair – Ottumwa	IA/MO	345 kV
8. West Adair – Palmyra Tap	MO	345 kV
9. Palmyra-Quincy-Meredosia-Ipava & Meredosia-Pawnee	MO/IL	345 kV
10. New Pawnee-Pana	IL	345 kV
11. Pana-Mt. Zion-Kansas-Sugar Creek	IL	345 kV
12. Reynolds-Burr Oak-Hiple	IN	345 kV
13. Michigan Thumb Loop Expansion	MI	345 kV
14. New Reynolds-Greentown	IN	765 kV
15. Pleasant Prairie-Zion Energy Center	WI/IL	345 kV
16. Fargo-Oak Grove	IL	345 kV
17. Sidney-Rising	IL	345 kV