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**MISSOURI PUBLIC SERVICE COMMISSION**

**FILE NO.**

**EA-2023-0017**

**DIRECT TESTIMONY**

**OF**

**AARON WHITE**

**ON**

**BEHALF OF**

**GRAIN BELT EXPRESS LLC**

**August 24, 2022**

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1 **I. INTRODUCTION**

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

3 A. My name is Aaron White. I work for Invenergy LLC (“Invenergy”) at One South  
4 Wacker Drive, Suite 1800, Chicago, IL 60606.

5 **Q. What is your position with Invenergy?**

6 A. I am a Senior Transmission Engineering Manager.

7 **Q. Please describe your educational background and employment experience.**

8 A. I obtained a Bachelor of Science degree in civil engineering from the University of  
9 Utah in May 2012. Following that, I became a Licensed Professional Engineer in December 2016  
10 and am registered with the State of Utah.

11 I have been employed by Invenergy LLC as a Senior Transmission Engineer since April  
12 2019. In that role, I have supervised the engineering and construction of several major  
13 transmission projects, which I describe in more detail below.

14 From May 2012 to April 2019, I worked as a consultant for Electrical Consultants, Inc.  
15 (“ECI”). In that role, among other things, I provided input to and created various ECI standards  
16 and design guidelines regarding the development, design and construction of power line systems  
17 ranging from 12.5 kV to 500 kV, which I describe in more detail below. I also provided training  
18 to multiple ECI offices for the implementation of standards and guidelines to promote early  
19 contractor coordination and efficiency.

20 From April 2010 to November 2011, I worked as an Engineer Technician with the United  
21 States Forest Services. In that role, among other things, I managed construction contracts,  
22 performed construction inspections and surveyed roads, bridges and culverts to produce surfaces  
23 that aided in design and reconstruction.

24 A copy of my curriculum vitae is attached as Schedule AW-1.

1           **Q.     Do you have experience in engineering, construction and project management**  
2 **of high voltage electric transmission lines?**

3           A.     Yes.   Currently, I am managing the civil and electrical engineering teams  
4 developing the Clean Path line in New York, including its converter station sites, and 175 miles  
5 of symmetric monopolar HVDC transmission line. Clean Path New York is a 400 kV transmission  
6 line with approximately 1300 MW of capacity. It has a projected commercial operation date of  
7 2027. I am also currently managing the civil and electrical engineering teams developing the North  
8 Path transmission project in New Mexico, including its converter stations and 400 miles of HVDC  
9 overhead transmission lines. North Path is a 525 kV transmission line with approximately 4000  
10 MW of capacity. It has a projected commercial operation date of 2028.

11           I previously served as Engineer of Record for the Sagamore Wind transmission line project  
12 in New Mexico. The Sagamore Wind transmission line was 345 kV and connected the Sagamore  
13 Wind electricity generator to the Crossroads substation. I prepared the written engineering report  
14 which detailed the recommended right-of-way width of the transmission line with supporting  
15 calculations and exhibit drawings. The New Mexico Public Regulation Commission approved the  
16 project.

17           I also previously served as electrical engineering manager for the Energia del Pacifico El  
18 Salvador project. In that role, I managed the preparation of the construction bidding documents  
19 for tie-in components of the LNG-to-power project which will provide power for 30 percent of the  
20 country's power demand. The tie-in components included a 230 kV substation, a 115 kV  
21 substation, 0.4 miles of double circuit underground 115 kV transmission line and 28 miles of  
22 double circuit 230 kV lattice towers. I was responsible for all contract exhibits, material  
23 specifications, design specifications, preliminary design drawings and construction specifications.

1 I also served as a program manager for the expansion of a 115 kV transmission line system  
2 owned by McKenzie Electric Coop., including right-of-way determination, surveying, permitting  
3 and detailed transmission design for over 33 projects totaling approximately 150 circuit miles.

4 I also served as the project engineer for an Invenergy transmission line connecting the  
5 generation from over 150 turbines as part of the Miami Wind project. In that role, I performed  
6 detailed design work for 23 miles of 345 kV transmission line and developed routing, PLS CADD  
7 modeling, structure configuration, structure point load calculations, swing calculations, EMF  
8 calculations, flashover calculations, insulation calculations, structure detail drawings, stringing  
9 charts, plan and profile drawings, staking sheets, phasing diagram and foundation calculations. I  
10 prepared specifications for optical ground wire (“OPGW”), insulators and hardware, steel poles  
11 and construction operations. I also worked closely with client, contractor and material suppliers  
12 regarding schedules and critical project items.

13 I also served as a design engineer for the Sigurd – Red Butte 345 kV transmission line built  
14 by PacifiCorp, which traversed 172 miles.

15 Further, I served as a design engineer for the Mona – Oquirrh 345 kV/500 kV transmission  
16 line built by PacifiCorp, which traversed 92 miles.

17 In addition, I have served as project manager, project engineer or design engineer for 17  
18 additional transmission lines ranging from 1 mile to 50 miles long and with voltages ranging from  
19 115 kV to 345 kV.

20 All of these projects are identified on my attached curriculum vitae.

1           **Q.     What are your duties and responsibilities in your present position?**

2           A.     I am the Engineering Manager for the Grain Belt Express Project, as defined below.  
3     In that role, my responsibilities include managing development support, early construction  
4     activities and engineering services for the entire transmission line.

5           **Q.     What is the purpose of your testimony?**

6           A.     I am testifying on behalf of Grain Belt Express, which is filing an Application to  
7     Amend Existing Certificate of Public Convenience and Necessity (“Application”) to construct an  
8     approximately 800-mile, overhead, multi-terminal +/-600 kilovolt (“kV”) high-voltage, direct  
9     current (“HVDC”) transmission line and associated facilities including converter stations and  
10    alternating current (“AC”) connector lines (the “Project”).

11           Specifically, the purpose of my testimony is to:

- 12           • Demonstrate Grain Belt Express’ experience and qualifications construct, own,  
13           operate, control, manage, and maintain the Project in satisfaction of the  
14           Commission’s *Tartan* Factor;
- 15           • Discuss Grain Belt Express’ plans to use local resources;
- 16           • Discuss the Project development timeline;
- 17           • Provide an update on plans and specifications for the HVDC portion of the Project;
- 18           • Describe plans and specifications for the Tiger Connector;
- 19           • Provide an update on construction costs of the Project; and
- 20           • Describe plans for operating and maintaining the Project and plans for restoration  
21           of service after unplanned/forced outages

22           Specifically, my testimony addresses the following filing requirements:

- 23           • “A description of the asset(s) to be operated (20 CSR 4240-20.045(5)(A));

- 1           • “Plans and specifications for the asset, including as-built drawings” (20 CSR 4240-  
2           20.045(5)(D));<sup>1</sup>
- 3           • “A description of the plans, specifications, and estimated costs for the complete  
4           scope of the construction project that also clearly identifies what will be the  
5           operational features of the asset once it is fully operational and used for service”  
6           (20 CSR 4240-20.045(6)(C));
- 7           • “The projected beginning of construction date and the anticipated fully operational  
8           and used for service date of the asset” (20 CSR 4240-20.045(6)(D));
- 9           • “An overview of plans for operating and maintaining an asset” (20 CSR 4240-  
10          20.045(6)(I)); and
- 11          • “An overview of plans for restoration of safe and adequate service after significant,  
12          unplanned/forced outages of an asset.” (20 CSR 4240-20.045(6)(J)).

13          **Q. Are you sponsoring any schedules or exhibits as part of your direct testimony?**

14          A. Yes, I am sponsoring the following exhibits/schedules:

- 15           • Schedule AW-1 – Curriculum Vitae  
16           • Schedule AW-2 – HVDC Tower Diagrams  
17           • Schedule AW-3 – Tiger Connector Poles and Assemblies  
18           • Schedule AW-4 – Converter Station Layout

19          **II. GRAIN BELT EXPRESS’ QUALIFICATIONS AND EXPERIENCE**

20          **Q. Please describe the business of Grain Belt Express.**

21          A. As set forth in the testimony in Shashank Sane, Grain Belt Express is a limited  
22          liability company organized under the laws of the State of Indiana. Grain Belt Express is a wholly

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<sup>1</sup> My testimony includes conceptual drawings in Schedules AW-2, AW-3, and AW-4. At this stage of development “as-built drawings” are not available. However, Grain Belt Express is not opposed to providing “as-built drawings” to the Commission when available.

1 owned subsidiary of Invenergy Transmission LLC (“Invenergy Transmission”), a Delaware  
2 limited liability company, which is a wholly owned subsidiary of Invenergy Renewables LLC  
3 (“Invenergy Renewables”), also a Delaware limited liability company. Invenergy Transmission  
4 and its affiliate company, Invenergy Renewables, are global leaders in renewable energy and  
5 transmission development. Invenergy Transmission or its affiliates are providing engineering,  
6 procurement and construction support and management for Grain Belt Express pursuant to  
7 agreements with Grain Belt Express.

8           Invenergy Transmission’s mission is to construct and operate high voltage transmission  
9 lines and associated facilities for the purpose of connecting the best renewable resources in the  
10 U.S. and delivering their output to load and population centers that have an increasing demand for  
11 electricity produced from renewable resources.

12           **Q.     Is Grain Belt Express qualified to provide services associated with the Project?**

13           A.     Yes. In the Commission’s March 20, 2019 Report & Order on Remand in Case  
14 No. EA-2016-0358, the Commission found that “Grain Belt and Invenergy together have the  
15 qualifications ... to develop, construct, and operate the Project,” citing Invenergy’s management  
16 team’s extensive experience in developing, constructing and operating transmission and energy  
17 infrastructure projects and Invenergy’s impressive record of development and construction of  
18 energy projects, including hundreds of miles of transmission lines, substations and transformers.<sup>2</sup>  
19 In the Commission’s September 11, 2019 Amended Report and Order in Case No. EM-2019-0150,  
20 the Commission restated that Invenergy possessed the requisite technical qualifications to develop,

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<sup>2</sup> Case No. EA-2016-0358, Report and Order on Remand, pp. 20-21, 43.



1 construct, and operate the Project.<sup>3</sup> Since 2019, the Invenergy family of companies have continued  
2 to expand their experience and qualifications.

3 **Q. Please describe the experience of Grain Belt Express' management team.**

4 A. Through its affiliates, Grain Belt Express has access to a management team that  
5 includes executive, professional and technical personnel who have managed, built, operated and  
6 financed projects in the renewable and traditional energy sectors. The management team has  
7 financed billions of dollars of energy projects and managed the development of projects that  
8 produce or transmit thousands of megawatts of power. Members of the management team have  
9 had management, engineering and other supervisory roles in the construction of transmission lines.  
10 Grain Belt Express is capable of planning, engineering, procurement and construction services for  
11 electric transmission systems, collection systems, substations, power generation (primarily  
12 renewable energy) and related systems.

13 **Q. Please describe Invenergy Transmission's and Invenergy Renewable's recent**  
14 **projects.**

15 A. Invenergy Transmission through its wholly owned direct and indirect subsidiaries  
16 is developing two significant high voltage transmission line projects in different regions of the  
17 United States. It is also associated with the development of a third significant high-voltage  
18 transmission line in the United States through its parent company, Invenergy Renewables.

19 Invenergy Renewables has developed and constructed over 4,000 miles of transmission  
20 and collection lines located throughout the United States and internationally, covering nearly all  
21 ice and wind structural loading regions, through various air contaminants and lightning isochronic  
22 levels, tying into weak and strong power grids while meeting interconnection requirements,

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<sup>3</sup> Case No. EM-2019-0150, Amended Report and Order, p. 7.

1 traversing geographical regions such as the Nevada desert, the mountainous terrain of Idaho, the  
2 wetlands of Texas, the farmland of Illinois, the swamps of Georgia and more. All this work has  
3 been performed utilizing various local and regional contractors. The company's success comes  
4 from a culture which strives for technical expertise, versatility and accountability. This culture is  
5 dominant throughout the company and is maintained throughout the corporate structure.

6 For example, Invenergy Renewables and its affiliate companies recently developed and  
7 constructed, and is currently operating, a 27-mile transmission line in eastern Texas. The  
8 transmission line includes seven miles of single circuit 345 kV and 20 miles of double circuit 345  
9 kV designed to deliver 1,600 MW of solar generation. Large areas of the planned transmission  
10 corridor were surveyed and classified as wetlands during early-stage development. A strategy was  
11 developed and discussed with the United States Army Corp of Engineers ("USACE") to perform  
12 the construction under what was Nationwide Permit 12, Utility Line Activities (prior to 2021  
13 renewal, now Nationwide Permit 57, Electric Utility Line and Telecommunications Activities).  
14 Permit requirements included limiting the loss of waters of the United States or permanent  
15 disturbance to wetlands. Components of the strategy developed in coordination with the USACE  
16 included using non-mechanized methods to clear vegetation from the right-of-way, incorporating  
17 a foundation design which did not require the removal of any soil and designing and planning for  
18 structure erection to be performed by helicopter to avoid heavy crane access within delineated  
19 wetlands located along the transmission corridor.

20 **Q. Please describe Grain Belt Express' approach to safety.**

21 A. Worker safety and the safety of the public is our number one priority through  
22 design, construction, and operations. Evaluating health and safety reports or OSHA Work-Related  
23 Injuries and Illnesses is critical when selecting the general and sub-contractors for each project to

1 ensure the success of any project. If an incident which risks the safety of the public or those  
2 working on the project does occur, it is Grain Belt Express' and its affiliate's practice to stop work  
3 and perform a full inspection of operations and equipment.

4 **Q. Does Grain Belt Express have specific experience constructing electric**  
5 **transmission lines and other linear infrastructure projects across agricultural lands, wooded**  
6 **lands and other rural properties?**

7 A. Yes. The management team for Grain Belt Express has significant experience in  
8 each of these environments. As an example, the management team for Grain Belt Express  
9 developed the Traverse Wind Project, which crossed more than 85 miles of rural properties,  
10 including agricultural properties on which crops such as soybeans, corn, hay and alfalfa were being  
11 grown. The development and construction site team worked diligently with landowners to  
12 minimize impacts to individual properties by keeping structures out of areas which would  
13 negatively impact agricultural operations, such as avoiding pivot circles and coordinating specific  
14 access to the right-of-way and individual structures. The Traverse Wind Project also crossed rivers  
15 and other sensitive or protected environments. The management team for Grain Belt Express was  
16 responsible for mapping access routes, conducting extensive surveys of endangered species (both  
17 plant and animal), designating wetlands and other sensitive areas and training over 400 workers  
18 on environmental compliance.

19 Grain Belt Express' environmental regulatory specialists, like Jennifer Stelzleni, who is  
20 also testifying in support of this Amendment Application, have experience managing  
21 environmental construction concerns and will do so for the Project.

1           **Q. Will Grain Belt Express have the managerial and technical capabilities to**  
2 **develop, construct and operate the Project?**

3           A. Yes. As the Commission twice found in 2019, Grain Belt Express and its affiliates  
4 have established a management and technical team with significant experience in regulatory and  
5 land development, procurement, construction management, technical requirements, and operations  
6 relevant to the Project.

7           Consistent with standard industry practice, the management and technical teams will  
8 supervise and oversee the contractors who will perform the detailed engineering/design,  
9 procurement, construction and operating and maintenance functions for the Project. As explained  
10 in more detail below, Grain Belt Express will contract with and rely on experienced, qualified  
11 companies to perform these functions. Grain Belt Express has and will select vendors, contractors,  
12 and consultants with strong and suitable expertise in all areas relevant to the Project.

13           **Q. Are you familiar with the Commission’s factors for granting a CCN, referred**  
14 **to as the “Tartan Factors”?**

15           A. Yes, it is my understanding that, in its review of CCN applications, the Commission  
16 has traditionally applied several criteria, which it refers to as the “Tartan Factors.” In this  
17 testimony, I provide support for the fourth *Tartan* Factor, which requires that an applicant for a  
18 CCN must be qualified to provide the proposed service.

19           **Q. In your view, does Grain Belt Express meet this factor?**

20           A. Yes. I as explained above, and consistent with previous findings of the  
21 Commission, Grain Belt Express is fully qualified to design, engineer, and construct the proposed  
22 Project and provide the proposed service, utilizing the significant expertise and resources of its  
23 Grain Belt Express’ affiliates.

1                   **III.    GRAIN BELT EXPRESS' USE OF LOCAL RESOURCES**

2           **Q.    Please describe Grain Belt Express' plans to use local resources.**

3           A.    Invenergy Transmission and its affiliate companies, including Grain Belt Express,  
4 strive to utilize a local workforce, local expertise and local material sourcing. Invenergy  
5 Transmission's success in utilizing local workers comes from experience having developed  
6 projects across the country and continually building new relationships. Engagement with local  
7 workforce and material sourcing includes a range of services throughout development and  
8 construction and includes but is not limited to land survey, environmental surveys, right-of-way  
9 acquisition, vegetation clearing contractors, material procurement and construction labor.

10           **Q.    Does Grain Belt Express have any current agreements with Missouri**  
11 **suppliers?**

12           A.    Yes. Grain Belt Express has entered into a Memorandum of Understanding with  
13 Hubbell Power Systems ("Hubbell") to supply conductor hardware and insulators for the Project.  
14 Hubbell is a global manufacturer of a wide variety of transmission, distribution, substation and  
15 telecommunications products that are well known and trusted throughout the industry and are used  
16 by many of the largest utilities in the U.S. Hubbell currently has a plant and distribution center in  
17 Centralia, Missouri that can be used for the Project. Hubbell can also make its engineering  
18 resources available to aid in the design of conductor hardware assemblies and insulators.

19           Grain Belt Express has also executed a Letter of Intent with Prysmian as a preferred  
20 supplier of conductor for the Project. Prysmian is the world's largest wire and cable manufacturer  
21 with revenues worth over 13 billion dollars in 2021. Prysmian will supply roughly 23 million feet  
22 of steel core for the transmission line conductor. Prysmian will use commercially reasonable  
23 efforts source aluminum rod used in the conductor for the Project with aluminum from the  
24 Magnitude 7 aluminum smelter near New Madrid, MO.

1           The aforementioned vendors and other vendors for the Kansas to Missouri portion of the  
2 project will be selected in near term and Grain Belt Express will weigh the selection of these  
3 vendors equitably for the value they bring to the local economy. On July 11, 2022, Invenergy  
4 Transmission coordinated with PAR/Quanta to host a supplier social event in St. Louis, MO where  
5 representatives provided a presentation on the scope, size, services and resources that will be  
6 needed to construct the Project. Attendees included suppliers who offer a variety of services across  
7 the route area and state-wide. Invitations were sent to about 50 suppliers<sup>4</sup>, and about 40 individuals  
8 attended, representing 30 supplier companies. Grain Belt Express will seek to continue to  
9 maximize the use of local contractors and suppliers where practicable.

10           Grain Belt Express will also continue to engage local communities prior to the start of any  
11 construction by, for example, holding project awareness meetings at local facilities to allow the  
12 public and the EPC contractor(s) to meet. These meetings will serve several purposes, including  
13 the following: (i) communicating to the public the details of the construction activities, sequencing  
14 and proposed schedules; and (ii) affording Grain Belt Express the opportunity to learn about and/or  
15 firm up local suppliers and service providers in the area that may be utilized on the Project.

#### 16                                   **IV. PROJECT DEVELOPMENT TIMELINE**

17           **Q. Is Grain Belt Express currently developing the certificated Project?**

18           A. Yes. Grain Belt Express continues to develop the certificated Project. There are  
19 no material changes to the HVDC portion of the Project, which constitutes the great majority of

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<sup>4</sup> Invited suppliers include Agricycle, Altec, ASP Enterprises, Bates Utility, CCI Effingham, Collins and Hermann, Concrete Strategies, Consolidated Pipe, DIG Castle, DJM Ecological Services, Fred Weber Building Products K&K Supply, Keeley Construction, Kiewit, Kimaterials, Kuesel, McGrath & Associates, Inc., Michaels, Millstone Weber, Nucor Harris Rebar, PAR, POWER Engineers, Rubin Brown, Safety International, Silver Eagle Construction Products, SITE, Terracon, Traffic Control Company, United Rentals, and Safety International.

1 the currently certificated Project. Accordingly, Grain Belt Express has been and continues to  
2 develop the certificated Project.

3 **Q. When will full-scale construction of the Project begin?**

4 A. As discussed in the Direct Testimony of Shashank Sane and others, Grain Belt  
5 Express is requesting to construct the Project in two phases (*i.e.* Phase I and Phase II). Subject to  
6 continuing land acquisition and financing, as discussed by witnesses Kevin Chandler and Ms.  
7 Shine, respectively, Grain Belt Express is targeting to begin construction on Phase I of the Project  
8 with an earliest possible construction start in 2024. It is anticipated that Phase I of the project will  
9 be fully operational and in service by the end of 2027. Grain Belt Express is targeting to begin  
10 construction on Phase II of the project lagging 18 months behind Phase I. It is anticipated that the  
11 completion or in-service period for Phase II would be the second quarter of 2029.

12 **Q. Please provide additional details on the construction timeline for Phase I.**

13 A. Grain Belt Express is currently advancing Phase I detailed engineering along with  
14 other pre-construction activities which include but are not limited to right-of-way acquisition,  
15 environmental permitting, utility crossing agreements, and road use agreements. Detailed  
16 structural design and full-scale tower testing is currently ongoing and is anticipated to be complete  
17 before the end of the year (2022). Grain Belt Express will begin tower procurement activities upon  
18 completion of the tower testing. Initial material sourcing activities for the conductor, line  
19 hardware, and insulator assemblies have begun. Limited geotechnical investigations have been  
20 performed with additional investigations anticipated to further inform design and construction of  
21 tower foundations. Structure locations and access to structures has been developed at a desktop  
22 level. Engineering and construction teams will begin micro siting structure locations the fourth  
23 quarter of this year (2022). Objectively the micro-siting of structures and access will further

1 minimize impacts to landowners, land resources, and the environment. Material procurement and  
2 micro siting activities will continue throughout 2023 and shall be advanced such to allow for the  
3 targeted construction start previously stated.

4 Detailed engineering for the converter stations will begin in 2023 following the initial  
5 engineering studies to be performed by the converter station vendor. It is intended that a civil  
6 contractor will be engaged prior to beginning detailed engineering and that civil contractor will  
7 assist in the construction planning process for the converter station. Construction planning  
8 activities will include but are not limited to logistics for major materials, site grading, structural  
9 design of valve hall and other converter station structures. The procurement of the converter  
10 station main components is currently anticipated to begin mid-2024.

11 **Q. Please provide additional details on the construction timeline for Phase II.**

12 A. Phase II is currently targeting start of construction lagging 18 months Phase I start  
13 of construction. No additional construction schedule details are available at this time.

14 **V. UPDATE ON THE OPERATIONAL FEATURES OF THE HVDC PORTION OF**  
15 **PROJECT**

16 **Q. Are there any material changes to the operational features of the HVDC**  
17 **portion of the Project?**

18 A. As discussed above, there are no material changes to the HVDC portion of the  
19 Project, and Grain Belt Express continues to develop that portion of the Project. However, Grain  
20 Belt Express has made some improvements to the operational features of the HVDC portion of the  
21 Project that are worth mentioning.



1           **Q.     Has Grain Belt Express made improvements to the converter station and**  
2 **HVDC conductors?**

3           A.     Yes. Improvements to the converter technology and technical specifications of the  
4 HVDC conductors are described in the Direct Testimony of my colleague, Carlos Rodriguez.

5           **Q.     Has Grain Belt Express made improvements to the HVDC towers?**

6           A.     Yes. The lattice towers for the  $\pm 600$  kV HVDC have adopted several updates  
7 specific to further strengthen the operational performance of the transmission line. The “extreme  
8 wind” structural load case for which the lattice towers were originally designed was based on wind  
9 speeds consistent with the 50-year Mean Recurrence Interval (“MRI”). The current lattice tower  
10 design has been updated to account for the 100-year MRI wind speed for the “extreme wind”  
11 structural load case. This is per recommendations released in the Guidelines for Electrical  
12 Transmission Line Structural Loading, 4<sup>th</sup> ed. ASCE (2020) 4<sup>th</sup> edition. Additionally, the lattice  
13 tower design was updated to account for modifications to the Dedicated Metallic Return (“DMR”)  
14 conductor. The DMR was modified to improve operational performance and to reduce electrical  
15 losses during various operating modes. Conceptual tower performance drawings for the HVDC  
16 towers are provided in Schedule AW-2.

17           **Q.     Do you consider the foregoing improvements to be “material change[s] in the**  
18 **design and engineering of the Project”?**

19           A.     From my perspective as an engineer, the foregoing improvements are not material  
20 changes in the design and engineering of the Project, as was approved in the Report and Order on  
21 Remand in Case No. EA-2016-0358. Improving upon design and technology as a project  
22 progresses from the permitting phase to construction is a common and beneficial process for any  
23 transmission project.

1                   **VI. OPERATIONAL FEATURES OF THE TIGER CONNECTOR**

2                   **Q. What is the Tiger Connector?**

3                   A. As discussed in the Direct Testimony of Carlos Rodriguez, Grain Belt Express is  
4 proposing to use two points of interconnection (“POIs”) at and near the McCredie Substation in  
5 Callaway County, Missouri. In order to reach the POIs, Grain Belt Express is proposing to move  
6 the Missouri converter station from Ralls County to Monroe County and in lieu of AC  
7 interconnection facilities in Ralls County, construct an approximately 40-mile, 345 kV AC  
8 transmission line from the converter station in southern Monroe County to the POIs in Callaway  
9 County. This approximately 40-mile transmission line is referred to as the “Tiger Connector.”

10                  **Q. Is the construction of an AC transmission line in Missouri a new feature of the**  
11 **Project?**

12                  A. No. The Project has always included AC interconnecting facilities to be  
13 constructed by Grain Belt Express to connect the converter station to the existing AC grid.<sup>5</sup>  
14 However, as a result of finalizing the proposed POIs, we now know the specifics of the AC  
15 facilities required to reach the POIs.

16                  **Q. What are the plans and specifications for the Tiger Connector?**

17                  A. The Tiger Connector as proposed is a double circuit 345 kV AC transmission line  
18 designed to deliver 2,500 MW to the proposed POIs. The structures for the Tiger Connector will  
19 be steel poles on concrete pier foundations. Typical in-line (“Tangent”) and tension holding

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<sup>5</sup> 2016 Application, ¶ 1 (seeking a CCN to, among other things, “construct, own, operate, control, manage and maintain ... alternating current (“AC”) interconnecting facilities, including an AC switching station and related AC transmission lines.”); CCN Order, p. 10 (“Grain Belt proposes to construct the Missouri converter station and associated AC interconnecting facilities in Ralls County”); CCN Order Attachment 1 at Section III.3 (discussing the “Grain Belt-owned portion of the AC electric transmission line connecting the Grain Belt proposed Missouri conversation to the AC grid”).

1 (“Dead End”) structures are depicted in Schedule AW-4. Each circuit of the transmission line will  
2 include three phases consisting of double bundle conductors and an Optical Ground Wire  
3 (“OPGW”) for communication and lighting protection. Typical span lengths will be range between  
4 800 and 1,000 feet. The insulator assemblies which will support the conductors are anticipated to  
5 be v-string as depicted in Schedule AW-4. The v-string insulator assembly is intended to minimize  
6 the conductor movement due to wind within the right-of-way.

## 7 **VII. UPDATES TO PROJECT COST**

### 8 **Q. What is the anticipated cost for the complete scope of the Project?**

9 A. The total cost for Phase I and Phase II is estimated to be 4.95 billion dollars. This cost  
10 excludes network upgrades. The cost for Phase I is estimated to be 3.52 billion dollars with  
11 Phase II estimated at 1.43 billion dollars. A portion of the Kansas converter station may be  
12 built out with Phase II in which case the proportional amount would change. [Add  
13 discussion of total cost, Phase I cost, Phase II cost, etc.].

### 14 **Q. How does the currently anticipated cost impact the economic viability of the** 15 **Project and the ability to finance the Project?**

16 A. Economic viability of the Project is discussed in the Direct Testimony of Mark Repsher  
17 and Shashank Sane. Plans for financing the Project are discussed in the Direct Testimony  
18 of Rolanda Shine.

## 19 **VIII. PLANS FOR OPERATING AND MAINTAINING THE PROJECT**

### 20 **Q. Please describe Grain Belt Express’ plans for operating and maintaining the** 21 **Project.**

22 A. Grain Belt Express will have a dedicated operations organization to oversee the  
23 operations and maintenance activities associated with the Project. This organization may utilize

1 in-house personnel to plan, manage and schedule the required maintenance on the HVDC and  
2 transmission facilities. The Project may also contract with a firm or firms experienced in  
3 maintaining transmission facilities to provide operational and maintenance services for the Project  
4 when it is in service. These firms will be required to have sufficient maintenance resources in  
5 place along the route of the Project in Kansas, Missouri, Illinois and Indiana to ensure timely  
6 responses to any operational or service issues. Further, in connection with its grant of authority  
7 by FERC to negotiate rates for transmission service, Grain Belt Express has committed to turn  
8 over functional control of the Project, including scheduling responsibilities, to an RTO (which will  
9 be SPP, MISO or PJM) and to operate the transmission line pursuant to an OATT.

10 With respect to maintenance of the Project, Grain Belt Express will contract with a firm or  
11 firms experienced in electric transmission maintenance and operations to provide maintenance  
12 services and capital replacements and upgrades as necessary. This contract could be with a utility  
13 or utilities or with a firm that performs transmission line maintenance and construction services.  
14 Given the approximately 800-mile length of the Project, Grain Belt Express could contract with  
15 more than one company to provide these services. Additionally, Grain Belt Express will work  
16 closely with the interconnected utilities, relevant RTOs and other entities in the region to ensure  
17 that appropriate operational agreements, which ensure coordinated operations, are in place per  
18 NERC reliability standards. Operations and maintenance will be performed to meet or exceed all  
19 applicable standards and codes.

20 **Q. Does Grain Belt Express expect to have an office or offices in Missouri in**  
21 **connection with the construction and the operation and maintenance of the Project?**

22 A. Yes. There will be temporary construction offices opened at various points along  
23 the route of the Project during its construction, including in Missouri. These offices may be

1 facilities of Grain Belt Express or facilities of one or more of the project contractors. After the  
2 transmission line is placed into service, Grain Belt Express anticipates that there will be one or  
3 more facilities opened along the route of the line as the base(s) of operations for operating and  
4 maintenance personnel. Again, these facilities will either be facilities of Grain Belt Express or  
5 facilities of the contractor or contractors retained to provide operating and maintenance services  
6 for the Grain Belt Express. The facility or facilities will be located such that resources can be  
7 quickly allocated to any point on the transmission line where maintenance or restoration services  
8 may be needed.

9 **Q. Will Grain Belt Express be prepared to comply with applicable NERC**  
10 **reliability standards in operating the Project?**

11 A. Yes. NERC reliability standards are mandatory and enforceable (through the  
12 imposition of monetary penalties or other sanctions), pursuant to Section 215 of the Federal Power  
13 Act and regulations and orders of the FERC. Compliance with these standards is important to  
14 ensure the reliability of the bulk power system. Grain Belt Express expects to be registered on the  
15 NERC Compliance Registry for the reliability functions of a “Transmission Owner,” a  
16 “Transmission Operator” and a “Transmission Service Provider” (depending on the nature of its  
17 arrangements with a third party or parties to operate the Project, which could result in some or all  
18 of the Transmission Operator or Transmission Service Provider functions being assigned to the  
19 third party). Therefore, Grain Belt Express will be subject to applicable requirements of one or  
20 more NERC reliability standards in some or all of the following categories: Resource and Demand  
21 Balancing; Communications; Critical Infrastructure Protection; Emergency Preparedness and  
22 Operations Procedures; Facilities Design, Connections and Maintenance; Interchange Scheduling  
23 and Coordination; Interconnection Reliability Operations and Coordination; Modeling, Data and

1 Analysis; Personnel Performance, Training and Qualifications; Protection and Control;  
2 Transmission Operations; Transmission Planning and Voltage and Reactive Control. Grain Belt  
3 Express will be prepared to comply with the requirements of the reliability standards that are  
4 applicable to its activities.

5 **Q. Please describe Grain Belt Express' plans for restoration of safe and adequate**  
6 **service after significant, unplanned/forced outages of an asset.**

7 A. Worker safety and the safety of the public is our number one priority through  
8 design, construction, and operations. Evaluating and maintaining health and safety reports or  
9 OSHA Work-Related Injuries and Illnesses, established operational procedures, pre-work  
10 inspections of equipment and tools, and the presence of health and safety inspectors during  
11 operations are all critical components for successful long-term operations.

12 Grain Belt Express will develop project specific procedures for unplanned or forced  
13 outages which will define the roles and responsibilities of those performing work under such  
14 conditions. Following disruption of operational data, the responsible party will assess the data and  
15 dispatch qualified field technicians to inspect the transmission line as determined. Those  
16 dispatched will be responsible for performing and documenting the initial assessment work which  
17 would include assessing whether the current status is safe, implementing protocol to ensure the  
18 safety of the public and immediate site safety as required, damage assessment, assessment of  
19 additional resources, and further coordination with operations and asset management to determine  
20 a detailed restoration plan which ensures worker safety and the safety of the public.

21 Grain Belt Express restoration procedures will involve maintaining readily available  
22 components and additional spare materials for replacement when needed. Spare materials would  
23 be located or staged at multiple locations such that resources can be quickly allocated to any point

1 on the transmission line where maintenance or restoration services may be needed. In the unlikely  
2 event that multiple structures fail in unison and insufficient materials are available for immediate  
3 replacement, restoration of the line would be addressed using predetermined temporary structures  
4 and material for rapid response and restoration. Additional materials would be procured, and a  
5 full restoration planned and coordinated with a scheduled outage.

6 **IX. CONCLUSION**

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

8 **A. Yes, it does.**

**BEFORE THE PUBLIC SERVICE COMMISSION  
OF THE STATE OF MISSOURI**


In the Matter of the Application of Grain Belt )  
Express LLC for an Amendment to its Certificate )  
of Convenience and Necessity Authorizing it to )  
Construct, Own, Operate, Control, Manage, and ) File No. EA-2023-0017  
Maintain a High Voltage, Direct Current )  
Transmission Line and Associated Converter )  
Station )

**AFFIDAVIT OF AARON WHITE**

1. My name is Aaron White. I am the Senior Transmission Engineering Manager for Invenergy, LLC (“Invenergy”). My business address is One South Wacker, Suite 1800, Chicago, Illinois 60606.

2. I have read the above and foregoing Direct Testimony and the statements contained therein are true and correct to the best of my information, knowledge, and belief.

3. Under penalty of perjury, I declare that the foregoing is true and correct to the best of my knowledge and belief.

DocuSigned by:  
  
445ACDCE7BC94A2...

Aaron White  
Senior Transmission Engineering Manager  
Invenergy LLC

Date: 8/24/2022