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Aaron White
Surrebuttal Testimony
File No. EA-2023-0017

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MISSOURI PUBLIC SERVICE COMMISSION

FILE NO.

EA-2023-0017

SURREBUTTAL TESTIMONY

OF

AARON WHITE

ON

BEHALF OF

GRAIN BELT EXPRESS LLC

MAY 15, 2023

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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. Have you previously submitted testimony in this proceeding?

6 Yes, I submitted direct testimony on August 24, 2022 and accompanying
7 exhibits/schedules identified as Schedules AW-1 through AW-4.

8 Q. What is the purpose of your surrebuttal testimony?

9 A. I am testifying to address issues discussed in the rebuttal testimony submitted by
10 Missouri Public Service Commission (“MPSC” or “Commission”) Staff Witnesses Alan Bax and
11 Michael Stahlman on April 19, 2023. I also respond to Staff’s Report, filed on April 19, 2023, and
12 several public comments submitted at Public Hearings held March 6–8, 2023 in accordance with
13 the Commission’s *Order Setting Local Public Hearings and Directing Notice*, issued February 8,
14 2023.

15 Q. Are you sponsoring any schedules or exhibits as part of your surrebuttal
16 testimony?

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

- 18
- Schedule AW-5 – Siemens Contract (Highly Confidential)

1 **II. RESPONSE TO STAFF WITNESS ALAN BAX’S REQUEST TO PROVIDE AS-**
2 **BUILT DRAWINGS**

3 **Q. On page 6 of his Rebuttal Testimony, Staff Witness Alan Bax recommended**
4 **the Commission order Grain Belt Express to provide “as-built” drawings of the various**
5 **stages of the design, construction and installation of associated equipment included with the**
6 **Project as they become available. How do you respond?**

7 A. As indicated by Footnote 1 of my Direct Testimony, Grain Belt Express is not
8 opposed to providing “as-built” drawings to the Commission when they are available, as required
9 under 20 CSR 4240-20.045(5)(D). It is unclear what Mr. Bax means by “as-built drawings of the
10 various stages of design, construction and installation,” but such language appears to go beyond
11 the Commission’s requirements and is problematically vague. If Mr. Bax is simply referring to
12 the Commission’s requirement, Grain Belt Express has no problem with complying.

13 **III. RESPONSE TO STAFF WITNESS ALAN BAX’S ASSERTION THAT GRAIN**
14 **BELT EXPRESS IS NOT WILLING TO MAKE THE INCREMENTAL INVESTMENT**
15 **IN BIDIRECTIONAL OPERATION**

16 **Q. On page 6 of Mr. Bax’s Rebuttal Testimony, relying upon Grain Belt Express’**
17 **response to Staff Data Request No. 0054, he states that Grain Belt Express is not planning to**
18 **undertake the incremental investment necessary to allow for bidirectional operation. How**
19 **do you respond?**

20 A. Mr. Bax’s characterization is incorrect. My response to Staff Data Request No.
21 0054 (“Staff DR No. 0054”) states:

22 Bidirectional power flow is inherent to the selected technology type (via the control
23 and protection system) - the voltage source converter can quickly reverse the
24 direction of current to change direction of power flow.

25 Although system capacity from eastern points to western points on the Grain Belt
26 assets has not yet been requested, Grain Belt is planning to undertake the

1 incremental investment to allow for bidirectional operation when the demand exists
2 in the future....

3 The contract between Grain Belt Express and Siemens (the converter station supplier), attached
4 hereto as Highly Confidential Schedule AW-5, provides for delivery of bidirectional converter
5 stations.¹

6 The “incremental investment” is in reference to withdrawal rights at the various regional
7 transmission organizations (“RTOs”). The Surrebuttal Testimony of Carlos Rodriguez provides
8 additional details regarding obtaining necessary withdrawal rights to permit bidirectional flow with
9 the Southwest Power Pool, Inc. (“SPP”), Midcontinent Independent System Operator, Inc.
10 (“MISO”), and the PJM Interconnection, LLC (“PJM”).

11 Nevertheless, to be clear, bidirectional flow is part of the Project’s capabilities.

12 **IV. RESPONSE TO STAFF WITNESS MICHAEL STAHLMAN’S**
13 **RECOMMENDATION TO DEFINE MATERIAL CHANGE**

14 **Q. On page 9 of Staff Witness Michael Stahlman’s Rebuttal Testimony, he**
15 **recommends adding further clarification on what constitutes a material change. What is the**
16 **scope of your response?**

17 A. To summarize Mr. Stahlman’s material change recommendations, he
18 recommended defining material change as (1) a change in the converter station location or point(s)
19 of interconnection, (2) a modification of 100 MW in converter station design size, (3) a change of
20 a half billion dollars in estimated cost; or (4) a change to injection rights and withdrawal rights.

21 My response addresses changing the converter station location or point(s) of
22 interconnection and modifying converter station design size by 100 MW. Rolanda Shine’s

¹ Schedule AW-5 is marked as Highly Confidential pursuant to the Amended Protective Order in this case because it contains information that Grain Belt Express classifies as proprietary, non-public financial and contractual information related to it and affiliated Invenenergy companies.

1 Surrebuttal Testimony addresses a change of a half billion dollars in estimated cost. Carlos
2 Rodriguez’s Surrebuttal Testimony addresses changes to injection rights and withdrawal rights.

3 **Q. What is Grain Belt Express’ position on the need to establish an explicit**
4 **definition for “material change”?**

5 A. Mr. Stahlman’s bright line definitions for “material change” are not necessary
6 because, as indicated by the current Amendment Application, Grain Belt Express will file an
7 updated application with the Commission if there are design and engineering changes that are
8 materially different from the certificated Project. Mr. Stahlman has not demonstrated why defining
9 material changes is necessary, given Grain Belt Express’ demonstration of compliance with the
10 current condition.

11 **Q. How do you respond to Mr. Stahlman’s recommendation that changing the**
12 **converter station location or point(s) of interconnection constitutes a material change?**

13 A. While a bright line definition is not necessary, as explained above, I agree that
14 moving the converter station location out of Monroe County or the points of interconnection out
15 of Callaway County would constitute a material change. I do not agree that minor changes to the
16 location of the converter station or points of interconnection within the counties and within the
17 bounds of Grain Belt Express’ routing authority would constitute a material change.

18 **Q. How do you respond to Mr. Stahlman’s recommendation that changing the**
19 **converter station design size by 100 MW constitutes a material change?**

20 A. While a bright line definition is not necessary, I agree that a change in converter
21 station size *could* constitute a material change. That view is consistent with Grain Belt Express’

1 Application and testimony in this docket,² as well as testimony in EC-2021-0059.³ In this Docket,
2 a 2000 MW increase in converter station size along with the 2000 MW change in injection rights,
3 a change in location of the converter station, and a change in points of interconnection constituted
4 a material change.

5 However, it is important to distinguish between changes in size that are improvements upon
6 the design and engineering of the Project and changes in size that are material changes that would
7 impact Missouri landowners or the Commission’s findings supporting Grain Belt Express’ existing
8 certificate of public convenience and necessity (“CCN”).

9 **Q. Please elaborate.**

10 A. As stated in my Direct Testimony on page 17, many changes to design are not
11 material because improving upon design and technology as a project progresses from the
12 permitting phase to construction is a common and beneficial process for any transmission line. If
13 Grain Belt Express were to change the converter station by a 100 MW to accommodate the request
14 of a future customer, it would be an improvement on the design that would not impact Missouri
15 landowners or the Commission’s prior findings.

16 **Q. Why does a 100 MW change in converter station size not impact Missouri**
17 **landowners?**

18 A. Landowners are not impacted by a 100 MW (or even a 1000 MW) change in the
19 capacity of a converter station, by itself, because it would not change the footprint or the physical
20 size of the converter station. Converter station size is driven by voltage, not megawatts. The

² Grain Belt Express LLC Application, p. 8 (Aug. 24, 2022) (“Application”) (stating “Changes to the Missouri converter station’s size (from 500 to 2500 MW) and location (from Ralls County to Monroe County ...)”); Direct Testimony of Shashank Sane at p. 4 (Aug. 24, 2022).

³ Case No. EC-2021-0059, Tr. Vol. 1, 95:5–8 (Testimony of Kris Zadlo, former Vice President of Invenenergy Transmission LLC)

1 transmission line right-of-way will also not be impacted by a change in the converter station
2 capacity.

3 **Q. Why does a 100 MW change in converter station size not impact the**
4 **Commission’s findings?**

5 A. The Commission’s findings supporting Grain Belt Express’ existing CCN would
6 not be materially different if the converter station’s capacity changed by 100 MW (or even 1000
7 MW) because such a change—in and of itself—does not meaningfully impact the Commission’s
8 finding on the necessity, economic viability, or the public interest of the Project.

9 **Q. Is there a change in converter station size that would impact the landowners**
10 **or the Commission’s findings?**

11 A. Because Grain Belt Express has already purchased approximately 160 acres of
12 property for the Missouri converter station and because the outer fence line of the converter station
13 is anticipated to enclose approximately 14 acres, any change in converter station size would not
14 impact landowners. Furthermore, any change in converter station size *by itself* would not impact
15 the Commission’s findings, because a change in the converter station size *by itself* does not change
16 the necessity, economic viability, or the public interest of the Project. If the change in the converter
17 station size was accompanied by a significant change in injection rights, it *might* impact the
18 necessity, economic viability, or public interest of the Project. Mr. Stahlman’s recommended
19 “material change” threshold for injection rights is addressed by Mr. Rodriguez.

1 **Q. What are the potential problems with Mr. Stahlman’s material change**
2 **recommendations?**

3 A. Mr. Stahlman’s material change recommendations could trigger unnecessary
4 additional applications with the Commission that further delay the construction of the Project and
5 result in re-litigation of issues.

6 **Q. If the Commission were to define “material change” as it relates to the**
7 **converter station, what would you recommend?**

8 A. Grain Belt Express agrees that a change in location of the converter station or
9 technology (*e.g.*, change from DC to AC) could constitute a “material change.”

10 **V. RESPONSE TO STAFF’S REPORT ADDRESSING AGRICULTURAL ACREAGE**
11 **IMPACTED**

12 **Q. On page 2–3 of Staff’s Report, Staff takes issue with Grain Belt Express’**
13 **decision to primarily use lattice towers because in Staff’s view it contradicts Grain Belt**
14 **Express’ prior statements and the findings of the Commission in EA-2016-0358 regarding**
15 **agricultural acreage impacted. How do you respond?**

16 A. I disagree with Staff’s characterization that Grain Belt Express’ use of lattice
17 structures contradicts Grain Belt Express’ prior statements or impacts the Commission’s prior
18 findings. While I am not a lawyer, I am advised by counsel that the Commission’s Report and
19 Order on Remand in EA-2016-0358 (“CCN Order”) did not impose any structure type
20 requirements. Nor did Grain Belt Express commit to using a specific mix of structure types.

21 As well, Grain Belt Express identified three potential structure types: 1) traditional self-
22 supporting lattice structures, 2) tubular steel “monopole” structures, and 3) self-supporting lattice

1 mast structures.⁴ Grain Belt Express also made clear that structure types would be dependent upon
2 land compatibility, project costs, environmental impacts, local terrain, and other relevant factors.⁵
3 Further, Grain Belt Express stated, “It is likely that a mix of structures will be utilized to design
4 the most efficacious solution.”⁶ In other words, there was no certainty on the mix of structure
5 types because the most efficient design would be utilized.

6 **Q. Is the current lattice tower design the most efficient?**

7 A. Yes. As described more fully in my Direct Testimony on page 17, the lattice towers
8 currently being used for the Project further strengthen the operational performance of the
9 transmission line. For example, the current lattice tower design has been updated to account for
10 the 100-year Mean Recurrence Interval (“MRI”) wind speed for the “extreme wind” structural load
11 case, which is based on recommendations released in the Guideline for Electric Transmission Line
12 Structural Load, 4th ed. ASCE 2020. Additionally, the lattice tower design was updated to account
13 for modifications to the Dedicated Metallic Return (“DMR”) conductor. The DMR was modified
14 to improve operational performance and to reduce electrical losses during various operating
15 modes.

16 Therefore, Grain Belt Express views the lattice tower design as the most efficient and
17 consistent with EA-2016-0358.

18 **Q. In its CCN Order on page 46, the Commission stated that “Out of 206 miles**
19 **that the Project will traverse in Missouri, no more than nine acres of land would be taken**
20 **out of agricultural production as a result of the structures installed for the Project in**

⁴ Case No. EA-2016-0358, Wayne Galli Direct Testimony, p. 11 (Aug. 30, 2016).

⁵ Case No. EA-2016-0358, Wayne Galli Direct Testimony, p. 11 (Aug. 30, 2016).

⁶ Case No. EA-2016-0358, Wayne Galli Direct Testimony, p. 11 (Aug. 30, 2016).

1 **cultivated lands.” How much agricultural acreage will be impacted as a result of the**
2 **Amended Project?**

3 A. Including the HVDC Main Line and the Tiger Connector, less than 1% of the total
4 right of way takes Missouri agricultural land impacted (“ag land impacted”):

- 5 • Missouri HVDC Main Line (Phase I): ~9 acres impacted
- 6 • Missouri HVDC Main Line (Phase II): ~7 acres impacted
- 7 • Tiger Connector: ~0.2 acres impacted
- 8 • Total: ~16.2 acres impacted

9 Those rough estimates are based upon the latest structure spotting and tower base
10 geometries as of November 23, 2022, the date these numbers were provided in response to MLA
11 data request AW-6. Tower base geometries that were counted towards ag land impacted were for
12 all towers on parcels that are primarily used for crop production according to the 2019 National
13 Land Cover Database.

14 To calculate the estimate for the Tiger Connector, Grain Belt Express conservatively
15 assumed agricultural land use for the entirety of the route and uses preliminary base and foundation
16 geometries as the area impacted.

17 **Q. How did Grain Belt Express minimize the impact on agricultural land?**

18 A. Wherever practicable, for both the HVDC Main Line and the Tiger Connector,
19 Grain Belt Express attempted to site structures outside of agricultural land, even if the parcel is
20 primarily agricultural.

21 **Q. Despite the increase in acreage of agricultural land impacted, why do you**
22 **consider Grain Belt Express’ representations in the Amended Application to be consistent**
23 **with EA-2016-0358?**

24 A. The Project must be considered as a whole. When considering the Project as a
25 whole, even with the increase, the agricultural land impacted by the transmission structures is still

1 less than 1% of the total right of way of the Project in Missouri. Further, as discussed in the
2 testimony of Kevin Chandler, Grain Belt Express remains fully committed to the Missouri
3 Agricultural Impact Mitigation Protocols.

4 **VI. RESPONSE TO PUBLIC COMMENTS**

5 **A. IMPACT OF THE PROJECT ON GPS EQUIPMENT**

6 **Q. Several public commenters expressed concern regarding the impacts of the**
7 **Project on GPS Satellite signals and farming equipment that utilize GPS. How are these**
8 **devices affected by the proposed line?**

9 A. GPS devices will continue to operate with their traditional degree of accuracy near
10 and under high voltage lines. The frequencies of radio noise from transmission lines are not the
11 same frequencies used by orbiting satellites and GPS units, including those associated with farm
12 equipment, therefore, there should not be any interference. The corona sometimes associated with
13 a transmission line primarily produces radio noise in the range of 0.1 megahertz (“MHz”) to 10
14 MHz.

15 Real Time Kinematic (“RTK”) systems, which are ground-based controls used to make
16 differential calculations and improve positional accuracy of GPS, receive GPS satellite signals at
17 1227.60 MHz to 1575.42 MHz frequencies. RTK systems transmit and receive terrestrial signals
18 typically at Ultra High Frequencies that are greater than 300 MHz. Since both GPS and terrestrial
19 signals on which RTK systems rely are not within the frequency ranges of transmission lines, it
20 would be highly unlikely for the lines to interfere with GPS communication.

21 GPS signals can be physically blocked by objects such as trees or they can be degraded by
22 reflections off large solid objects. It is technically possible that the signal from *one* GPS satellite
23 could be blocked or degraded by a transmission structure. However, it is extremely unlikely that

1 this could result in a loss of functionality for a GPS receiver in an agriculture setting. The United
2 States government ensures that at any given time there are at least 24 functioning GPS satellites in
3 geosynchronous orbit in all parts of the sky, and many GPS receivers today make use of other
4 sources of satellite signals. A GPS receiver requires signal from only three satellites to calculate
5 the horizontal position on earth; all GPS receivers regularly add and drop satellites and receive
6 signals from twelve or more satellites simultaneously. Hence, it is unlikely that a brief or even
7 prolonged blockage of a single satellite would adversely affect GPS operation.

8 **B. RESPONSE TO CONCERNS ABOUT ELECTRIC AND**
9 **MAGNETIC FIELDS**

10 **Q. Can you describe the public comments relating to electric and magnetic fields?**

11 A. Yes. In the context of the Project, public commenters have expressed concern about
12 the impact of electric and magnetic fields (“EMF”) on human health, animal health, and various
13 other concerns. These issues were addressed thoroughly in the Direct Testimony of William
14 Bailey filed in EA-2016-0358 on August 30, 2016. There, Mr. Bailey described the impacts of
15 EMF in the context of both direct current (“DC”) and alternating current (“AC”) electric
16 transmission lines. I encourage interested persons to review Mr. Bailey’s Direct Testimony for
17 additional information on the impacts of EMF as they relate to the Project.

18 The Commission’s CCN Order cited Mr. Bailey’s Direct Testimony when stating that “the
19 scientific weight of evidence does not support the conclusion that electric and magnetic fields

1 cause any long-term adverse health effects, and the levels of electric and magnetic fields associated
2 with the Project do not pose any known risk to human health.”⁷

3 No evidence has been introduced by public commenters or intervenors to disturb that
4 conclusion.

5 **C. RESPONSE TO WHETHER THE PROJECT SHOULD BE BURIED**

6 **Q. Several public commenters have suggested the Project should be buried. How**
7 **do you respond?**

8 A. The suggestion that the Project should be buried is not as straightforward as
9 implied. The Project should not be buried for a variety of reasons, but the primary reasons are 1)
10 facility design considerations, 2) increased land impact, and 3) increased costs. An underground
11 transmission line is fundamentally different than an aboveground transmission line. In the case of
12 the Grain Belt Express Project, burying the Project is not in the best interests of Missouri.

13 Construction of underground transmission cables generally involves the following
14 sequence of events: 1) ROW clearing, 2) trenching/blasting, 3) laying conduit, 4) duct bank and
15 vault installation, 5) backfilling, 6) cable installation, 7) adding fluids or gas (if needed) and 8) site
16 restoration. Each of these events bring various engineering and constructability considerations.
17 To begin, the line cannot be buried under the ground without additional protection. The lines must
18 be mechanically protected by being buried in a duct bank, conduit, tunnel and vault with access
19 from the surface.

20 Vaults are large concrete boxes buried at regular intervals along the underground
21 construction route. Vaults’ primary function is to provide permanent access to underground cable
22 for maintenance and repair. The number of vaults required for an underground transmission line

⁷ Case No. EA-2016-0358, Report and Order on Remand, ¶ 118 (Mar. 20, 2019).

1 is dictated by the following: 1) the maximum length of cable that can be transported on a reel, 2)
2 the cable's allowable pulling tension, 3) elevation changes along the route and 4) the cable's
3 permissible sidewall pressure as the cable goes around bends. Vaults take up a surface area of
4 approximately 10 feet by 30 feet and have a depth of approximately 10 feet. They typically have
5 two chimneys constructed with manholes which workers use to enter the vaults for cable
6 maintenance.

7 Before the cable can be buried in a duct bank, conduit, tunnel, and vault, splicing of the
8 cable is necessary. Splices determine the location of vaults. I would expect that 2,000-foot reels
9 could be effectively spooled and transported, which would mean that a splice would be needed
10 every 2,000 feet or less.

11 Therefore, vaults would be required every 2,000 feet or less to permit permanent access to
12 the splices when repairs are needed. As a reminder, the Project will be approximately 246 miles
13 long in Missouri (including the Tiger Connector).

14 Burying the Project would also impact the land between the vaults. Burying transmission
15 lines requires digging a continuous trench at least ten feet wide at the bottom and eight feet deep
16 to keep cables below the frost line. Considerable clearing and grading is necessary within the
17 trench. After burial, site restoration is extensive. Top-soils must be restored and hard surfaces must
18 be re-established to meet local codes. Regardless of restoration efforts, it may take years for
19 vegetation to return to preconstruction conditions and crop yields will likely be negatively
20 impacted due to subsoil compaction and the disturbance of top-soil in the right-of-way.

21 In short, burying the Project would have a significantly greater impact on the portions of
22 the Project in which it is buried. Whereas the impacts of aboveground transmission lines are much

1 more limited to areas immediately surrounding structure footprint locations, which are at a distance
2 from one another.

3 There are circumstances where burying transmission lines is viable. The circumstance of
4 Missouri and this Project is not one of them.

5 **VII. CONCLUSION**

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

7 **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 Rebuttal 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: 5/15/2023