

COMMONWEALTH OF KENTUCKY
BEFORE THE KENTUCKY STATE BOARD ON ELECTRIC GENERATION
AND TRANSMISSION SITING

In the Matter of:

<i>Electronic</i> Application of Golden Solar, LLC)	Case No.
for Certificate of Construction for an up to 200)	2020-00243
Megawatt Merchant Electric Solar Generating)	
Facility in Caldwell County, Kentucky)	

**Post-Hearing Brief re Proposed Gen-Tie’s Inclusion in the requested
Construction Certificate for a Merchant Electric Generating Facility**

Applicant, Golden Solar, LLC (“Golden”), herein lists and explains reasons why no separate KRS 278.714 “transmission certificate” is required for the gen-tie line that is part of its Project proposal and which will convey the electricity generated to the Project-adjacent LG&E/KU substation for interconnection with the interstate transmission grid. Although some of the reasons given may apply to all gen-ties for merchant electric generating facilities, this brief is not intended to argue for a generally applicable rule (such as might be the subject of a regulation duly promulgated pursuant to KRS 278.702(3)) dividing gen-ties that are included within an associated generating facility construction certificate from those that are not. Instead, this brief addresses the particulars of the Project and its gen-tie line and demonstrates that wherever the dividing line might be, the only reasonable construction of KRS 278.700 – .718 is that this gen-tie line for this Project falls on the side for which no separate “transmission certificate” is required.

STATEMENT OF THE CASE:

The gen-tie line is a short, integral part of the merchant electric generation facility.

Golden has applied to the Board for a certificate of construction for an approximately 100 MW merchant electric solar generating facility pursuant to KRS 278.704. In ¶17 of its Application, Golden stated that as part of its proposed Project, it “will construct a substation within the

Project boundary to connect to the North Princeton Switching Station owned by LG&E/KU.”

Among the materials Golden submitted as exhibits to its Application were:

- an analysis of the expected effect on the electricity transmission system in Kentucky (Exhibit E, per KRS 278.706(2)(i)),
 - attaching reports from the LG&E/KU Feasibility Study, System Impact Study, and Facilities Study,¹ and
 - noting that a Large Generator Interconnection Agreement (LGIA) had been signed with LG&E/KU on August 23, 2021.
- a description of the interconnection with the North Princeton substation (SAR 1.2.1, 1.2.2 ¶6, Exhibit H, per KRS 278.708(3)(a)), to be accomplished by constructing a Project substation within the Project area and an approx. 300-foot generator interconnection or tie line (“gen-tie”) to facilities at that LG&E/KU substation.

The preliminary site development plan filed with the Application (App. Exh. J, sheets C.200 and C.201) and as amended/updated in a 11/22/22 filing (Am. Exh. J pp. 2 & 3 of 5, 2 ESB 14 Response Attachment) show the proximity of the proposed Project substation and the existing LG&E/KU substation to each other. The LG&E/KU substation and the land on which it is located are not leased by Golden and are in the exclusive control of LG&E/KU. The Project boundary maps (App. Exh. I figures 2.3 and 3) illustrate this by showing a small parcel (with the existing LG&E/KU substation) bounded by Project properties on three sides and by Goodsprings Road to the east. See Brief Exhibits 1 and 2 attached hereto.

The proximity of the North Princeton substation and the location of the gen-tie within the general footprint of the Project makes its effects negligible. It does not add impacts to habitats or species or involve avoidance areas. There will be no trees cleared for the gen-tie. With the North Princeton substation so close, there are existing distribution lines and overhead infrastructure in this area. Origination in and proximity to the proposed Project substation (with its greater

¹ The reports contain references and links to Study criteria, guidelines, inputs, and other documentation on the LG&E/KU Open Access Same-Time Information System (OASIS) or its Critical Energy Infrastructure Information File Transfer Protocol (CEII FTP) site.

setback commitments) means that (a) there are no residences within 1900 feet (0.35 miles) of the gen-tie and (b) its path did not add to the list of adjoining landowners for whom notice was required.

Details of the “generation interconnection” between the Project and an existing 161 kV ring bus at the North Princeton substation are provided in the reports from the LG&E/KU Feasibility Study, System Impact Study, and Facilities Study attached to Application Exhibit E.² These Studies refer to Golden as the interconnection customer, LG&E/KU as the transmission owner, and the requested interconnection as between the generator lead-line and the transmission owner’s transmission system.³ For the interconnection, Golden is responsible for the step-up transformer at its substation, the generator lead-line, and customer protective devices up to the metering equipment of the transmission owner (LG&E/KU) at the Point of Change of Ownership.⁴ LG&E/KU are to own all the transmission interconnection facilities (TIF) including all equipment between the metering equipment and the Point of Interconnection, plus network facilities added to the existing ring bus for the generation interconnect line, telecom infrastructure, and other changes to accommodate the new generation interconnect line.⁵ The TIF “are sole use facilities.... Only generation facility power can flow through TIF equipment.”

² See also Am. Exh. J (2 ESB 14 attachment), sheet C. 700 (typical substation profile); 11/22/22 Response to 2 ESB 16 and attached Substation Protection and Control Plans diagram (noting proposed substation facilities and the interconnection to the North Princeton 161 kV substation).

³ See, esp., the 1/22/21 Facilities Study Report (FSR), attached as Brief Exhibit 3. FSR p.10 §4.2.1.4, for example, refers to the proposed Golden substation and gen-tie as “the collector substation” and “the IC line segment” or “the new GI line connection” respectively. This is consistent with FERC definitions, e.g., in 18 CFR §37.3, in which the *Transmission Provider* “owns, operates, or controls facilities used for the transmission of electric energy in interstate commerce.”

⁴ FSR p.7 (§4.1; definition and responsibility for *Generator Owner Facilities*); p.13 (§4.5.1).

⁵ FSR p.7 (§4.1; definition of *Transmission Interconnection Facilities*), pp. 13-16 (§§ 4.5.2 –4.5.4). All TIF costs are the sole responsibility of the interconnection customer (Golden). FSR pp.7-8 (§4.1), citing LGIA Art. 11. KRS 278.212(2) provides that costs or expenses for upgrading the existing electric-ity transmission grid resulting from a merchant electric generating facility’s additional load are to be

ARGUMENT:

The applied-for KRS 278.704 certificate for constructing the merchant electric generating facility will include authorization to construct the gen-tie line, without the necessity for a KRS 278.714 certificate.

For at least three reasons, the only reasonable construction of KRS 278.700–.718 is that the Application and the requested construction certificate include the gen-tie line as part of the proposed merchant electric generating facility Project.

1. The gen-tie is an associated facility of the merchant electric generating facility Project to be certificated under KRS 278.704.

Without access to the transmission grid — in this case by interconnection with the North Princeton substation — the Project would not be a merchant electric generating facility because it could not sell what it generated in the wholesale markets — an essential element in the definition of “merchant electric generating facility.” *See* KRS 278.700(2)(b). Kentucky end-users are within the utilities’ statutorily-directed monopolized territories, so retail distribution-voltage sales are not available to Golden. If Golden were, for example, a large industrial user it could supply itself alone with the electricity generated by the Project but then it would not be a merchant at all.

KRS 278.700(2) expressly defines a “merchant electric generating facility” to include not only the generating equipment itself but also all “associated structures and facilities”:

“Merchant electric generating facility” means ... an electricity generating facility or facilities that, together with all associated structures and facilities: (a) are capable of operating at ... ten megawatts (10 MW) or more; and (b) sell the electricity they produce in the wholesale market....

borne by the one constructing the facility “and shall in no way be borne by the retail electric customers of the Commonwealth.”

Thus, even if the gen-tie were not essential for the Project to sell the electricity generated in the wholesale market, it is a structure or facility “associated” with the generating equipment and is a component of the “merchant electric generating facility” to be certificated. A certificate from the Board for construction of the proposed Project may and should authorize construction of the associated facilities that will interconnect the generation equipment and structures with the North Princeton substation.

Although it is sufficient for this brief to show that the associated gen-tie proposed in the Application may be authorized by a construction certificate for a generating facility, it should be noted that the proposed gen-tie is not a “nonregulated electric transmission line” within the meaning of the KRS 278.714 certificate requirement. KRS 278.700(5) defines a “nonregulated electric transmission line” to mean:

... an electric transmission line and related appurtenances for which no certificate of public convenience and necessity is required; which is not operated as an activity regulated by the Public Service Commission; and which is capable of operating at or above sixty-nine thousand (69,000) volts....

Although the equipment, structures, and other facilities between the proposed Golden substation and the Point of Change in Ownership at the LG&E/KU substation may be (in part) an electric line and related appurtenances capable of operating at 69kV or above, they are not a transmission line. The interconnection facilities that Golden proposes to construct and operate are not for common carriage or two-way traffic, nor would they be regulated as transmission in interstate commerce by the Federal Energy Regulatory Commission (FERC). Instead, the line is energized only by Golden and only to convey the electricity generated to a hand-off point with LG&E/KU at the North Princeton substation. Transmission function begins on the LG&E/KU side of the interconnection; however, even between the Point of Change of Ownership and the Point of Interconnection to the transmission grid, the LG&E/KU interconnect facilities are “sole use”

through which “[o]nly generation facility power can flow.” Brief Exh. 1, Facilities Study Report p.7 (§4.1). Nonetheless, because a KRS 278.704 generation construction certificate plainly can encompass the proposed gen-tie, the question is moot whether the gen-tie could also be authorized under a KRS 278.714 certificate.

2. For a gen-tie line of this length and adjacency to the electric generating facilities, the statutory goals of KRS 278.700 *et seq.* are met by considering it under the requirements for a generation certificate.

The requirements for a KRS 278.704 construction certificate are more comprehensive than those for a KRS 278.714 certificate and include consideration of transmission-related issues associated with the proposed generating project. For example, all the notice and public information requirements and opportunities for an electric transmission certificate are part of the required procedures for a generation certificate, and there must be further notice and opportunities for a proposed generation project, including direct individual notice to landowners of bordering properties (KRS 278.706(2)(c)).⁶ Maps must show residential neighborhoods, schools, and public/private parks within one mile of a proposed transmission line (KRS 278.714(2)(B)(4)(a)); the distance is doubled to two miles for a proposed generating facility and the nearest residential structures must also be shown (KRS 278.706(2)(b)).

A transmission certificate does not require consideration or description of anything other than:

- the proposed route/location of the line and its appurtenances and whether that “will minimize significant adverse impact on the scenic assets of Kentucky”; and
- whether the applicant will construct and maintain the line in accordance with all applicable legal requirements.

⁶ Compare KRS 278.714(2)(e)-(f) (proposed electric transmission requirements) with KRS 278.704(6)-(9), 278.706(2)(c),(f),(h) (proposed generating facility requirements).

KRS 278.714(2)(b)-(d), (3).⁷ A generation certificate, on the other hand, expressly requires consideration and description of the “location of facility buildings, transmission lines, and other structures,” “evaluation of the compatibility of the facility with scenic surroundings,” and projected effect on the electric transmission system and reliability of utility service. *See* KRS 278.706(2)(i); KRS 278.708(3)(a)(4), (2)(b); 278.710(1)(a),(f). Among other things, effects on property values, economic impact, and noise levels from construction and operation must also be considered, *see, e.g.*, KRS 278.710(1)(a)-(c), and a KRS 278.708 site assessment report is required only for a proposed generation facility. KRS 278.706(2)(I), 278.708(1).⁸

The scope and depth of scrutiny for proposed construction of a merchant electric generating facility thus is greater than that for a transmission line. Approval of a transmission line’s construction cannot encompass construction of “associated” proposed generation facilities but, conversely, generation approval can encompass associated transmission-related facilities like the gen-tie in this case. A proposed interconnection line that extends far away from the generation site might be more appropriately and efficiently reviewed simply as a transmission line (under KRS 278.714) particularly along its route located outside the overall generation site footprint; such a line might have scenic impacts on different viewsheds than the associated on-site substation and related facilities. However, as in this case, where the proposed interconnection line is less than 500 feet long and terminates on a parcel abutting the generation site, it is both more rigorous and wholistic to consider it as part of the generation project and under the same standards.

⁷ It is also permissible, but not mandated, to “consider interstate benefits expected to be achieved from the proposed construction or modification of electric transmission facilities in the Commonwealth.” KRS 278.714(3) (emphasis added).

⁸ In addition, KRS 278.212(1) requires a transmission-provider utility to wait to begin constructing/installing any equipment or facility “to establish an electrical interconnection with a merchant electric generating facility” (but not with a nonregulated electrical transmission line) until the interconnection plans and specifications have been filed with the PSC.

3. Granting a construction certificate for the gen-tie as an associated facility and part of the proposed Project comports with Board decisions and practice.

KRS 278.704(1) prohibits commencing to construct a merchant electric generating facility unless “that person has applied for and obtained a construction certificate for the facility from the board.” KRS 278.714(1) prohibits commencing to construct a nonregulated electric transmission line or a carbon dioxide transmission pipeline “without a construction certificate issued by the board.” The more general wording of the latter statute suggests that the certificate might be one for a generating facility project, but both statutes contemplate that there will be a construction certificate (singular). Final orders on proposed generating facility projects have followed suit by conditionally granting a construction certificate regardless of whether the applicant requested a certificate for a generating facility alone⁹ or for a generating facility and a transmission line¹⁰ or filed an application for a generation certificate and another application for a transmission certificate.¹¹ Board decisions on requests styled as for both a generating facility and a transmission line also give more space and priority to the KRS 278.710 determination and then make a relatively brief, *a fortiori* KRS 278.714 determination,¹² implicitly recognizing that the former essentially takes care of the latter.

⁹ See, e.g., *Turkey Creek Solar, LLC* (Madison County), Case No. 2020-00040, 9/23/20 Order p.40, ordering ¶1; *Caldwell Solar, LLC* (Caldwell County), Case No. 2020-00244, 4/8/22 Order p.23, ordering ¶1; *Ashwood Solar I, LLC* (Lyon County), Case No. 2020-00280, 6/21/21 Order p.38, ordering ¶1; *Russellville Solar LLC* (Logan County), Case No. 2021-00235, 8/23/22 Order p.25, ordering ¶1.

¹⁰ See *SunCoke Energy South Shore, LLC* (Greenup County), Case No. 2014-00162, 2/20/15 Order p.21, ordering ¶1; *Unbridled Solar, LLC*, Case No. 2020-00242, 6/4/21 Order p.45, ordering ¶1; *Seebree Solar, LLC* (Henderson/Webster Counties), Case No. 2021-00072, 2/9/22 Order pp.24-25, ordering ¶1; *Blue Moon Energy, LLC* (Harrison County), Case No. 2021-00414, 8/3/22 Order p.24, ordering ¶1.

¹¹ See *Rhudes Creek Solar LLC* (Hardin County), Case No. 2021-00127, 3/4/22 Order, p.26, ordering ¶1.

¹² The *SunCoke Energy*, *Rhudes Creek*, and *Blue Moon* final orders address the KRS 278.714 criteria in a paragraph or two immediately preceding the conclusion and ordering paragraphs. The *Unbridled* and *Seebree* decisions devote 7 and 5 pages, respectively, to discussing those criteria, but do so after an extensive discussion of KRS 278.704, .706, .708, and .710 criteria, including those related to transmission and interconnection issues.

The Board has not questioned or contradicted the applicants' choice whether to distinguish the interconnection lines from the associated generating facilities in requesting a project certificate. In general, applicants have requested a certificate for a transmission line when the gen-tie is of higher voltage than 69 kV and at least one mile in length, and often traversing county or state boundaries. For example:

- SunCoke Energy (2014-00162) – 138 kV line approximately one mile long, crossing the Ohio River to interconnect at an AEP substation in Ohio.
- Unbridled Solar (2020-00242) – 161 kV line approximately 3.15 miles long, interconnecting with BREC transmission facilities at the Reid Station plant site.
- Seebree Solar (2021-00072) – 161 kV line approximately 4.85 miles long, interconnecting at the BREC Reid substation.
- Rhudes Creek (2021-00127) – 138 kV line approximately 1.5 miles long to interconnect at a to-be-constructed KU substation on the Hardinsburg KU transmission line.

Applicants have generally included shorter or lower-voltage gen-ties as part of the generating facilities construction certificate request,¹³ and the Board has granted those certificates. In particular, two projects near to Golden's proposed project received construction certificates with the gen-tie considered as part of the merchant electric generating facility. The Ashwood Solar project in neighboring Lyon County (2020-00280) will interconnect its proposed substation with a short gen-tie to the existing 161 kV KU North Princeton to South Paducah line. The Caldwell Solar project "across the road" in Caldwell County (2020-00244) will interconnect its proposed substation with a short gen-tie to BREC's 161 kV Barkley transmission line. Those minimal gen-tie facilities were among the associated structures and facilities that were included in the construction certificate granted for the respective proposed merchant electric generating facility.

¹³ Recent filings indicate a trend toward applicants choosing to distinguish a gen-tie from the rest of the proposed generating facility project and characterizing it as a transmission line, even though the interconnection is neither lengthy nor higher-voltage (perhaps as a "belt and suspenders" approach). The *Blue Moon* Application (Case No. 2021-00414) reflected such a choice, and the Board did not question or contradict it in the 8/3/22 final order conditionally granting a construction certificate.

Like the nearby Caldwell Solar and Ashwood Solar projects, the proposed gen-tie for Golden's project is a very short (300 feet) line from its on-site substation to an interconnection point with transmission facilities — at the LG&E/KU North Princeton substation. Like those projects, construction of Golden's proposed gen-tie may and should be authorized by the grant of a certificate to the merchant electric generating facility as a whole.

Respectfully submitted,

/s/ Katherine K. Yunker

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Attached Exhibits:

1. Project Layout portion depicting existing LG&E/KU substation (Appl. Exh. I-1, Fig. 2.3)
2. Proposed Gen-Tie Route, Am. Exh. J sheet C.201 (2 ESB 14 Response attachment)
3. 1/22/21 Facilities Study Report, FS-LGE-GIS-2019-008 (Appl. Exh. E)

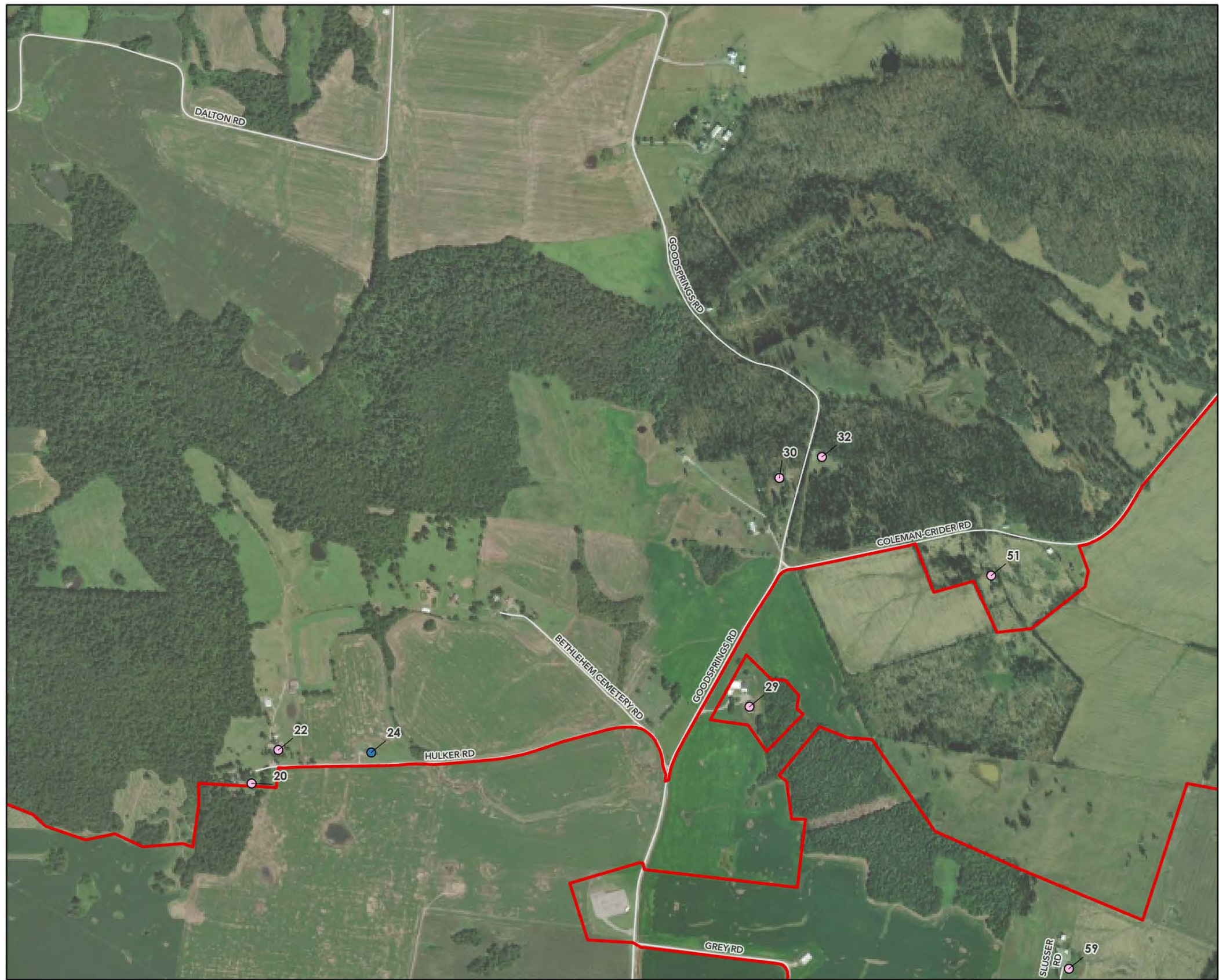


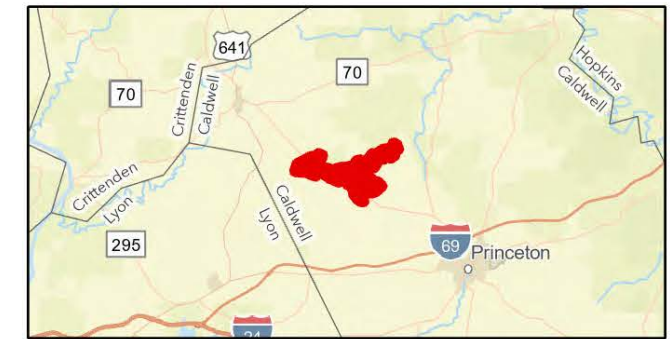
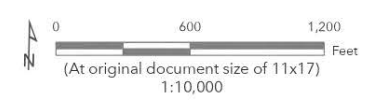
Figure No.
2.3

Title
Project Layout Map

Client/Project
Golden Solar Project

Project Location
Caldwell County, Kentucky

- Project Area
- Residence
- Church



Notes
 1. Coordinate System: NAD 1983 2011 StatePlane Kentucky FIPS 1600 Ft US
 2. Background Source: Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, Maxar



Brief Exhibit 1

Path: K:\Project_Data\Geronimo\Golden\Projects\Mrds\Golden.aprx Revised: 8/10/2022, By: leonard.luz

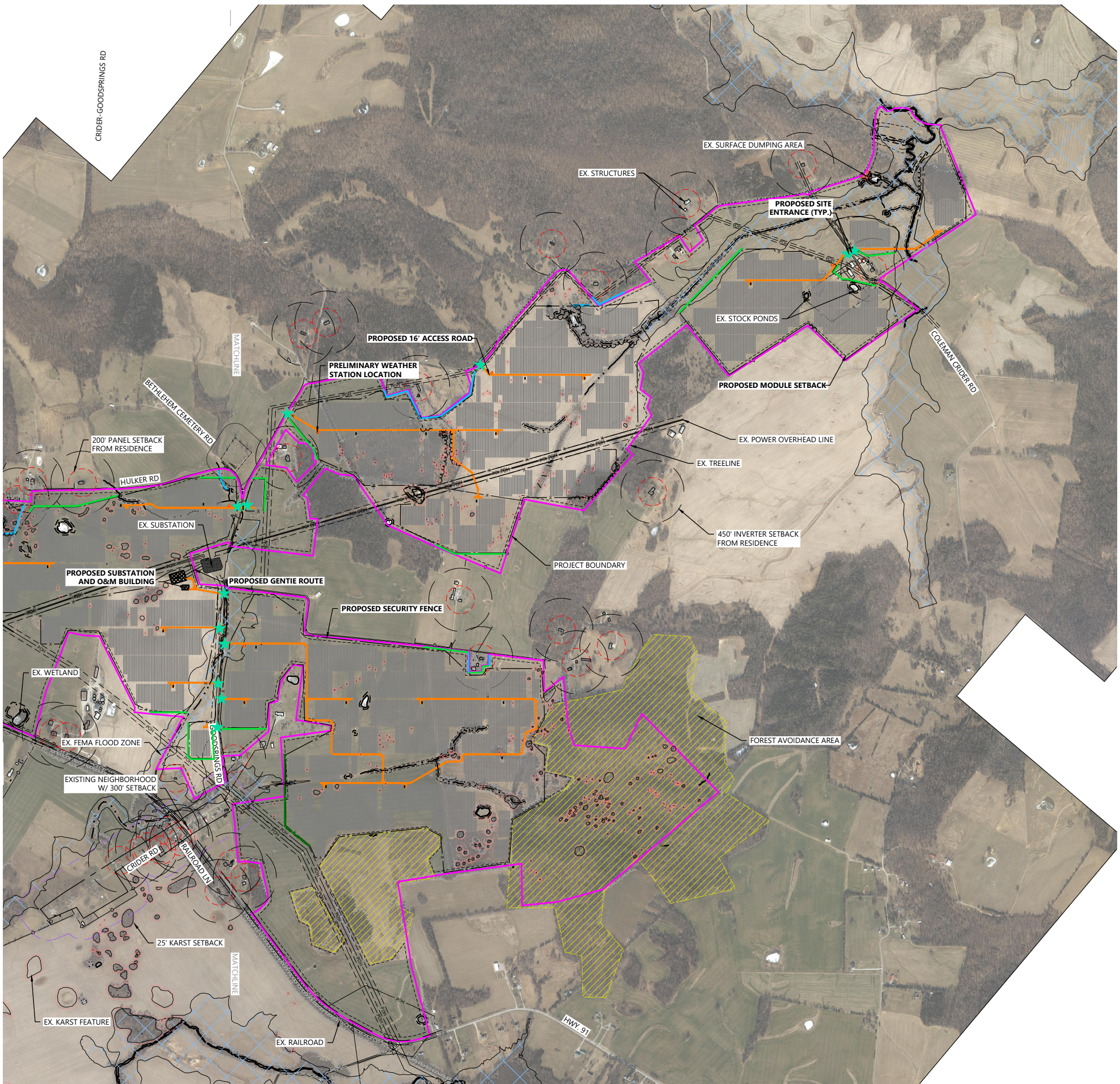
PREPARED FOR:



8400 Normandale Lake Blvd, Suite 1200
 Bloomington, MN 55347

REVISIONS:

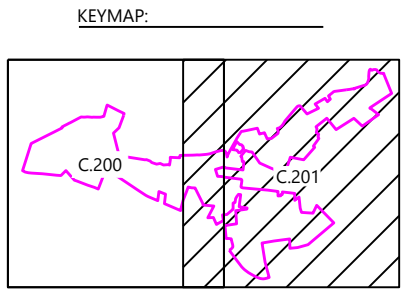
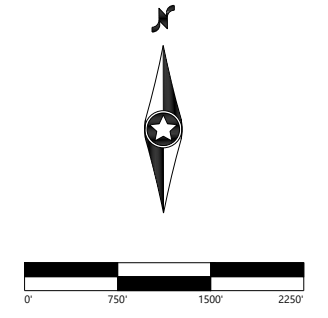
#	DATE	COMMENT



LEGEND:

	PROJECT BOUNDARY
	EASEMENT LINES
	EX. TREELINE
	EX. PAVED ROAD
	EX. GRAVEL ROAD
	EX. FENCE
	EX. RAILROAD
	EX. CULVERT
	200' PANEL SETBACK FROM RESIDENCE
	450' INVERTER SETBACK FROM RESIDENCE
	FOREST AVOIDANCE
	EX. OVERHEAD POWER
	EX. STREAM CHANNEL
	EX. WETLAND
	EX. VEGETATIVE BUFFER
	WETLAND SETBACK
	FEMA FLOOD ZONE
	EX. KARST FEATURE
	EX. SURFACE DUMPING AREA
	25' KARST SETBACK / AVOIDANCE
	PROPOSED SOLAR ARRAY
	PROPOSED INVERTER AND TRANSFORMER SKID
	PROPOSED MODULE SETBACK FROM PROPERTY LINE AND AVOIDANCE AREAS
	PROPOSED VEGETATIVE BUFFER TYPE 1
	PROPOSED VEGETATIVE BUFFER TYPE 2
	PROPOSED ACCESS ROAD
	PROPOSED SECURITY FENCE
	PRELIMINARY WEATHER STATION LOCATION
	PROPOSED TREE LINE
	PROPOSED SITE ENTRANCE

- NOTES:**
- FURTHER FIELD INVESTIGATION FOR POTENTIAL KARST LOCATIONS TO BE COMPLETED PRIOR TO CONSTRUCTION.
 - WEATHER STATION LOCATIONS ARE PRELIMINARY AND SUBJECT TO CHANGE WITH FURTHER DESIGN.



Golden Solar Project
 Caldwell County, Kentucky

Overall Site Plan - 2

Not for Construction

DATE: 11/17/2022
 SHEET: C.201

Brief Exhibit 2



PPL companies

FS-LGE-GIS-2019-008 Facilities Study Report

January 22, 2021

Study & Preliminary Report Completed By:
LG&E/KU Transmission

Report Prepared By:
TranServ International, Inc. (ITO)

TranServ International, Inc.
3660 Technology Drive NE
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1. Executive Summary

A Facilities Study was performed by LG&E/KU for the following request:

**Table 1-1
Request Details**

Queue Position	Queue Date	County	State	Max Output (MW) S/W	Point of Inter-connection	In-Service Date	Inter-connection Service Type	Generator Type
LGE-GIS-2019-008	03/22/2019	Caldwell	KY	100	North Princeton 161 kV Substation	12/31/2021	NRIS/ERIS	Solar

TranServ as Independent Transmission Organization (ITO) completed a Generator Interconnection (GI) System Impact Study (SIS). The GI SIS analyzed the impact of this Generator Interconnection, located near Louisville, Kentucky, in accordance with the LG&E and KU Large GI Study Criteria document as posted on the LG&E and KU Open Access Same-Time Information System (OASIS). Customer executed a Facility Study Agreement with the ITO and LG&E and KU to complete a Facilities Study. LG&E and KU Services Company (LG&E-KU) contracted Black & Veatch (BV) to complete a +/-20% cost estimate study for the Generation Interconnect Request GI-2019-008 facility study. The request requires interconnecting to the existing 161 kV North Princeton substation in Caldwell County, Kentucky.

The LG&E/KU Open Access Transmission Tariff (OATT) states that the Facilities Study will include a good faith estimate of (i) the cost of Direct Assignment Facilities to be charged to the Eligible Customer, (ii) the Eligible Customer’s appropriate share of the cost of any Network Upgrades, and (iii) the time required to complete such construction and initiate the requested service.

TranServ has reviewed the Facilities Study results from LG&E and KU and prepared this report in accordance with the LG&E and KU OATT.

2. Constraint Identified in the SIS

2.1 Steady State Constraints

No constraints were found in the SIS report.

2.2 Contingent Facility Analysis Results

There are no planned transmission improvements associated with any earlier queued LG&E and KU GI request. Thus, no study to determine whether or not those facilities would be contingent facilities for this request was performed. There were no GI-2019-008 contingent facilities identified in the SIS report.

2.3 Short Circuit Analysis Results

The Short Circuit Analysis results from the SIS indicate the transmission system has adequate interrupting capabilities to accommodate the addition of the new solar generator.

2.4 Stability Analysis Results in the SIS

For all tested disturbances in the SIS study, all monitored voltages and angles were found to be within acceptable limits with the addition of the 100 MW generation at the point of interconnection with assumed coordination to eliminate islanding of the GI-2019-008 request and the Princeton load after a P6 disturbance. The need for coordination to prevent islanding is documented in Section 5.7.1 of the full SIS report.

The study also relied on the following all of which are discussed in detail in Section 5 of the full SIS report:

- MISO's determination that the oscillations emanating from J753 were not considered constraints to the GI-2019-003 request, as the GI-2019-003 request did not cause instability. Thus, the J753 generation was modeled as Gnetted in the GI-2019-008 models.
- For simulation with no fault, slight drift in bus angles for some solar generation buses were ignored as discussed in Section 5.7.3 of the full SIS report.

2.5 Stiffness Verification due to Inverter Based Resource Interconnection

The GI-2019-008 Short circuit ratio (SCR) was found to exceed the minimum requirement of 2.0. Due to the location of the GI-2019-008 POI, the Weighted SCR (WSCR) did not apply. There are no Grid Stiffness constraints to granting the GI-2019-008 GI request.

3. Affected System Impacts from SIS

An Ad Hoc Study Group was involved in the study process. Table E-2 documents the Ad Hoc Study Group Comments which relate to independent testing performed by the Ad Hoc Study Group members consistent with the allowance for such testing in the LG&E and KU GI Criteria document.

**Table E-2
 Ad Hoc Study Group Independent Study Comments**

Ad Hoc Group Member	Date Received	Ad Hoc Group Member Comment provided within the 03/30/2020 Deadline
PJM	07/13/2020	PJM does not see any impacts due to this project.
No other Ad Hoc Member chose to provide independent testing results for this request by the 07/30/2020 deadline.		

In addition to the Table E-2 Ad Hoc Study Group responses received prior to the 07/30/2020 deadline, Table E-3 documents additional responses received.

**Table E-3
 Additional Ad Hoc Study Group Comments**

Ad Hoc Group Member	Date Received	Ad Hoc Group Member Comment provided after the 07/30/2020 Deadline
TVA	08/24/2020	Our planning engineers have indicated that that PTDF values on TVA facilities associated with the GI-2019-008 generator require that TVA perform an Affected System Impact Study on this project.
MISO	09/18/2020	MISO will perform Affected System Studies for LKE-GI-2019-008 as impacts on MISO facilities are greater than screening threshold.
No other Ad Hoc Member chose to provide a response between 07/31/2020 and issuance of this report.		

4. Facilities Study Results from LG&E and KU

4.1 Methodology

The following terms are defined in this facilities study report

- **New Network Facilities (NNF)** - additions, modifications, and upgrades to the Transmission Owner's system required at or beyond the Point of Interconnection (POI) to accommodate the interconnection of the Generating Facility to the Transmission System. It is possible for system network power to flow through NNF equipment, along with generation facility power.
- **Transmission Interconnection Facilities (TIF)** - all facilities and equipment owned by the Transmission Owner from the Point of Interconnection (POI) to the Point of Change of Ownership (PCO); including any modifications, additions, or upgrades to such facilities and equipment. Transmission Interconnection Facilities are sole use facilities and shall not include Distribution Upgrades, Generator Upgrades, Stand Alone Network Upgrades, or Network Upgrades. Only generation facility power can flow through TIF equipment.
- **Generation Owner Facilities** – all facilities and equipment owned by the Interconnection Customer starting at the Point of Change of Ownership (PCO).
- **Point of Interconnection (POI)** – the point where the transmission interconnection facilities connect to the new network upgrades.
- **Point of Change of Ownership (PCO)** – the point where the Interconnection Customer's facilities connect to the transmission interconnection facilities.
- **Distribution Upgrades (Distribution Facilities)**
- **Interconnection Customer (IC)** - The Generator Owner.

Article 11 of the LGIA specifies which party (Transmission or Generator Owner) has a construction obligation and who bears the expense of that obligation. Based on the requirements within the LGIA:

- **Generator Owner Facilities:** The Generator Owner is responsible for building, owning, and maintaining the assets. The Generator Owner bears the expense for these assets.
- **Transmission Interconnection Facilities (TIF):** LG&E and KU Transmission is responsible for building, owning, and maintaining the assets. The Generator Owner bears the non-refundable expense for these assets (Generation contribution to Transmission).
- **Network Facilities (NF) (include NNF):** LG&E and KU Transmission is responsible for building, owning, and maintaining the assets. However, the Generator Owner funds the initial expense for the Network Facilities unless LG&E and KU Transmission chooses to fund

them. Any funds received from the Generator will be refunded to the Generator, plus interest, as the Generator takes transmission service, or repayment can be set up over a defined period. The Terms of payment for the Network Facilities will be determined in the negotiation period (identified in the LG&E and KU OATT: Attachment M Section 11) of the LGIA.

- **Distribution Facilities:** LG&E and KU Transmission does not own any Distribution Assets. So, Distribution Asset Costs identified would be reviewed and determined with the local distribution utility.

The LGE-GIS-2019-008 Solar Transmission Estimate was created following the below steps:

- Engineering and Project Management costs were estimated. LG&E and KU project Management & Engineering labor were estimated at 20% of the contracted project Management & Engineering labor cost.
- Construction Management labor costs were estimated. LG&E and KU Construction Management were estimated at 50% of the contracted Construction Management labor costs.
- The Generator Owner facilities are not included in the estimates.
- The Transmission Owner's Telecommunications Department provided an estimate for telecom facilities.
- Cost estimates were broken down between Company labor, contracted labor, materials, and contingency.
- Pricing provided by the vendor was combined with Transmission Owner's burdens and contingency cost
- Pricing provided by the Transmission Owner's Telecommunications Department was aggregated in the cost summary table.
- The responsibility for costs was determined per the Transmission Owner's Allocation of Costs for Generator Interconnections document, effective January 1, 2018, for connecting to an existing substation ring bus configuration. As such, costs associated with this estimate are categorized as Transmission Interconnect Facilities (TIF) and New Network Facilities (NNF). All costs associated with Transmission Interconnect Facilities (TIF) will be the sole responsibility of the Interconnection Customer. Transmission Interconnect Facilities (TIF) cost estimate and summary are shown on Section 4.5.2. New Network Facilities (NNF) cost estimate and summary are shown on Section 4.5.4.

4.2 Major Project Assumptions, Constraints, and Risks

4.2.1 Assumptions and Clarifications

The cost estimates prepared for this interconnect request are based on the following assumptions.

- The IC's interconnection circuit construction and the IC's generation facilities are not included in this study.
- Estimate accuracy is +/- 20%.
- Internal LG&E-KU costs for Project Management & Engineering labor were estimated at 20% of the contracted Project Management & Engineering labor costs.
- Internal LG&E-KU costs for Construction Management were estimated at 50% of the contracted Construction Management labor costs.
- Telecom labor and material costs were provided by LG&E-KU and are assumed to be 100% LG&E-KU costs.
- LG&E-KU burdens and contingency were estimated internally by LG&E-KU.
- All contracted costs presented within this report include 6% escalation on cost, contractor burdens, and markups.
- Union Labor rates were utilized for construction labor.
- Materials are assumed to be tax exempt. No sales taxes are included in the estimate.
- Insurance is included for contracted costs.

4.2.1.1 Construction

- Temporary construction power is assumed to be provided by LG&E-KU.
- Costs for subcontracted site security are included for non-work hours, holidays, and weekends for the duration of construction.
- Costs are included for a part-time onsite Construction Safety manager.
- Temporary laydown, matting, or other improvements are not included.

4.2.1.2 Civil-Site Development

- No site development is included in the estimate. All work will occur within the existing station fence.
- Surfacing stone for the disturbed areas within the station fence is included.

4.2.1.3 Civil-Structural

- A-frame structures will be comprised of bent plate and will be detail-designed by a steel fabricator, with loads provided by the substation engineer.
- All remaining steel will consist of standard AISC shapes to be detail-designed by the substation engineer.
- Geotechnical soil information was not available at the time of the estimate completion. BV completed a geotechnical desktop review of the site location to generate foundation design assumptions for the estimate. Costs for procurement of soil borings, soil resistivity testing, ground penetrating radar, and completion of a geotechnical report are included in the estimate.
- The soil conditions are assumed to be conducive for the installation of drilled pier foundations terminating in soil based on the existing foundation details for the site. Soil conditions will require verification during drilling operations.
- Based on the proposed location of the site, it is expected that the site will fall under Seismic Design Category D. Liquefaction was not considered for foundation design estimates.
- Based on Hazard Maps there is a low to moderate risk of Karst. Based on existing substation foundations, it has been assumed that no voids or other karst features exist below substation.

4.2.1.4 Electrical Installation, Relaying & Communications

- The IC will supply the fiber communication (OPGW) channel between the IC collector substation and the LG&E-KU station.
- The estimate includes costs for the fiber connection from the new LG&E-KU Control House to the dead end structure.
- The IC will supply a line protection relay panel in the IC-owned collector substation to interface with the LG&E-KU-owned line protection relay panel in the interconnection station for coordinated protection of the IC line segment.
- The existing AC/DC system is assumed to be adequate for the new GI Line connection. Cost for new station service are not included.
- New DFR and RTU panels are not included in the estimate.

4.2.2 Project Risks and Constraints

- Geotechnical soil information was not available at the time of the estimate completion. BV completed a geotechnical desktop review of the site location to generate foundation design assumptions for the estimate. Costs for procurement of soil borings and completion of a geotechnical report are included in the estimate. Site soil conditions that differ from anticipated conditions could have significant impact on foundation design and below grade construction.
- Material and labor availability at the time of project execution could have significant cost impacts.

4.3 Interconnection Facilities Needs

Figure 1 shows the division of responsibility for an existing substation ring bus configuration, per the Transmission Owner's *Allocation of Costs for Generator Interconnections* document, effective 01/01/2018.

The IC will be responsible for the design, construction, and permitting of the 161 kV transmission line from their facilities to the Point of Change of Ownership (PCO) at the existing North Princeton station.

Figure 1: Point of Interconnection

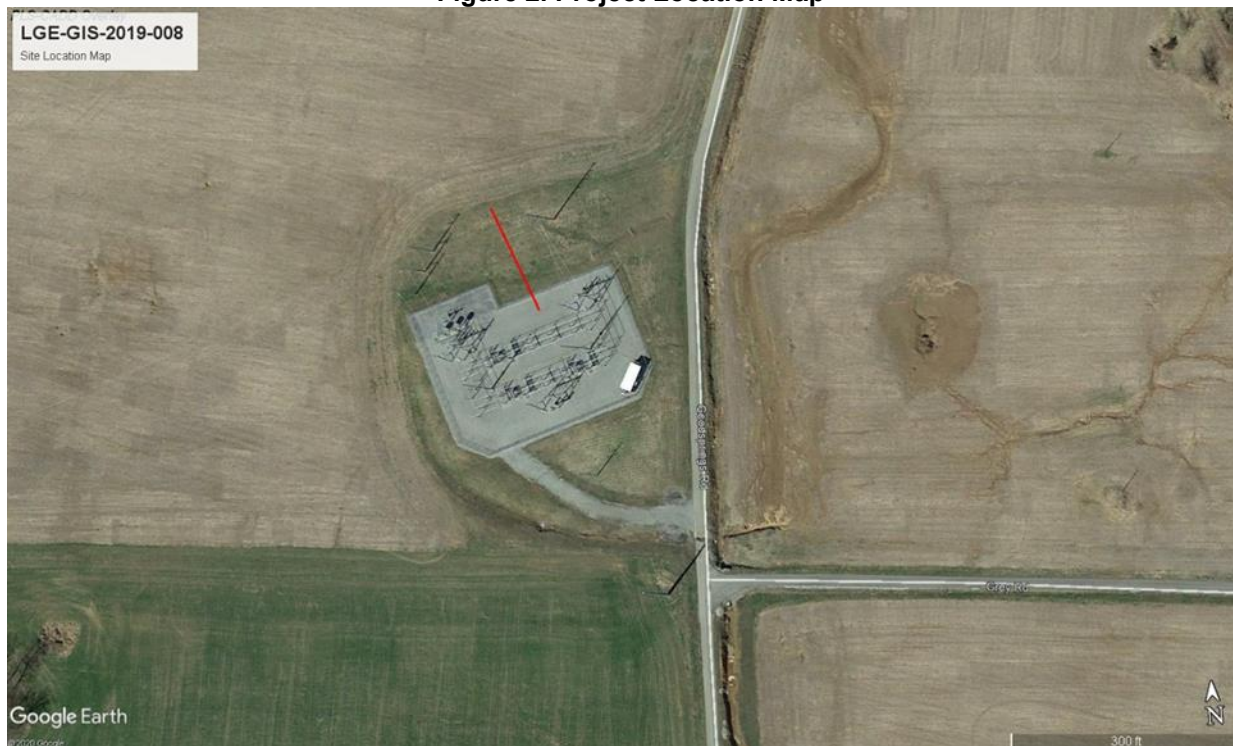
Details of the Transmission Interconnection Facilities and New Network Facilities required for the generation interconnection are provided in Section 4.5.

4.4 Description of Upgrades

The next section describes facilities identified to be installed, replaced, and/or upgraded by LG&E-KU to accommodate the project. During detailed design other components may be identified for installation or replacement due to this interconnection.

The conceptual station arrangement developed for this estimate is included as Appendix A. The station and transmission line structure locations are shown below in Figure 2. The approximate latitude and longitude of the POI is 37.167839°N, 87.973511°W.

Figure 2. Project Location Map



4.5 Total Conceptual Cost Estimate: (Total Estimated Cost \$2,756,709 USD)

The cost estimates are based on existing substation ring bus interconnection configuration as shown in Figure 1 of Section 4.3 and the assumptions provided in the Section 4.2. The estimated total project cost is estimated with +/- 20% accuracy.

4.5.1 Generator Owner Facilities

The generator owner is responsible for the installation and costs for the generator, step up transformer, generator lead line and customer protective devices up to the Transmission Owner (TO) metering equipment at the Point of Change of Ownership. The customer is responsible for determining the generator owner costs for the facilities owned and operated by the customer.

4.5.2 Transmission Interconnection Facilities: (Total Estimated Cost \$1,033,341)

The transmission interconnection facilities will include all equipment and materials at the interconnection facility between the Point of Ownership Change and the Point of Interconnection. The required equipment and materials are identified below, and a summary of the interconnection facilities costs are provided in Table 4-1.

4.5.2.1 Station

The transmission interconnection facilities will include the following:

4.5.2.1.1 High Voltage

- One (1) 161kV Motor-Operated Disconnect Switch (mounted on A-Frame)
- Three (3) 161kV Surge Arresters (mounted on A-Frame)
- Three (3) 161kV Metering CT/PT Combo Units (mounted on A-Frame)

4.5.2.1.2 Civil/Structural

- One (1) Steel A-Frame Structure & Foundation
- Two (2) 1-Phase Low Bus Supports & Foundations

4.5.2.1.3 Protection & Control

- One (1) Line protection panel for GI
- One (1) Retrofit Metering panel for GI

4.5.3 Transmission Lines

- Not applicable.

4.5.3.1 Telecommunication Facilities

- Not applicable.

Table 4-1
Transmission Interconnection Facility Cost Estimate

Description	Cost
Company Labor	\$99,927
Contract Labor	\$427,109
Materials	\$412,365
Contingency	\$93,940
Total	\$1,033,341

4.5.4 Network Facilities: (Total Estimated Cost \$1,723,368 USD)

The network facilities include a new 161 kV circuit breaker and two (2) disconnect switches that will be added to the existing ring bus for the new GI line. Other Network Facility requirements include telecom infrastructure and rerouting of existing OPGW static wire on transmission structures outside of the North Princeton station to allow room for the new GI Line. The required equipment for each component of the network facilities is identified below and a summary of the network facilities costs are provided in Table 4-2.

4.5.4.1 Network Interconnection Facilities: (Total Estimated Cost \$1,723,368)

LG&E/KU and the vendor combined cost estimate for network interconnection facilities is shown in Table 4-2 and includes the following:

4.5.4.1.1 High Voltage

- One (1) 161kV Circuit Breaker
- Two (2) 161kV Manually Operated Disconnect Switches

4.5.4.1.2 Civil/Structural

- One (1) 161kV Circuit Breaker Slab Foundation
- Two (2) Low Switch Structures and Foundations to replace existing steel bus supports and foundations

4.5.4.1.3 Protection & Control

- Not applicable.

4.5.4.2 Transmission Lines

- OPGW Static wire to loop through station structures from existing Livingston Co. line dead end structure to existing Earlington North line dead end structure.

4.5.4.3 Telecommunication Facilities

- Data Network Systems
 - Ethernet Switch, Router / Firewall
 - Fiber Distribution Panel / Wire Management

- 90H" x 24W" Hybrid Rack
- Telecom Systems
 - ICON Mux Access Modules for SCADA and Telemetry
- PGW Termination and ADSS End Section
 - 48-SMF ADSS for dielectric end section
 - Slack Drum and attachment hardware at each end
 - Splicing Materials & Fiber Termination Panel

Table 4-2
Network Interconnection Facility Cost Estimate

Description	Cost
Company Labor	\$313,816
Contract Labor	\$962,666
Contracted Materials	\$290,217
Contingency	\$156,670
Total	\$1,723,368

4.5.5 Distribution Facilities: (Total Estimated Cost \$0 USD)

No distribution facility upgrades have been identified.

5. Conclusion and Project Completion Timeframes

This report does not consider any issues related to the proposed routing of the generator lead-line to connect to the Transmission Owners Transmission System. If it is later determined that there are line clearance issues related to the generator's proposed lead-line, the customer must provide an alternate route that avoids such issues. In the event an alternate route is not available, the Transmission Owner may need to modify its transmission facilities to maintain adequate clearances. The Customer will be responsible for the costs and any schedule delay as a result.

The customer must have adequate protection in place to prevent islanding of the Princeton load during applicable P6 disturbances. The customer must coordinate and verify this protection scheme with the TO and ITO prior to commissioning the unit. If the assumption of the GI-2019-008 generation tripping 10 cycles after the creation of the island is determined to be invalid, additional study maybe required.

The study determined that the inverters' 0.95 PF capability along with the customer indicated inclusion of four 8 MVAR switched capacitors is expected to provide at least +/- 0.95 power factor at the high side of the customer main transformer.

No third-party constraints were identified in this study, but TVA and MISO Affected System Studies are required as indicated in Table E-3. The customer must work with TVA and MISO to initiate the TVA and MISO Affected System Impact Studies and keep the ITO and TO informed of the status of the studies.

The engineering, design, and construction of the interconnection facilities and network upgrades is estimated to take twenty-four (24) months from receipt of the Interconnection Customer's execution of the LGIA or notice to proceed in the event of a suspension. Additionally, this estimate assumes that the project schedule would not be impacted by storm damage and restoration, time of year limitations, permitting issues, outage scheduling, system emergencies, and contractor and equipment availability, or other unforeseen circumstances.

Interconnection to LG&E and KU system is contingent on steady state, short circuit and dynamic model, assumptions and settings used in the SIS and Facilities Study.

6. References

[1]https://www.oasis.oati.com/woa/docs/LGEE/LGEEdocs/Allocation_of_Costs_for_Generator_Interconnections_effective_1-1-2018.pdf

Appendix A. Conceptual Substation Layout

The appendix A of this report is available on the LG&E and KU Critical Energy Infrastructure Information (CEII) File Transfer Protocol (FTP) site. The LG&E and KU secure CEII FTP site URL is: <https://eftws.lge-ku.com/EFTClient/Account/Login.htm>.