Generation Interconnection Facility Study Report

For

PJM Generation Interconnection Request Queue Position - AC1-074

Bluebird Solar – 80 MW

November 2020

General

Bluebird Solar LLC, the Interconnection Customer (IC), has proposed a solar generating facility located in Harrison County, Kentucky. The installed facilities will have a total capability of 80 MW with 56 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is June 1, 2019. **This study does not imply an EKPC commitment to this in-service date.**

This new commercial operation date for this project is November 30, 2022. Please note that this Facilities Study Report was prepared based on an older commercial operation date.

Point of Interconnection

AC1-074 shall interconnect with the EKPC's system at the new proposed Harrison County Substation, located along the Jacksonville – Renaker 138 kV line.

Cost Summary

The AC1-074 project shall be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 350,000
Direct Connection Network Upgrades	$ 6,810,000
Non Direct Connection Network Upgrades	$ 130,000
Allocation for New System Upgrades	$ 0
Contribution for Previously Identified Upgrades	$ 0
Total Costs	**$ 7,290,000**

A. Transmission Owner Facilities Study Summary

1. General Description of Project

Bluebird Solar LLC (Solar), the Interconnection Customer (IC), has proposed an 80 MW solar powered generating facility located near Leesburg, in Harrison County, Kentucky. PJM studied AC1-074 as an 80 MW injection into the East Kentucky Power Cooperative ("EKPC") Transmission System at a newly constructed 138 kV switching station, and evaluated it for compliance with reliability criteria for summer peak conditions in 2020. The proposed in-service date is June 1, 2019.

The intent of this study is to define the cost and construction schedule for EKPC and other transmission facilities, necessary system reinforcements, and protection requirements to accommodate the above Generator Interconnection Request.

2. Amendments to the System Impact Study Data or System Impact Study Results

The project costs and construction schedule have been refined in this report for increased accuracy and thereby differ from that which was presented in the Feasibility and System Impact Study reports. All estimates have been created based on meeting the earliest in-service date possible at the request of the IC. From EKPC's perspective, subject to the assumptions tabulated throughout this study, the requested in-service date of June 1, 2020 cannot be met, with the EKPC portion of the project expected to be complete by **November 30, 2021**. In order to maintain this schedule, an executed Construction Service Agreement (CSA) is required no later than **December 13, 2019**. Any delay to the execution of this CSA shall result in a delay to the projected in-service date.

3. Interconnection Customer's Milestone Schedule

IC's requested Commercial Operation Date (COD) for the generation facility is **June 1, 2020**. Milestone details were not provided for the IC's schedule.

4. Scope of Interconnection Customer's Work

The Point of Interconnection ("POI") will be the IC side of a 138 kV disconnect switch. The location of this switch will be determined during project scoping, and EKPC may require that this switch be located in the IC's substation. The IC substation shall be constructed adjacent to the new EKPC switching station (referred to as "Harrison County" herein). The IC customer will install 138 kV bus work or conductor from this 138 kV disconnect switch to their associated equipment. The IC will be responsible for acquiring all right of way, easements, and environmental approvals and permits for both the IC required facilities and any facilities that are to be constructed by EKPC. The IC will be responsible for constructing, owning, operating, and maintaining its facilities, and EKPC will have no responsibility for any of these activities.

5. Description of Facilities Included in the Facilities Study

This report describes the electrical facilities and system upgrades necessary to support the IC's project.

EKPC will construct a 138 kV switching station to include a new loop in tap on the EKPC Renaker to Jacksonville 138 kV line section to accommodate the direct connection of the IC's substation. EKPC will also construct a 138 kV disconnect switch structure which will be the POI. A temporary one line diagram and proposed draft layout of the EKPC substation is included in Attachment I of this study.

EKPC will also complete the required non direct connection network upgrades which includes relay upgrades at both Renaker and Avon to accommodate the addition of this new facility.

6. Total Costs of Transmission Owner Facilities included in Facilities Study

The costs estimated below are in 2018 dollars and do not include a Contribution in Aid of Construction ("CIAC") Federal Income Tax Gross Up charge. This tax may or may not be charged based on IRS requirements.

Description	Total Cost
Attachment Facilities	$ 350,000
Direct Connection Network Upgrades	$ 6,810,000
Non Direct Connection Network Upgrades	$ 130,000
Total Costs	**$ 7,290,000**

7. Summary of Milestone Schedules for Completion of Work Included in Facilities Study:

A proposed twenty-two (22) month direct connection construction schedule is estimated from the date of a fully executed Interconnection Service Agreement and Construction Kick-Off Meeting to complete construction and the associated activities listed. This schedule assumes that all issues covered by the "Environmental, Real Estate, and Permitting Issues" section of this document are resolved, relevant PJM RTEP baseline projects will be completed as needed and all required outages occur as planned. A more detailed construction schedule will be developed for the Interconnection Construction Service Agreement. Construction shall not begin until all applicable permits and/or easements and land rights have been obtained.

This proposed schedule assumes the following:

1. Required transmission line outages can be scheduled as planned. Transmission line outages are:

a. Typically not taken from June to August or December to February,
b. Discouraged during extreme weather conditions, and
c. In some cases, transmission outages must be scheduled twelve (12) months or more in advance.

2. No delays due to equipment delivery, environmental, regulatory, permitting, real estate, extreme weather, or similar events.
3. No significant rock is encountered during construction, and soil conditions are suitable for EKPC standard ground grid and foundation installations.
4. Required access and line easements are acquired by the IC and conveyed to EKPC in a timely manner.
5. Required substation property is acquired by the IC and conveyed to EKPC in a timely manner.
6. Environmental permits and requirements are completed by the IC in a timely manner.

EKPC's proposed schedule, as shown below, does not match the IC's requested schedule. The following schedule is contingent upon receipt of an executed ICSA by **December 13, 2019.** A project meeting must occur no later than **January 1**, **2020** to meet EKPC's Milestone Schedule.

Description	**Start Date**	**Completion Date**
Design (Including Site Grading Design)	2/2020	5/2020
Procure Materials and Equipment	5/2020	5/2021
Site Preparation	7/2020	1/2021
Line Upgrade – OPGW	1/2021	5/2021
Substation Construction	2/2021	9/2021
Tap Line Construction	8/2021	10/2021
Commissioning and Testing	10/2021	11/2021

B. Transmission Owner Facilities Study Results

The facilities identified to be installed, replaced, and/or upgraded by EKPC to accommodate the proposed project are described in this section. During detailed design and analysis, other components may be identified for installation or replacement due to this project.

1. Transmission Lines – New

A new loop-in tap line will be constructed from EKPC's existing Jacksonville to Renaker 138 kV transmission line to the new switching station as shown in Attachment I of this study, which will be owned, operated, and maintained by EKPC. Several new transmission poles will be installed to tap the existing line section and bring the two ends into the new switching station. The loop from the Jacksonville to Renaker 138 kV circuit to the new substation is expected to extend approximately 500 feet.

The estimated cost for the new line construction for this project is $520,000.

Transmission Line Assumptions:

The following general assumptions have been included for the transmission line information provided:

1. Required transmission line outages can be scheduled as planned. Transmission line outages are:
    a. typically not taken from June to August or December to February,
    b. discouraged during extreme weather conditions, and
    c. in some cases, must be scheduled twelve (12) or more months in advance.
2. No delays due to equipment or material delivery, environmental, regulatory, permitting, real estate, extreme weather, or similar events.
3. No significant rock encountered during construction, and soil conditions suitable for standard foundation installations.

The following engineering assumptions have been included for the transmission line information provided:

1. Neither foundation nor tower structural analyses have been performed.
2. Construction will be scheduled to avoid summer and winter peak load periods (June-August or December - February).
3. Schedule assumes no issues with obtaining transmission outages.
4. Material and equipment costs are based on current (May 2018) pricing.
5. Easements shall be acquired by the IC and conveyed to EKPC.
6. Environmental permits and requirements shall be completed by the IC.

2. Transmission Line – Upgrades

OPGW installation will be required to meet communications requirements for this facility. This OPGW will provide communications to the new facility on the line section to Renaker Switchyard. OPGW will be installed on the Harrison County – Renaker line section, which is approximately 9.35 miles in length.

The estimated cost for the new OPGW installation for this project is $1,270,000.

3. New Substation/Switchyard Facilities

EKPC will build a new 138 kV switching station adjacent to the IC's substation.

The project will be connected to a new 138 kV switching station which will be owned, operated, and maintained by EKPC. The new interconnection substation is to be constructed adjacent to the Jacksonville to Renaker 138 kV transmission line, approximately 1.6 miles from Jacksonville Substation.

Below is a list of the major equipment and material associated with the new substation:

QTY	Unit	DESCRIPTION
1	Each	138 kV High Profile Substation Structure
4	Each	138 kV, 2000 Amp Circuit Breakers
15	Each	138 kV GOAB Switches
1	Lot	Electrical Material (insulators, terminals, etc.)
1	Each	Station Service Transformer, 100 KVA (138000-120/240V)
9	Each	Arresters, Lightning 108Kv Station 88Mcov Polymer Upright
3	Each	CT's, 138 kV
3	Each	CCVT's , 138 kV

For attachment facilities, EKPC will also construct a 138 kV switch structure. The exact location of the switch structure will be determined at project scoping, and it may be determined that the location should be in the IC's substation. EKPC will own, operate, and maintain this switch and its associated structure. EKPC will require permanent access to the IC substation for this switch if the switch is located in the IC substation.

The IC is responsible for construction of all of the facilities on its side of the POI, as shown in the attached one-line diagram.

The IC is responsible for obtaining property rights for the EKPC switching station site, and all necessary easements for a permanent drive to provide substation access. This substation access shall be from an existing county road. The IC shall convey these rights to EKPC.

System Protection

The following system protection scope applies for this project. All system protection equipment in this section will be owned, operated, and maintained by EKPC.

Control House: EKPC shall procure and install a drop-in style control building fully furnished and complete with one Bus Differential Panel, three Line Panels, one Transfer Line Panel, two 125VDC battery banks, and all required operating equipment.

Relay Panels: EKPC shall install a standard bus panel complete with P1 & P2 SEL-587Z relays tripping a P1 & P2 lock out relay. Line Transfer Panel (819) – EKPC shall install a standard transfer line panel with P1 & P2 SEL-421 relays. A SEL-451 relay shall be utilized for breaker control, breaker failure, and reclosing. The line panel shall have the capability to transfer breakers 834, 844, & 854. Line Panel (834) – EKPC shall install a standard line panel with P1 & P2 SEL-421 relays. These relays shall utilize step distance protection to reach into the Bluebird Solar GSU transformer impedance with an instantaneous zone 1. A SEL-451 relay shall be utilized for breaker control, breaker failure, and reclosing. Line Panel (844) – EKPC shall install a standard line panel with P1 & P2 SEL-421 relays. The P1 relay shall utilize a high speed POTT scheme over fiber. A SEL-451 relay shall be utilized for breaker control, breaker failure, and reclosing. Line Panel (854) – EKPC shall install a standard line panel with P1 & P2 SEL-421 relays. The P1 relay shall utilize a high speed POTT scheme over fiber. A SEL-451 relay shall be utilized for breaker control, breaker failure, and reclosing.

EKPC requires the IC to utilize all Schweitzer Engineering Laboratories (SEL) relays and related protective equipment that will be interconnecting or communicating with EKPC relaying. EKPC reserves the right to specify relays or other protection equipment utilized in the IC substation as required based on the protection schemes utilized. All protection system designs shall be reviewed by EKPC System Protection during the design phase to ensure proper clearing times, coordination, and compliance with any applicable NERC regulations.

Control cable shall be pulled from new breakers and other required equipment to the control house.

Commissioning: Each relay panel shall be fully commissioned prior to being placed in service. Commissioning shall include AC current and potential circuits, DC functional, relay testing, and end-to-end testing where required. Each of the remote line ends (Renaker and Avon/KU Paris) shall be commissioned using end-to-end testing prior to energizing the POTT scheme to Harrison County. The end-to-end testing shall require coordination with neighboring utilities during commissioning.

The estimated cost for the substation and system protection construction for this project is $5,370,000. This estimate includes $350,000 for the previously mentioned attachment facilities

between the IC substation and the EKPC substation. This estimate also includes costs for metering and telecommunications equipment that will be located inside the EKPC substation.

Substation & System Protection Assumptions:

The following general assumptions have been included for the substation information provided:

1. No delays due to equipment or material delivery, environmental, regulatory, permitting, real estate, extreme weather, or similar events.
2. No significant rock encountered during construction, and soil conditions suitable for standard ground-grid and foundation installations.
3. IC shall acquire adequate land size to accommodate EKPC's interconnection substation, as mentioned above.
4. The IC shall obtain property rights for all necessary easements for a permanent drive to provide substation access. This access shall be from an existing county road.

The following engineering assumptions have been included for the substation information provided:

1. Neither foundation nor structural analyses have been performed.
2. Schedule assumes no issues with outages.
3. Schedule assumes no coordination issues with neighboring systems for relay testing and commissioning.
4. Material and equipment related costs are based on current (May 2018) pricing.
5. Environmental permits and requirements will be completed by the IC in a timely manner.

4. Upgrades to Substation/Switchyard Facilities

EKPC shall complete the required non-direct connection network upgrades which may include relay upgrades at both Renaker and Avon to accommodate the addition of this new facility.

Renaker – Relay settings shall be reviewed for the Renaker line to accommodate the new switching station and relay files updated accordingly.

Avon/KU Paris Line – Relay settings shall be reviewed for the three terminal Avon/KU Paris line to accommodate the new switching station and relay files updated accordingly.

The estimated cost for the relay upgrades required for this project is $130,000.

5. Metering & Communications

Metering:

Metering requirements for this facility include the installation of EKPC's standard revenue quality metering package, including potential transformers, current transformers and the associated SCADA equipment.

The cost for installation of the metering facilities contained in the new EKPC substation are included in the substation costs above.

Metering Assumptions:

The following assumptions have been included for the metering information provided:

1. No delays due to equipment or material delivery, environmental, regulatory, permitting, real estate, extreme weather, or similar events..
2. Fiber installation is completed as scheduled.
3. Material and equipment related costs are based on current (May 2018) pricing.
4. Once fiber installation is complete, the fiber will not be damaged.

Communications:

EKPC shall use telecom equipment that matches its current network and equipment requirements. The scope shall also include a standard 48VDC charger and battery system to power the communications equipment in the control house

A 48-count ADSS fiber will be installed between the EKPC substation control house and the IC facility for relaying, metering, and/or SCADA circuit requirements. Exact details and installation plans for this fiber will be developed during project scoping.

The cost for installation of the telecommunications facilities contained in the new EKPC substation are included in the substation costs above.

Communications Assumptions:

The following assumptions have been included for the communications information provided:

1. No delays due to equipment or material delivery, environmental, regulatory, permitting, real estate, extreme weather, or similar events.
2. Material and equipment related costs are based on current (May 2018) pricing.
3. Once fiber installation is complete, the fiber will not be damaged

Other Required Upgrades

PJM has indicated the need for the Spurlock Reactor Resize project, (PJM upgrade id b2827) to be completed before the AC1-074 project can be placed in service. The cost to accelerate the completion date of baseline project b2827 is not included in this Facilities study since the expected commercial operation date of b2827 (6/1/2021) is before the commercial operation date of the AC1-074 project (11/30/2021).

6. Environmental, Real Estate and Permitting Issues

The IC is responsible for obtaining all of the required property rights to provide EKPC ownership of the new switching station site, as well as, any permanent easements needed for the switching station access road and the transmission tap line. The IC shall convey these rights to EKPC. The IC shall work directly with EKPC when acquiring these rights to ensure that they meet EKPC requirements and standards.

In addition, the IC is responsible for performing, any and all environmental assessments, as well as obtaining any and all permits needed to construct the interconnection facilities.

7. Summary of Results of Study

The following schedule corresponds with the schedule in Section A.7 of this Facilities Study Report:

Description	Start Month	End Month
Design (Including Site Grading Design)	1	3
Procure Materials and Equipment	3	15
Site Preparation	5	11
Line Upgrade – OPGW	11	15
Substation Construction	12	19
Tap Line Construction	18	20
Commissioning and Testing	20	21

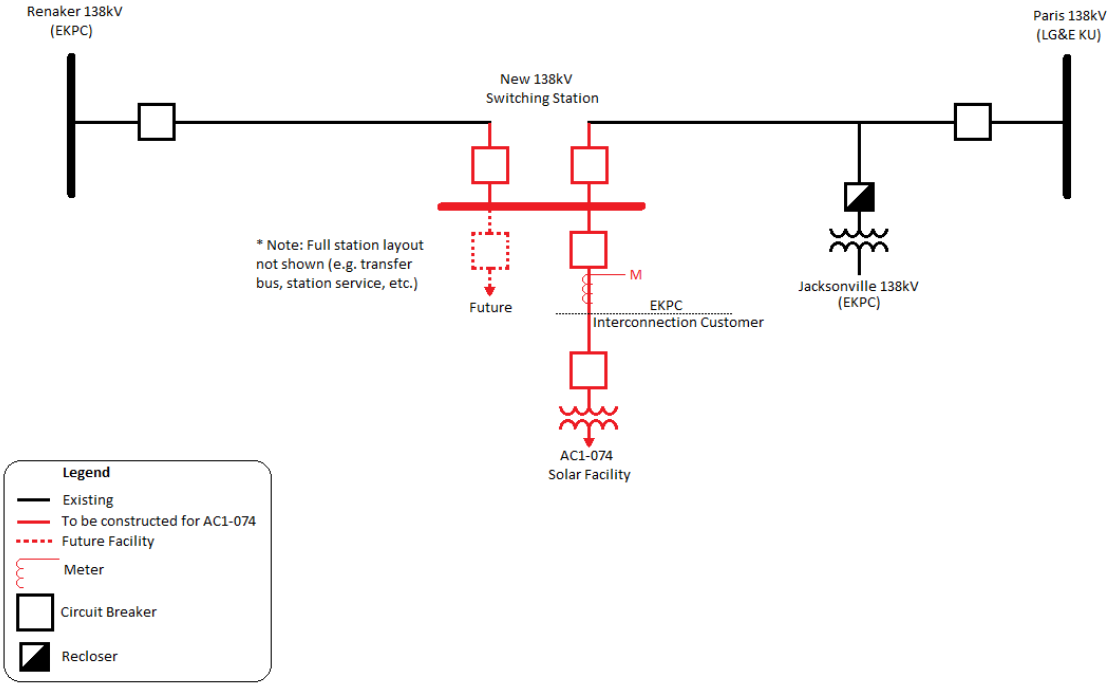
Below is a summary of costs for the AC1-074 project:

Description	Direct Labor	Direct Material	Indirect Labor	Indirect Material	Total
Attachment Facilities					
Install an Attachment facility line from the Queue #AC1-074 interconnection substation to the first structure located outside of the switchyard (Point of Interconnection structure). And install revenue metering. PJM Network Upgrade Number n6274.	$159,145	$145,215	$24,220	$21,420	$350,000
Direct Connection					

Description	Direct Labor	Direct Material	Indirect Labor	Indirect Material	Total
AC1-074 138kV Interconnection Substation – Build a new 138kV switching station along the Jacksonville – Renaker 138kV line to interconnect the Queue #AC1-074 solar generating facility. PJM Network Upgrade Number n5929.	$1,594,779	$2,672,400	$419,099	$333,722	$5,020,000
Non-Direct Connection					
Jacksonville – Renaker 138kV – A new loop-in tap line will be constructed from EKPC's existing Jacksonville to Renaker 138 kV transmission line to the new switching station. PJM Network Upgrade n6275.	$339,589	$108,160	$56,589	$15,662	$520,000
Avon 138kV Substation – Upgrade line relaying. PJM Network Upgrade Number n5630	$38,811	$0	$26,189	$0	$65,000
Renaker 138kV Substation – Upgrade line relaying. PJM Network Upgrade Number n5931	$38,811	$0	$26,189	$0	$65,000
Install OPGW fiber from on the Harrison County – Renaker line section, which is approximately 9.35 miles in length. PJM Network Upgrade n6276.	$829,381	$264,160	$138,208	$38,251	$1,270,000
Total Facility Costs	**$3,000,516**	**$3,189,935**	**$690,494**	**$409,055**	**$7,290,000**

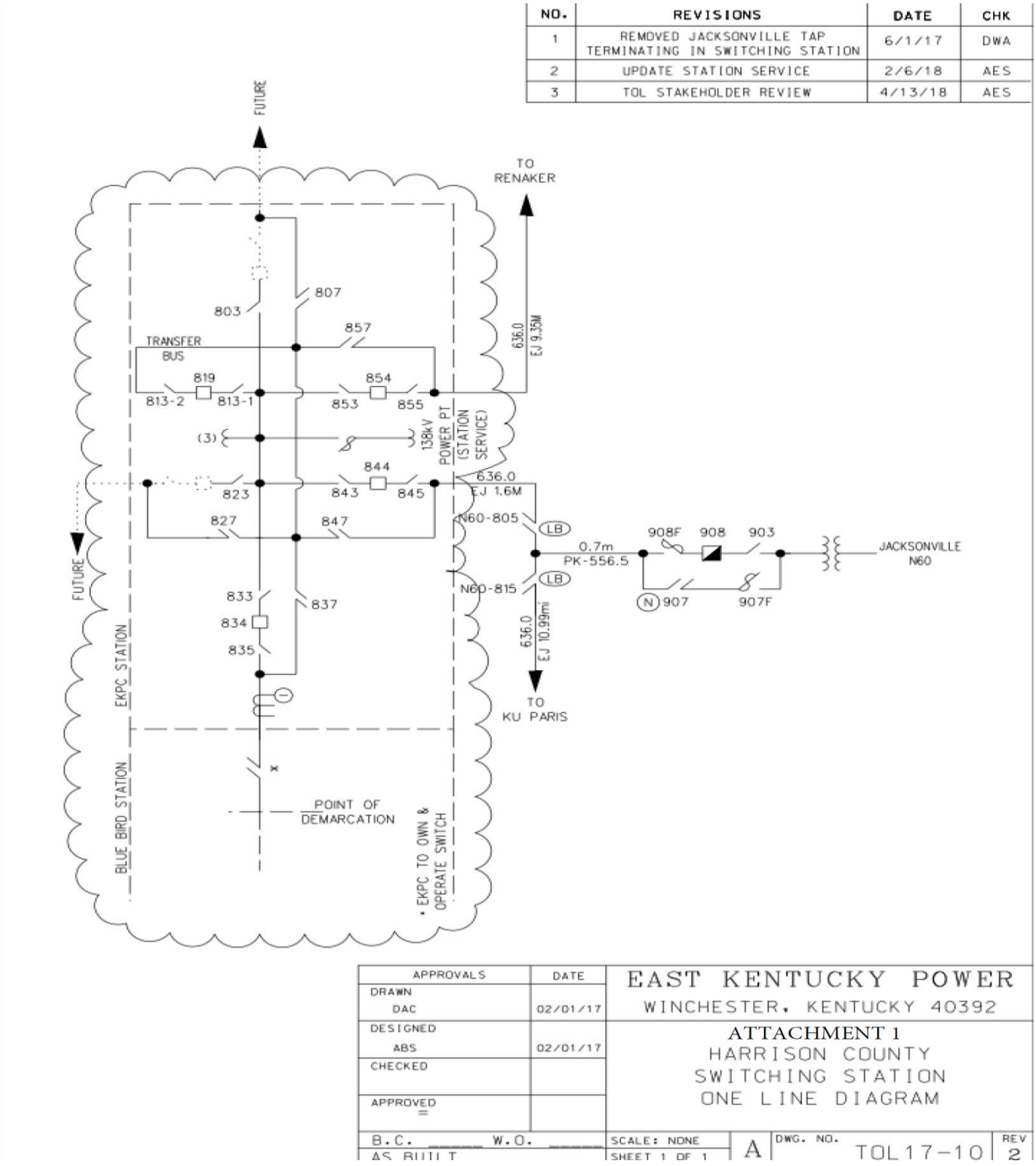
Attachment 1:

Planning One Line Diagram



Attachment 2:

Engineering One Line Diagram



Attachment 3:

EKPC Preliminary Station Layout