GENERATOR INTERCONNECTION REQUEST

BHCT-G18
INTERCONNECTION FACILITIES STUDY

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TRANSMISSION PLANNING

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1 INTRODUCTION

1.1 Scope & Objective

This report presents the Interconnection Facilities Study results for the interconnection of a proposed 60 MW wind generating facility (the Project) to the Transmission Provider's transmission system in Huerfano County, Colorado. The objective of the facilities study is to:

- Complete a facilities analysis, which shall specify and estimate the cost of equipment, engineering, procurement, and construction required to address issues as outlined in the system impact study, and

- Provide a scope of work and an estimated cost and schedule for completing the work.

1.2 Background

The point of interconnection for the proposed BHCT-G18 project will be the 115 kV Rattlesnake Butte substation located approximately 36 miles south of the Reader Substation. See **Figure 1** for the Project layout. The substation was initially configured as a two terminal straight bus to facilitate the integration of a 29 MW wind interconnection (BHCT-G8) and another planned expansion to a three terminal ring bus for the integration of a 29MW wind interconnection (BHCT-G10). The proposed project's in-service date occurs prior to the BHCT-G10 project, so the BHCT-G18 project will have to upgrade the Rattlesnake Butte substation to a three terminal ring bus as previously planned. The Rattlesnake Butte substation will retain the ability to be expanded into a four terminal four breaker ring bus for the integration of project BHCT-G10 and any other subsequent interconnections at that location.

The BHCT-G18 wind project will utilize Network Resource Interconnection Service. System upgrades specified in the System Impact Study report that were associated with Energy Resource Interconnection Service are not required and were omitted from this report.

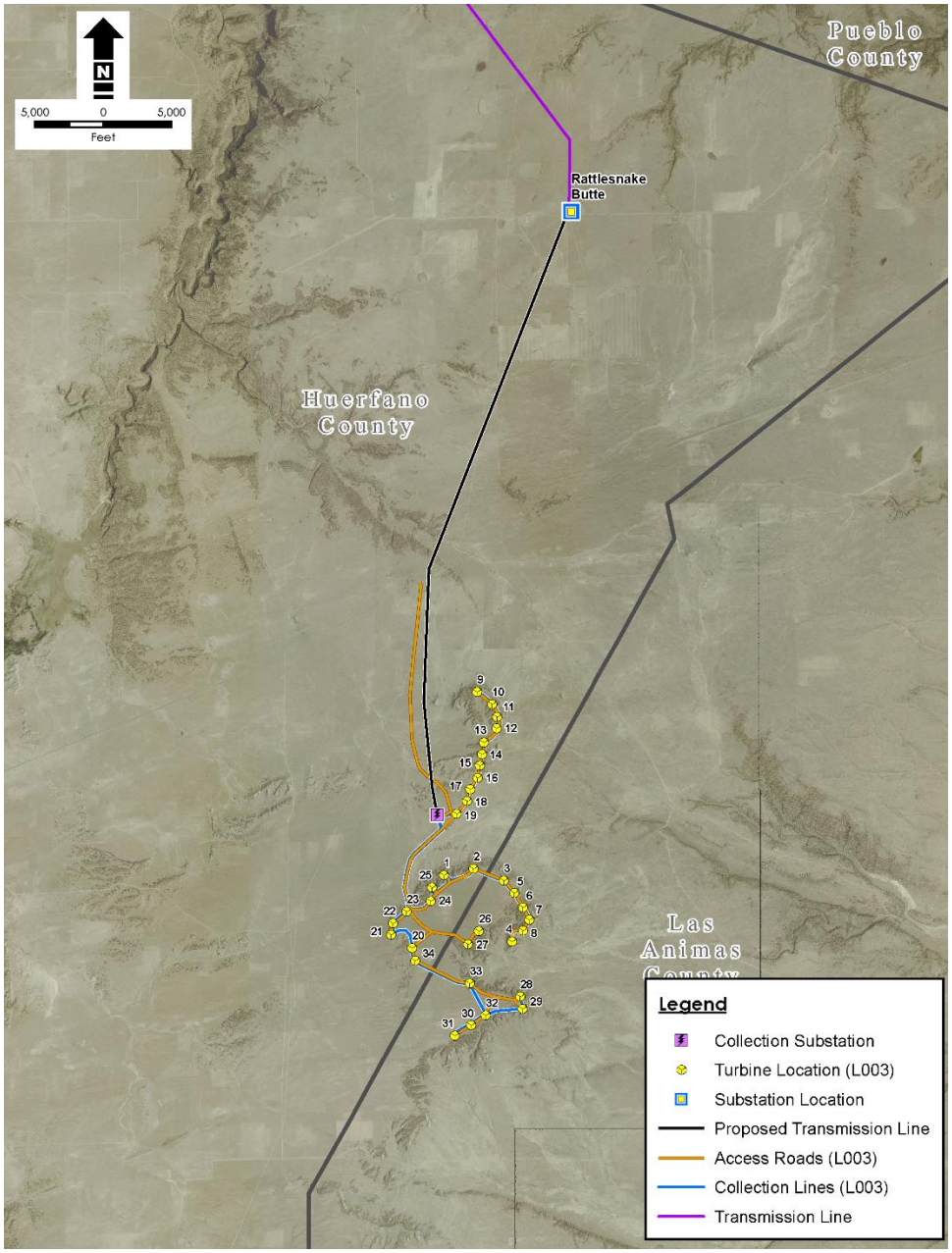


Figure 1: BHCT-G18 Project Layout

A System Impact Study (SIS) report for this project has been issued. The study was conducted in accordance with the Transmission Provider's Large Generator Interconnection Procedures (LGIP) and included power flow, transient stability, and short circuit analyses as well as preliminary cost and schedule estimates for interconnection of the Project. The SIS report concluded that the Project may be added with the following system upgrades:

- New 115 kV terminal position at the BHCE 115 kV Rattlesnake Butte substation
- New shunt reactor sized to at least 2.1 MVAR connected to the tertiary winding of the 115/34.5 kV step-up transformer

- Upgrade CT ratios at Rattlesnake Buttes as necessary to achieve a facility rating on Reader-Rattlesnake Buttes 115 kV line in excess of 600 amps.

The anticipated date for back feed energy for BHCT-G18 is August 1, 2016 and the start of commercial operation is planned for October 1, 2016.

1.3 Scope of Work

Interconnecting the BHCT-G18 project will require the expansion of the Rattlesnake Butte substation yard, adding a terminal to the 2 position bus making it a 3 position ring bus, installation of 2 new 115kV breakers and 4 disconnect switches, 3 metering units, protection and control and communications equipment. Voltage and real/reactive power metering will be required at the 34.5 kV level of the collector substation. Also required at the Project's collector substation is a switched shunt reactor of at least 2.1 MVAR. See Appendix A for the latest revision of the Rattlesnake Butte substation switching diagram.

2 INTERCONNECTION OF THE PROJECT

2.1 General Discussion

A new 115 kV terminal position including two (2) new 115 kV circuit breakers, four (4) 115 kV disconnect switches, conductors, structures, foundations, etc. required to convert the bus configuration from a two breaker straight bus to a three breaker ring bus.

2.2 Required Facilities and Upgrades

The report includes two categories of system upgrades and associated costs: 1) the facilities between the POI and the change of ownership at the line dead-end structure (direct-assigned costs), and 2) the upgrades to existing BHCE facilities to accommodate the interconnection (network upgrades). This project and associated upgrades are completely independent of other queued projects and their respective ISDs.

2.2.1 Network Upgrades to be owned and funded by the Transmission Provider

- All equipment associated with the completion of the Rattlesnake Buttes 115 kV 3-position ring bus
  - Two (2) 115kV 1200 amp circuit breakers
  - Three (3) 115kV 1200 amp disconnect switches
  - Two (2) 115 kV relaying panels
  - Three (3) 115 kV Potential Transformers (CCVT)
  - Miscellaneous including completion of ring bus & structural steel
- Modify the CT ratios within the Rattlesnake Butte 115 kV substation on the Reader-Rattlesnake Buttes 115 kV line as needed to achieve a facility thermal rating in excess of 600 amps.

2.2.2 Interconnection Facilities to be funded by the Interconnection Customer (Direct-Assigned Costs)

- One (1) 115kV 1200 amp disconnect switch
- Three (3) 115 kV metering units
- One (1) 115 kV Dead End Structure
- Access to analog, indicating, control and data circuits, as required to integrate into the design and operation of the Transmission Operator's control system. This includes access to voltage, MW and MVAR metering at the 34.5 kV level of the collector substation.

3 COST ESTIMATE

3.1 Network Upgrade Costs

The total estimated cost for the engineering, procurement, and construction of the interconnection facilities as described in Section **Error! Reference source not found.** is $1,500,000.

- Land, access roads and any state or local permits required for the Project, excluding facilities associated with the Rattlesnake Buttes substation are excluded.
- Labor, engineering, transportation and loading are included in the estimates.

3.2 Direct Assigned Costs

The total estimated cost for the engineering, procurement, and construction of the Direct Assigned described in Section **Error! Reference source not found.** is $350,000.

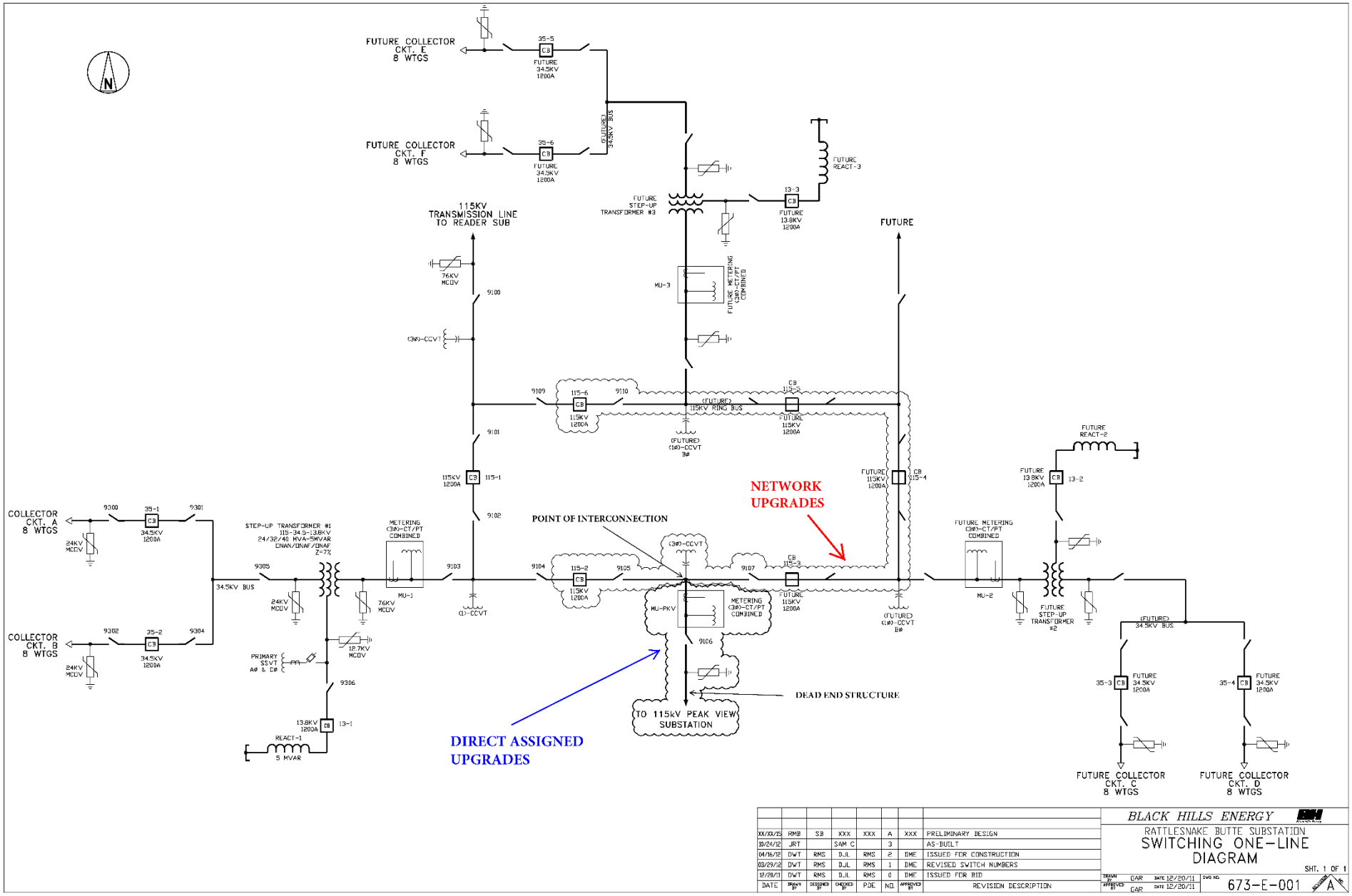
- All equipment between the point of ownership change at the dead-end structure and the Rattlesnake Buttes 115 kV POI is included in this scope.
- Costs associated with the routing of the requested project's generator tie line due to any relocation of existing transmission lines, structures, terminals, etc. are not included in the specified interconnection costs. Those costs are considered part of the generator facility's construction and are the sole responsibility of the customer. It is the Transmission Provider's preference to utilize 795 ACSR conductor for the generator tie line per current design standards, however this is not a requirement.

4 SCHEDULE

The estimated completion time for the system upgrades is approximately 8 months from project commencement (engineering design/materials procurement/construction & commissioning). The Network Upgrades should be completed in time to provide the generator step-up transformer back feed power by August 1, 2016. The anticipated start of commercial operation for BHCT-G18 is planned for November 1, 2016. This reflects a delay from the previous expected in-service date of October 1, 2016.

Appendix A:

Project Drawing


FUTURE COLLECTOR CKT. E 8 WTGS
FUTURE COLLECTOR CKT. F 8 WTGS
35-5
35-6
FUTURE 34.5KV 1200A
(FUTURE) 34.5KV BUS
FUTURE REACT-3
13-3
FUTURE 13.8KV 1200A
FUTURE STEP-UP TRANSFORMER #3
115KV TRANSMISSION LINE TO READER SUB
FUTURE
76KV MCOV
9100
MU-3
FUTURE METERING (3Ø)-CT/PT COMBINED
(3Ø)-CCVT
9109
115-6
9110
115KV 1200A
(FUTURE) 115KV RING BUS
CB 115-5
FUTURE 115KV 1200A
(FUTURE) (1Ø)-CCVT BØ
9101
115KV 1200A
115-1
9102
FUTURE 115KV 1200A
CB 115-4
FUTURE REACT-2
FUTURE 13.8KV 1200A
13-2
NETWORK UPGRADES
POINT OF INTERCONNECTION
COLLECTOR CKT. A 8 WTGS
9300
35-1
9301
34.5KV 1200A
24KV MCOV
STEP-UP TRANSFORMER #1 115-34.5-13.8KV 24/32/40 MVA-5MVAR ONAN/ONAF/ONAF Z=7%
METERING (3Ø)-CT/PT COMBINED
9305
9103
9104
115-2
9105
(3Ø)-CCVT
9107
CB 115-3
FUTURE METERING (3Ø)-CT/PT COMBINED
34.5KV BUS
24KV MCOV
76KV MCOV
MU-1
(1)-CCVT
115KV 1200A
MU-PKV
METERING (3Ø)-CT/PT COMBINED
FUTURE 115KV 1200A
(FUTURE) (1Ø)-CCVT BØ
MU-2
FUTURE STEP-UP TRANSFORMER #2
(FUTURE) 34.5KV BUS
COLLECTOR CKT. B 8 WTGS
9302
35-2
9304
34.5KV 1200A
24KV MCOV
PRIMARY SSVT AØ & CØ
12.7KV MCOV
9306
9106
DEAD END STRUCTURE
TO 115kV PEAK VIEW SUBSTATION
13.8KV 1200A
13-1
REACT-1
5 MVAR
DIRECT ASSIGNED UPGRADES
35-3
FUTURE 34.5KV 1200A
35-4
FUTURE 34.5KV 1200A
FUTURE COLLECTOR CKT. C 8 WTGS
FUTURE COLLECTOR CKT. D 8 WTGS
BLACK HILLS ENERGY
RATTLESNAKE BUTTE SUBSTATION
SWITCHING ONE-LINE DIAGRAM
SHT. 1 OF 1
DRAWN BY GAR DATE 12/20/11
APPROVED BY GAR DATE 12/20/11
DWG NO. 673-E-001
REVISION A
XX/XX/15 RMB SB XXX XXX A XXX PRELIMINARY DESIGN
10/24/12 JRT SAM C 3 AS-BUILT
04/16/12 DWT RMS DJL RMS 2 DME ISSUED FOR CONSTRUCTION
03/29/12 DWT RMS DJL RMS 1 DME REVISED SWITCH NUMBERS
12/20/11 DWT RMS DJL RMS 0 DME ISSUED FOR BID
DATE DRAWN BY DESIGNED BY CHECKED BY PDE NO APPROVED BY REVISION DESCRIPTION