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Facilities Study
for
Black Hawk Substation
Add One 345 kV, 100 MVAR STATCOM

Related to ERIS Results
for
MISO Affected System Study for SPP DISIS 2017-001

Submitted by
MidAmerican Energy Company

January 2023

1.1 Project Summary

MidAmerican Energy Company ("MidAmerican" or "Transmission Owner") was retained by MISO ("Transmission Provider") to perform a facilities study for the upgrades necessary to add one 345 kV, 100 MVAR static synchronous compensator ("STATCOM") at Black Hawk Substation for the Energy Resource Interconnection Service ("ERIS") impacts by the Interconnection Customers in MISO's Affected System Study for SPP DISIS 2017-001. MidAmerican owns the Black Hawk Substation affected by this work.

Updates to this facilities study may be necessary to reflect 1) effects of the required upgrades identified in restudies of the MISO Affected System Study for SPP DISIS 2017-001 steady state and stability studies, 2) changes in information from the Interconnection Customers, 3) updates or restudies made to previously completed DPP studies and/or 4) results of any Optional Studies being performed for the Interconnection Customers. The following table summarizes the estimated costs of the Network Upgrades.

Table 1-1. Cost Estimate of Network Upgrades

Upgrade Classification	Description of Upgrade	Cost Estimate ($)*
Non-Stand Alone Network Upgrade	Black Hawk Substation Add One 345 kV, 100 MVAR STATCOM and associated transmission line additions/relocations	$50,000,000
	Total	$50,000,000

* Estimated cost includes AFUDC and is in 2022 U.S. dollars +/-20% and does not include the effects of inflation or escalation to future years. Tax gross-up does not apply based on present IRS rules. Transmission Owner plans to elect self-funding.

1.2 Election to Transmission Owner self-fund of Network Upgrades

Transmission Owner plans to self-fund these Network Upgrades in this facilities study. As a result, the Interconnection Customers would provide suitable financial security such as a parent guaranty, letter of credit or surety bond as part of the Multi-Party Facilities Construction Agreement ("MPFCA"). Later, the Interconnection Customers and Transmission Owner would enter into a Facilities Service Agreement ("FSA") or Multi-Party FSA ("MPFSA") covering the payments for the Network Upgrades.

2 Transmission Owner Interconnection Facilities

Not Applicable

3 Stand Alone Network Upgrades

None

4 Non-Stand Alone Network Upgrades

Network Upgrades to be installed by Transmission Owner

4.1 Black Hawk Substation Add One 345 kV, 100 MVAR STATCOM

4.1.1 Overview

The MISO Affected System Study for SPP DISIS 2017-001 study showed the need for additional capacitive VAR support at Black Hawk Substation to increase voltages in the area to mitigate the impacts of the Interconnection Customers on the system. The Black Hawk Substation is a 345 kV ring bus with only three networked transmission elements (line or transformer). The substation will already have a large 345 kV, 150 MVAR switched capacitor bank installed as a network upgrade for DPP 2016 February West. A NERC TPL-001 Category P2 or P4 breaker failure contingency within the 345 kV ring bus or Category P6 N-1-1 contingency can result in the loss of two of the three networked transmission elements leaving the substation on a radial from the remaining transmission element. As a result, adding additional shunt reactive power devices can result in high post-contingent voltages unless the incremental devices are dynamic such as a STATCOM so the device can automatically reduce output following contingencies.

The Black Hawk Substation was reviewed to determine the potential placement of one 345 kV, 100 MVAR STATCOM including the additional bus expansion needed to accommodate the STATCOM. If a MISO Affected System restudy for SPP DISIS 2017-001 required a different amount of STATCOM at Black Hawk Substation, then a revised or new facilities study would be required. The review did not include a STATCOM switching analysis or a harmonic frequency scan analysis. Such analyses will be completed as part of the design process should this project proceed.

The scope of the substation and transmission line work assumed in the estimated cost and schedule for the 345 kV STATCOM installation at Black Hawk Substation includes one 345 kV, 100 MVAR STATCOM, 345 kV line terminal with breaker and disconnects in a standalone fenced in area, a short new line to Black Hawk Substation and expansion of Black Hawk Substation including moving an existing line to accommodate a new 345 kV line to the STATCOM facility. The expansion work at Black Hawk Substation includes bus and breaker additions to expand the ring bus to provide terminals for the new 345 kV line to the STATCOM and the relocated Black Hawk-Hazleton 345 kV line, 345 kV breaker for the line to the STATCOM, breaker disconnect switches, control and relaying, steel support structures, yard expansion and high security fence expansion. No land costs are included in the estimate because the STATCOM site and line is assumed to be on land that Transmission Owner already owns.

The substation and transmission line upgrades are estimated to cost $50,000,000 in year 2022 U.S. dollars +/-20% and does not include the effects of inflation or escalation to future years. The upgrades are described below and shown in preliminary drawing in Exhibits A2 and A3.

4.1.2 Assumptions

- It is assumed outages to complete the Network Upgrades will be granted when requested to meet project schedule
- It is assumed based on the present tax laws in effect at the time of this study that tax gross-up would not apply and is not included in the cost estimates
- It is assumed labor resources and equipment will be available at reasonable costs. For example, low unemployment rates and significant amounts of transmission and substation project work related to new wind and solar farm interconnections requesting to be eligible for the Federal Production Tax Credit ("PTC"), the Infrastructure Investment and Jobs Act ("IIJA") and other initiatives may drive costs significantly higher and affect schedule
- It is assumed that timely receipt of financial security will be provided by all Interconnection Customers
- It is assumed the STATCOM switching analysis and harmonic frequency scan analysis that will be completed as part of the design process will not result in significant changes to the project scope and cost
- The results of recent DPP studies or affected system studies have required numerous capacitor banks and/or STATCOMs in eastern Iowa to improve system voltage; it is assumed these installations will not have negative interactions with each other
- The STATCOM addition requires construction of a separate substation yard for the STATCOM. For the purposes of the cost estimate, it is assumed the Transmission Owner owns the land the new substation yard will be constructed. If additional land is also needed to meet governmental setback or other requirements, it is assumed additional land can be purchased. No land costs are included in the estimate, but it is assumed land can be obtained at a reasonable cost, if necessary. This is a preliminary design that is subject to change during detailed design stage should the Interconnection Customers proceed further

4.1.3 Structure and Foundation

<u>Yard Development</u>

<u>For existing Black Hawk Substation</u>

- Grading and expansion of existing yard
- Installation of additional station ground grid system
- Installation of additional substation yard rock surfacing
- Installation of additional below grade control conduit and manhole system
- Modification, removal and installation of high security fence

<u>For STATCOM yard</u>

- Grading of yard
- Installation of a station ground grid system
- Installation of the substation yard rock surfacing
- Installation of the below grade control conduit and manhole system
- Installation of a 12 feet high security mesh fence with 1 foot of barbed and razor wire

- Installation of substation yard lighting
- Installation of a lightning shielding system

Steel Structures

- Support structures for two (2) 345 kV dead-end structures
- Support structures for three (3) 345 kV breakers
- Support structures for five (5) three phase 345 kV switches; four (4) manual breaker disconnects and one (1) motor operated line disconnect
- Support structures for three (3) single phase 209 kV MCOV surge arresters
- Bus support structures, ten (10) 345 kV supports
- Drilled pier foundations will be used for all equipment support structures as design permits

4.1.4 Major Items

345 kV STATCOM

- One (1) 345 kV, nominal 100 MVAR STATCOM and associated equipment from manufacturer
- Includes installing foundations, support structures, arresters

345 kV Gas Circuit Breakers

- One (1) 345 kV, SF6 gas circuit breaker rated 3000 A, 50 kA interrupting capability in ring bus
- Two (2) 345 kV, SF6 gas circuit breakers rated 3000 A, 50 kA interrupting capability for transmission line to STATCOM
- Includes installing foundations, control conduit to the circuit breakers, jumpers to the associated disconnect switches and control cable to the control building

345 kV Disconnect Switches

- Five (5) disconnect switches rated 345 kV, 3000 A continuous, 100 kA momentary, 1300 kV BIL are required to allow isolation of the added circuit breakers and bus
- Includes installing foundations and support structures

345 kV Rigid Aluminum Bus

- The main bus additions will be aluminum rigid tubular bus

4.1.5 SCADA and Communications

- Updates to RTU and SCADA for STATCOM and breaker additions

4.1.6 Protection and Control

345 kV Relay/Control/Metering Panels

- One (1) protection panel for line to STATCOM, SEL-411L or equivalent
- One (1) protection panel for the relocated line, SEL-411L or equivalent
- One (1) breaker control panel

- Includes installing the panels in the control building, connection of control cable wiring, checkout and commissioning of the associated systems
- Includes modification to other protection panels

4.1.7 Transmission Line Work

- One (1) new 345 kV line to be constructed from existing Black Hawk 345 kV bus to the separate STATCOM yard
- Existing Hazleton 345 kV line to be relocated to a new 345 kV line terminal on Black Hawk 345 kV bus
- Includes conductor, structures and foundations for the new and relocated lines

4.1.8 Price

The cost estimate for Network Upgrades is $50,000,000 in year 2022 U.S. dollars +/-20% and does not include the effects of inflation or escalation to future years.

5 System Protection Facilities constructed by Transmission Owner

None

6 Distribution Upgrades

None

7 Exhibits

7.1 A1 - Interconnection Customer One Line and Site Map

A1-1 One-line Diagram for IC Project

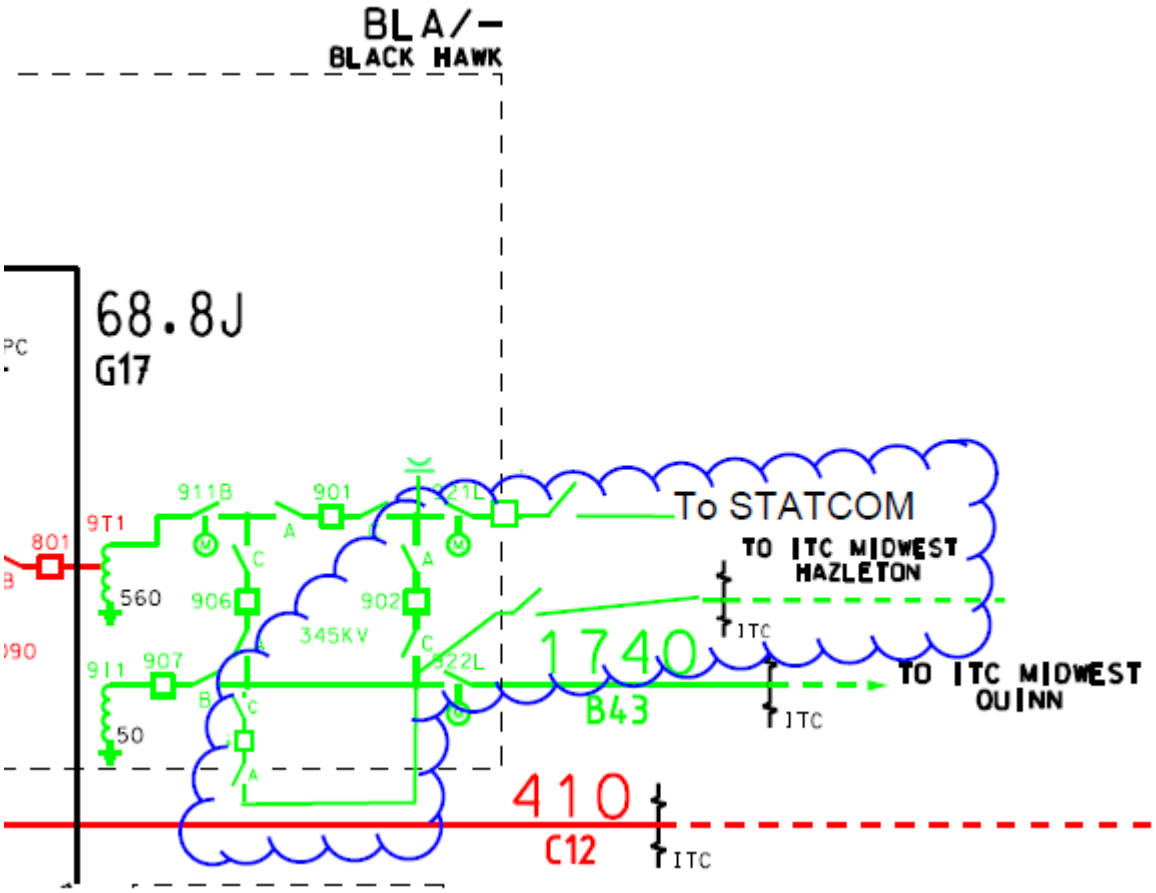
Not Applicable

A1-2 Site Map for IC Project

Not Applicable

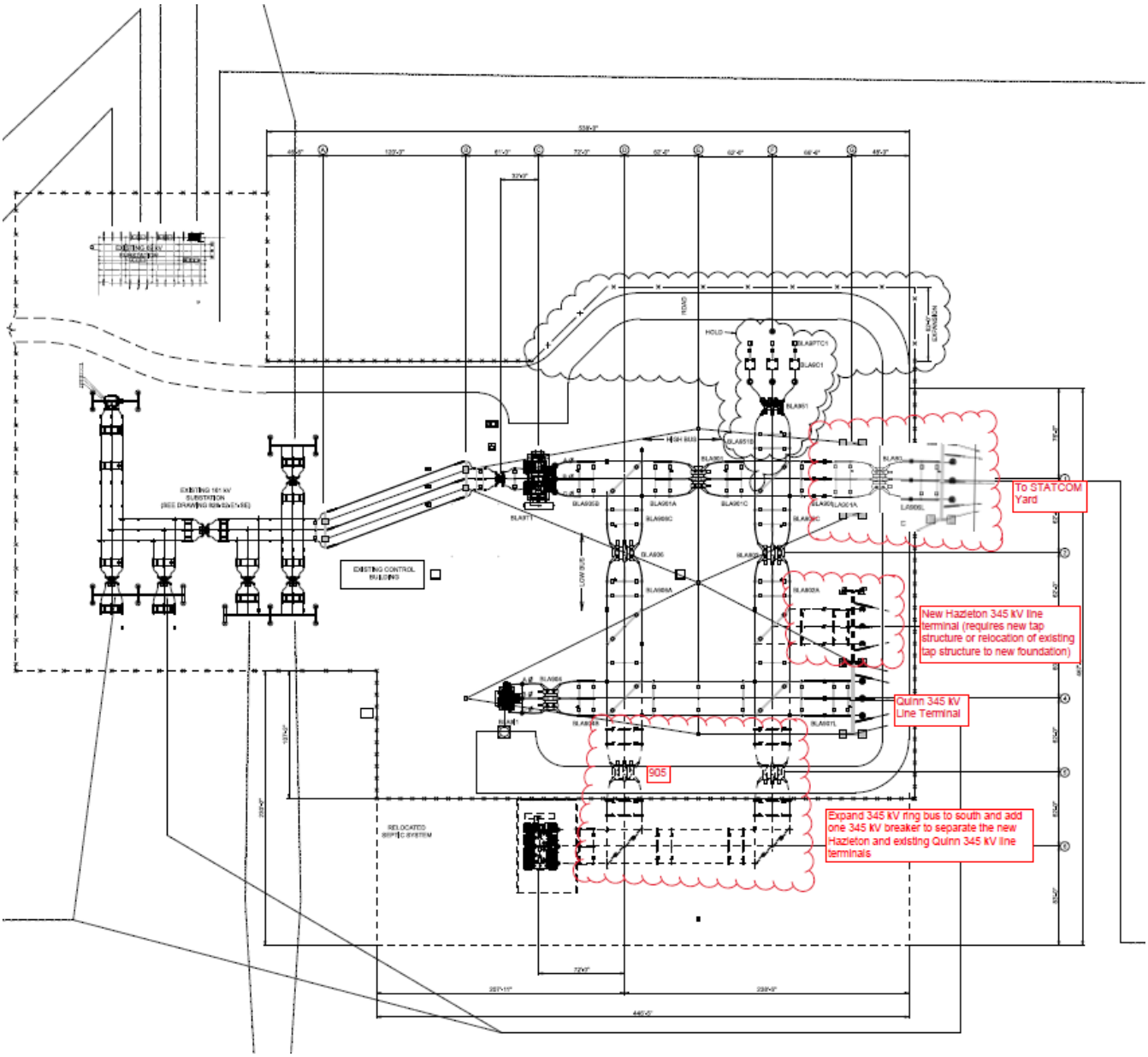
7.2 A2 - Transmission Owner One Line

Black Hawk Substation: Expansion to Add One 345 kV, 100 MVAR STATCOM



7.3 A3 - Site Plans or General Arrangement Drawing

Black Hawk Substation: Expansion to Add One 345 kV, 100 MVAR STATCOM



7.4 A4 – Network Upgrade Plan and Profile

7.5 A5 - Facilities to be Constructed by Transmission Owner

Upgrade Classification	Description of Upgrade	Cost Estimate ($)*
Non-Stand Alone Network Upgrade	Black Hawk Substation Add One 345 kV, 100 MVAR STATCOM and associated transmission line additions/relocations	$50,000,000
	Total	$50,000,000

7.6 A6 - Detailed Cost of Facilities to be Constructed by Transmission Owner

Table A6-1 Construct Transmission Owner Interconnection Facilities
Not Applicable

Table A6-2 Construct Stand Alone Network Upgrade
Not Applicable

Table A6-3 Construct Non-Stand Alone Network Upgrade

Black Hawk Substation Add One 345 kV, 100 MVAR STATCOM
Network Upgrade Estimate

Description	Cost Estimate ($)*
Stores (arresters, insulators, conductor, etc.)	$250,000
Substation Steel, Bus, Connectors	$500,000
STATCOM	$27,000,000
Disconnect Switches	$120,000
Circuit Breakers	$1,100,000
Instrument Transformers	$200,000
Control, Metering and Communications	$500,000
Civil (foundations, raceways, grounding, yard)	$4,000,000
Consultant Design Labor & Project Management	$1,000,000
Contractor Labor & Commissioning	$5,650,000
Company Labor	$250,000
Transportation	$5,000
Transmission Line Costs	$2,500,000
Miscellaneous	$500,000
General & Administrative	$3,925,000
AFUDC	$2,500,000
Total Substation Network Upgrades w/ AFUDC	**$50,000,000**

* Estimated cost includes AFUDC and is in 2022 U.S. dollars +/-20% and does not include the effects of inflation or escalation to future years. Tax gross-up does not apply based on present IRS rules. Transmission Owner plans to elect self-funding.

Schedule is dependent on outage availability, labor availability, equipment lead times and milestones in the Multi-Party Facilities Construction Agreement ("MPFCA") including receipt of acceptable financial security and what time of year the MPFCA is signed because of the effect on the available construction seasons.

See Section 4.1.2 Assumptions for more information.

7.7 A7 - Facilities to be Constructed by Interconnection Customer

None

7.8 A8 - Detailed Cost of Transmission Owner Facilities to be Constructed by Interconnection Customer

Not applicable

7.9 A9 - Facilities Subject to MISO Attachment FF

Upgrade Classification	Description of Upgrade	Cost Estimate ($)*
Non-Stand Alone Network Upgrade	Black Hawk Substation Add One 345 kV, 100 MVAR STATCOM and associated transmission line additions/relocations	$50,000,000
	Total	$50,000,000

* Estimated cost includes AFUDC and is in 2022 U.S. dollars +/-20% and does not include the effects of inflation or escalation to future years. Tax gross-up does not apply based on present IRS rules. Transmission Owner plans to elect self-funding.

For Network Upgrades at 345 kV, ten percent (10%) of the total costs identified as Network Upgrades are eligible for reimbursement according to the existing provisions in Attachment FF of the MISO Open Access Transmission, Energy and Operating Reserve Markets Tariff. The cost estimate is the 100% cost estimate.

Since the Transmission Owner plans to elect self-funding, the Network Upgrade costs included in the FSA or MPFSA would reflect the ten percent (10%) reimbursement being effectively paid to the Interconnection Customer, subject to the terms of the FSA or MPFSA.

7.10 A10 - Contingent Facilities

MISO will provide this exhibit.

7.11 A11 - Interconnection Customer Milestones

Not Applicable

7.12 A12 - Construction and Coordination Schedules

Transmission Owner estimates that construction of the Network Upgrades described in this report can be completed approximately 36-42 months after the Interconnection Customers meet financial security requirements in the executed MPFCA. The proposed schedule is dependent on the time of year the MPFCA is executed as it affects the construction seasons available, timely receipt of all approvals associated with constructing the Transmission Owner Network Upgrades, higher queued projects, outage availability, equipment lead-time and labor resource availability. As previously mentioned, the availability of labor resources at reasonable costs is a concern as well as outage availability given the amount of work expected in Iowa and MISO West footprint. It is anticipated that outages will be restricted during the mid-May to mid-September period. No additional right-of-way is expected for this project. Long lead-time items include substation steel structures, circuit breakers, conductor and STATCOM.

1. Prepare preliminary engineering, procurement and construction ("EPC") documents
2. Order or reserve certain long lead equipment
3. Finalize EPC bid documents and issue project for bids
4. Review proposals and award bid
5. Commence STATCOM and capacitor switching study
6. Complete engineering
7. Review and submit all necessary permits for the project
8. Coordinate outages, material and resource availability
9. Begin construction
10. Complete project work

7.13 A13 - Permits, Licenses, Regulatory Approvals and Authorization

It is not expected that any required approvals will delay completion of this upgrade. Typical permits, licenses and approvals required to construct the Transmission Owner facilities may include, but are not limited to:

- Landowner easements – No additional easements assumed
- Local Building/Construction permit for substation
- County Engineer Approval – 1 to 2 months
- Local City Government Approval
- Iowa Department of Transportation
- Iowa Department of Natural Resources – 3 to 6 months
- Iowa Historical Society Review and Application – 1 to 2 months
- US Corps of Engineers Approval
- US Fish and Wildlife Approval
- Foreign Utility Conflicts Approval
- FAA Approval
- Iowa Utilities Board (Assumed not to be required.)

7.14 A14 - Interconnection and Operating Guidelines

Not Applicable