

Economic Development and Growth Enterprise
Falls City, NE

EDGE Electric Power Study
2019

Prepared by
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Norfolk, NE
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Purpose

This report documents the 2019 EDGE Electric Power Study and summarizes the findings for development of an electric infrastructure necessary to serve a proposed model 10 MW mega site facility. The proposed facility would be located within the City of Falls City electric service area and be provided electric service from the City's distribution system. This analysis is to provide design considerations with opinions of cost for how an electrical infrastructure could be developed within the mega site facility. Additional options are included to allow for some diversity as to the use of the facility and considerations for a more robust type system for reliability and redundancy.

The EDGE committee has established a 1,000 acre UPRR mega site that is located south of City limits and extends 2.5 Miles along the Union Pacific Railroad. Detail 3 is a map of the proposed site.

An engineering analysis was completed to support preliminary design options with opinions of cost. The design criteria used in this analysis is for system voltages and currents to be within industry standard operating conditions with 0.9 power factor.

Historical System Data

The City of Falls City (City) receives its electric energy and capacity requirements from three wholesale providers: Western Area Power Administration (WAPA), Omaha Public Power District (OPPD) and the Municipal Energy Agency of Nebraska (MEAN). The WAPA requirement is a fixed 3 MW monthly allocation, OPPD is a fixed 6MW monthly allocation and MEAN provides the remainder of the requirements above the WAPA allocation. MEAN is also the market participant and coordinates transmission and sub-transmission service charges by Southwest Power Pool (SPP) and Omaha Public Power District (OPPD) for the delivery of bulk power through their electric system.

OPPD also provides the City with a 69 kV sub-transmission connection to the Nebraska Transmission Network near Humbolt, Nebraska. Within the City, OPPD has a substation with a 15/20/25 MVA transformer. The City has a 14.3 MW (15.89 MVA) peak demand that was recorded in 2017. The City has a back-up generation power plant for its customers. The City owns and operates the electrical distribution system within city limits, as well as, a rural service area that comprises approximately 32 miles. The City currently has approximately 2,750 customers within its service area.

Substations and Generation

Detail 1 is a google earth site plan layout of the OPPD substation and City owned 13.8/7.96 kV switching substation, power plant and 4.16/2.4 kV substation. Detail 2 is a one-line diagram for how the substations and power plant are connected. The City utilizes a 13.8/7.96 kV switching substation to connect the OPPD substation to the generation plant, 4.16/2.4 kV substation and distribution circuits. A 4.16/2.4 kV substation with 7.5/9.375/10.5 MVA transformer is connected to the 13.8/7.96 kV switching substation and power plant and has five (5) spacer cable circuits for within city limits. The City also has four (4) substations around the perimeter of city limits that are connected to the ring bus and used to support the 4.16/2.4 kV distribution system within City limits.

From the existing drawings of the 13.8/7.96 kV switching substation, the bussing is constructed with a 1.5" main copper bus and 0.75" branch feeder copper bus, the main bus switches are 1200 amp rated, the feeder/generator switches are 600 amp rated, the feeder/generator circuit breakers are rated 560 amps. Per national safety codes, the main copper bus is rated for 30 MVA and the branch feeder copper bus is rated for 16 MVA. For a 13.8 kV system, the main bus switches have a rating limit 28 MVA and the 600 amp feeder/generator switches are rated for 14 MVA. The three (3) power plant generators connected to this substation have a total 21.55 MW (23.94 MVA) capacity.

The generation power plant has nine (9) generators with a total 25.35 MW (28.17 MVA) generating capacity available for backup generation. In 2019 the City completed installation of a new 9.3 MW generator, Wartsila with dual fuel capabilities, to assist in keeping their generation capacity at a high level of reliability.

Distribution Systems

Detail 3 is a map of the City Rural Distribution System, with the distribution voltages identified for the areas served. The City has three (3) distribution voltages that are used for connections of its customers, 13.8/7.96 kV, 12.47/7.2 kV and 4.16/2.4 kV. The 4.16/2.4 kV voltage is used within City limits. The 12.47/7.2 kV is for rural customers west of the City. The 13.8/7.96 kV voltage has ring bus with two feeders (Ring Bus North and South) that loop the outer limits of the City and connects to four (4) step-down substations that support the 4.16/2.4 kV voltage within City limits, as well as, for 32 miles of rural distribution. The ring bus loop has been upgraded to 477 ACSR (Hawk). The City also has an additional 13.8/7.96 kV south industrial circuit that extends around the southwest part of the City and ends at the railroad tracks as they cross Hwy 73.

Rural customers to the north, south and east of the city are connected to the 13.8/7.96 kV ring bus. Rural customers to the west of the city are connected to the Ring Bus North with a single 750 KVA transformer and 12.47/7.2 kV distribution feeder voltage.

With the upgrading of the ring bus conductor to 477 ACSR (659 amps at 75 degree C, Southwire Overhead Conductor Manual 2nd Edition), national safety codes recommend only 80% of published ampacity ratings can be utilized, the circuit rating of this conductor is 12.6 MVA. To allow for backup operations of the entire load being connected to either the north or south ring bus, the rating of the entire ring bus distribution system is 12.6 MVA.

In review of existing drawings, the south industrial circuit is 500 MCM copper underground (465 amps, National Electric Code Table 310.77) for approximately 150 feet and then is #4/0 aluminum overhead (383 amps at 75 degree C, Southwire Overhead Conductor Manual 2nd Edition) to the southwest corner of the City limit with a circuit rating 7.3 MVA.

The EDGE Project

The EDGE committee has established a 1,000 acre UPRR mega site that is located south of City limits and extends 2.5 Miles along the Union Pacific Railroad. The goal is to solicit customers that 10 MW's (11 MVA) capacity is available to utilize with access to the railroad and provide some options and opinions of cost for how the new infrastructure could be connected to the City's distribution system. Detail 4 is a map of the proposed site plan with options for connection to the city distribution system. The new peak

demand of the system would be 24.3 MW (27 MVA). The city electric service area would also need to be extended south to be all inclusive of the mega site.

Two types of distribution systems are proposed for the mega site, the first is for a large demand type customer that would require the city to provide and maintain a distribution system with multiple transformers. Examples of this type of customer are grain storage facilities with possible fertilizer capabilities or a large delivery or transportation type facility with separate buildings spaced out to allow for large vehicles to transfer materials.

The second is for a “high tension” type customer that requires a substation only for connections. This type of customer provides and installs the remainder of the distribution system. Examples of this type of customer are ethanol facilities or large manufacturing industrials that require a large property. This type of customer typically receives a discount on electric rates for owning and maintaining the distribution facilities.

The OPPD substation transformer has a nameplate rating 15/20/25 MVA, this means the base core rating is 15 MVA and with two (2) stages of fans can be added to enhance the cooling capacity of the fins for the total capacity of the transformer to be increased to 25 MVA. Typically a transformer of this type has a limit of two stages of fans that can be added. The additional 10 MW (11.1 MVA) load would exceed the capacity rating of this transformer by approximately 2 MVA.

To provide 10 MW (11.1 MVA) to a new customer of this type, a separate feeder or dedicated circuit would be necessary, by developing a loop that could be interconnected to the city ring bus would allow for the entire system to be enhanced with more redundancy and reliability.

The existing south industrial circuit would need to be upgraded to 477 ACSR (Hawk) to add the additional 10 MW load of the proposed EDGE Project. Two design criteria were load flow studied for this application, for a large demand customer, the voltage regulation would be maintained from the OPPD substation, similar to how the rural distribution system currently operates, in other words, this matches the design criteria of the existing rural distribution system. This would allow for 4-2,500 KVA or 8-1,250 KVA transformers connected with overhead to underground cabling and padmounted switchgear. The second design criteria, for a high tension type customer, would be for a 10 MVA transformer/substation located on the north end of the property, the substation would maintain adequate voltage criteria for the customer, similar to the City’s other substations.

Opinions of Cost

The following opinions of cost are provided for materials and labor being installed by a private contractor.

An estimated cost to upgrade the OPPD substation transformer with new 30/35/40 is \$1.5 Million. With the increased capacity of the OPPD substation, the 13.8/7.96 kV substation 1,200 amp main switches and buss would need to be upgraded to 2,000 amp. The estimated cost for 2,000 amp switches and minimum 2.5” copper bus to be furnished and installed at the 13.8/7.96 kV substation is approximately \$60,000. Table 1 is the cost of distribution system upgrades for the EDGE Project customer Options 1 and 2.

Table 1

City of Falls City
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Option 1 "Large Demand" Customer

Project Description: 477 ACSR 3 Phase OH Line for EDGE Sub-division

Demolition: Replace Existing OH 3 Phase and 1 Phase Lines

Location: Along Hwy 73 from North City Limit to 340 St. with loop to connect to Ring Bus

Justification: New Customer

Estimated Cost:	Miles		\$\$/mile		Difficulty Factor	Total
15 kV 3-Phase OH #477 ACSR	12.00 Miles		\$ 75,000	\$\$/mile	1.00	900,000
Demolition Existing Dist OH3P	1.00 Miles		\$ 10,000	\$\$/mile	1.00	10,000
Demolition Existing Dist OH1P	2.5		\$ 7,500	\$\$/mile	1.00	18,750
Sub-Total						\$ 928,750.00
	QTY					
2,500 KVA Transformer 13,800-480V With Fiberglass Pad	4.00		\$ 60,000	Each	1.00	\$ 240,000.00
Padmounted Switchgear	4.00		\$ 25,000	Each	1.00	\$ 100,000.00
Underground Cable, Elbows and Connections	4.00		\$ 60,000	Each	1.00	\$ 240,000.00
Metering	4.00		\$ 2,500	Each	1.00	\$ 10,000.00
Sub-Total						\$ 590,000.00
Construction Total						\$ 1,518,750.00
Contingency 10%						\$ 151,875.00
Engineering and Legal 6.5%						\$ 98,718.75
Total						\$ 1,769,343.75

Option 2 "High Tension" Customer

Project Description: 477 ACSR OH Line with New EDGE Substation

Demolition: Replace Existing OH 3 Phase and 1 Phase Lines

Location: Along Hwy 73 from North City Limit to entrance of 703 Road with loop to connect to Ring Bus

Justification: New Customer

Estimated Cost:	Miles		\$\$/mile		Difficulty Factor	Total
15 kV 3-Phase OH #477 ACSR	5.00 Miles		\$ 75,000	\$\$/mile	1.00	375,000
Demolition Existing Dist OH3P	1.00 Miles		\$ 10,000	\$\$/mile	1.00	10,000
Demolition Existing Dist OH1P	2.11		\$ 7,500	\$\$/mile	1.00	15,825
Sub-Total						\$ 400,825.00
	QTY					
10 MVA Substation Transformer 13.8-4.16 kV	1.00			Each	1.00	\$ 380,000.00
Pre-Engineered Building, MetalClad Swgr 6 Breakers	1.00			Each	1.00	\$ 960,000.00
Sub-Total						\$ 1,340,000.00
Construction Total						\$ 1,740,825.00
Contingency 10%						\$ 174,082.50
Engineering and Legal 6.5%						\$ 113,153.63
Total						\$ 2,028,061.13

Summary and Recommendations

The City has a 14.3 MW (15.89 MVA) peak demand recorded in 2017, an additional 10 MW (11.1 MVA) capacity, for the proposed EDGE project, would increase the peak demand to 24.3 MW (27 MVA).

The OPPD substation transformer would need to be increased in size to 30/35/40 MVA. The estimated cost to upgrade is \$1.5 million. The City would need to replace two (2) sets of 1200 amp main switches with 2000 amp switches at the 13.8/7.96 kV switching substation with an estimated cost \$60,000. This would increase the standard rating of the substation from 28 MVA to 47 MVA.

Options are provided for a new Large Demand or High Tension type customer to be added to the rural distribution system with provisions to back-feed from the city ring bus. The south industrial feeder is proposed to be upgraded to 477 ACSR and looped back to the existing City Ring Bus. This allows the upgraded feeder to compliment the ring bus distribution system with backup redundancy operations for enhanced reliability of each. This would also allow for the existing customers, in the area near this project, to be provided with an upgrade to the system. The estimated costs for these options are estimated to be \$1.769 – 2.028 million.

To limit the capacity of the EDGE project to 7.5 MW (8.33 MVA), at least short term, would provide time for the existing OPPD and City main substation facilities to be upgraded. If the desire of the City is to continue to grow, conversations should begin to increase the total capacity size of the city electrical infrastructure. The age and condition with remaining life expectancy of the OPPD and City substations need to be considered. The options would include upgrading the existing substations to a new capacity or installing new substations that can split the city capacity requirement. Considerations should also include increasing the sub-transmission voltage to 115 kV to allow an alternate transmission source to be connected.

Respectfully Submitted

A handwritten signature in blue ink that reads "David R. Peterson". The signature is written in a cursive, flowing style.

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