City of Columbia

701 East Broadway, Columbia, Missouri 65201

Department Source: City Utilities - Water and Light
To: City Council
From: City Manager & Staff
Council Meeting Date: January 19, 2016
Re: Second Public Hearing on route selection for The Columbia Electric Transmission Line Project

Executive Summary

In July 2013 a Public Hearing was held to select a route for The Columbia Electric Transmission Line Project from three options, Option A, Option B and Option B-2. At the conclusion of that Public Hearing, Option A was selected by Council and staff began working on design, funding and project details. In April 2015, Columbia voters approved a bond issue with a portion of its funds to finance this project. On September 30, 2015 an open house was held to review project design details with the public and collect feedback regarding locations of pole structures. Since that time, citizens have expressed concerns and confusion with the project as a whole and at the November 16, 2015 City Council meeting, Council decided to hold a second Public Hearing on the route options and asked for some additional details.

Staff still supports Option A because it solves the need for both the transmission and distribution capacity for the longest term with a single, cost effective solution.

Staff supports Option A for the following reasons:
•Solves the need for both the transmission and distribution capacity for the longest term with a single cost effective solution
•Transfers load to the 161 kV system and preserves current 69 kV capacity
•161 kV lines have more than double the power transmission capacity of 69 kV lines
•Does not require rebuilding of existing 69kV system
•Provides connections between 3 different import substations which is a more reliable & longer term solution
•Option B has four times the number of second contingency issues than Option A
•Has more existing easements than Option B
•Water & Light Advisory Board endorsed Option A without undergrounding options

Discussion

Background:

After electricity is generated, substations step up the voltage to move bulk amounts of power long distances over transmission lines. The network of transmission lines and substations in the United States is known as the Bulk Electric System (BES). Transmission line voltages in the US include 765, 500, 345, 230, 161,138 and 115 kV levels. Columbia imports 90% of its power from its 161 kV assets. 69 kV and 34.5 kV lines, sometimes known as subtransmission, are typically used to move smaller amounts of power within regional areas as the City of Columbia does with its existing 69 kV ring. The City of Fulton

and the University of Missouri (MU) both have agreements with the City to import power through Coumbia's transmission system. Both entities have their ties to the system at the 69 kV level, which is approaching its capacity to reliabily provide electric service. Both the City of Fulton and MU pay for the use of the City's transmission system and the electricity they have delivered to them.

Where the electricity is needed by customers, substations step down the voltage to the local area's distribution system. The City of Columbia uses 13.8 kV as its distribution sytem and as of September 2015 it had 282 miles of overhead construction and 553 miles of underground construction. At a customer's facility, the distribution voltage is stepped down once more to their desired level. As planned, the distribution lines within the new transmission corridor will be placed underground.

Columbia is considered a Balancing Authority and Transmission Operator by federal electric reliability entities. The North America Electric Reliability Corporation (NERC) standards require that certain transmission outages cannot cause the overloading of any neighboring transmission elements and/or cause cascading outages. In 2007, a deficnency with the City's portion of the transmission system was identified. Solutions were reviewed with the City Council and included adding a new power plant in south Columbia, adding a second 161 kV transmission line to the City's Perche Creek substation or restricting electric load growth in south Columbia. At that time it was decided that a second 161 kV transmission line to the City's Perche Creek substation was the most acceptable solution.

In planning for future electric load growth in the southern portions of Columbia's electric service territory, staff engineers recommended building a new substation as part of this project. Addional information on this issue can be found in the NERC Requirements and Electric Load Reliability section of this memo. Staff developed a single, cost effective solution to address both the transmission and distribution capacity issues. The project would build a new 161 kV line from the City's Grindstone Substaion to its Perche Creek Substaion and build a new 161 kV substation attached to this new line. A redundant 161 kV line from Associated Electric Cooperative, Inc's (AECI) McBaine Substation would also attach to the new substation.

Project History and Public Outreach:

As outlined in Section 22-71 in the City's code of Ordinances, the City of Columbia's Public Improvement Process, PROPERTY OWNERS were invited, by mail, to FIVE Interested Parties meetings regarding the route selection process for the transmission line project. There was also an Interested Parties meeting held in September 2015 to review the first stage of line design including pole placement along Option A.

In October of 2010, letters were sent to 1,250 property owners near one of the ten suggested route options inviting them to attend one of three meetings. Since the list included property owners, Boone Electric customers were also notified during this process. Comments collected from those who owned property and lived in the area were used to formulate a selection matrix. This feedback was shared with the City Council at a work session in November 2010 and in April 2011. At that time, the route, now known as Option A was finalized. The City Council requested staff to explore other possible engineering solutions and place the 161 kV transmission line on the west side of town. Council also approved extending the contract for the engineering work to investigate this and the results are now known as Option B.

Throughout the entire transmission and substation process information about the transmission and substation project was continually updated on the City's website. Information that was presented to property owners and the Council can still be found on the website. A transmission project list-serve was established in 2010 for people to receive e-mailed updates about the project. Articles were included in the newsletter sent with utility bills and this project was heavily reported on by the local media.

In August 2011, the City Council received a report about eight possible route options for Option B. Any PROPERTY OWNER along any of the ten routes for Option A and the eight routes for Option B were notified of an Interested Parties meeting in September 2011. Letters were sent to 4,308 property owners. Since the list included property owners, Boone Electric customers were also notified during this process as well. Again, the feedback from the property owners living in the area were collected and put into a selection matrix. In August 2012, the City Council received a report about the route options for Option B so one route could be determined from the eight that were proposed. Option B-2 was suggested by staff at that time since the preferred route for Option B was close to city owned property.

In November 2012, any PROPERTY OWNER living along any of the 18 previously proposed routes were notified by mail that an Interested Parties meeting was being held to gather feedback on whether Option A, B or B-2 was most preferable. Letters were sent to 4,246 property owners and electric customers. The meeting was broadcasted live and rebroadcast on Columbia Access Television from the Stephens College campus.

In January 2013 a letter was sent to 39,500 Columbia Water & Light electric customers urging them to take a survey regarding this project since it involved the reliability of their electric system and they would be paying for the project through their electric rates. Input from entire Columbia electric customer base was not collected until this time. Before that, only property owners and customers in the area of the project provided route selection input. The purpose of the survey was to gather feedback for the City Council before the project's public hearing.

Different aspects of this project had been covered at City Council work sessions and meetings 14 times. During these Council meetings and the Interested Parties meetings, discussions on how high voltage transmission lines are used in the electric system were reviewed. There was information about overhead versus underground transmission lines and why undergrounding transmission lines are more expensive than burying distribution lines. Artist renderings of steel pole structures, both single and double circuited lines were available in presentations and on the City's website. Information and discussions regarding Electric and Magnetic Fields were provided throughout the entire process.

The Water & Light Advisory Board endorsed Option A being built overhead on June 12, 2013. Three City Council meetings were reserved for the public hearing on the final option selection and whether to build the lines overhead or underground. At the July 15, 2013 meeting, there were 17 people who testified. After Council discussion, Option A, built overhead, was approved by a vote of five to two.

From 2013 through 2015, customers and property owners within 150 feet of Option A were sent letters about surveying and soil sampling taking place along the Option A route. There were a total of five letters sent to these property owners during the months of October 2014, January 2015 and May 2015. Property owners were notified by phone of any work being conducted on their property. In April 2015, all Columbia voters were given the opportunity to vote on a bond issue for electric system improvements. Partial funding for the transmission lines and substation were included in the

approved bond issue.

For more details on the history of the project see Project History in the attachments.

Details on Decision Matrix for Option A:

In spring 2008 Sega, Inc. was hired by the City to help evaluate and select property for a new substation in the southern portion of the City's electric service territory and to conduct a route study to connect the substation to the 161 kV transmission system. The project was to build a new substation and to place it into the surrounding 161 kV transmission system and connect the City's Grindstone Substation, Perche Creek Substation and Associated Electric Cooperative Inc.'s McBaine Substation. The substation would also serve as a new source of capacity for the City's 13.8 kV distribution system in the southern portion of its electric service territiory. This is now what is known as Option A.

In a September 2009 Council work session SEGA presented its criteria for the transmission line route decision matrix. A grid of potential line routes was also reviewed. The evalution criteria catagories for the transmission line route decision matrix reviewed was as follows:
•Transmission line characteristics
•Buildings and other facilities near line (distance)
•Crossings
•Right of way characteristics
•Costs

The substation purchase was finialized in July of 2010 and staff began process for the route selection utilizing the initial route decision matrix mentioned above. The consultants divided the project into three different sections and proposed three to four different routes for each section to be further analyzed with the decision matrix. The routes were chosen using these criteria:
•Streets preferred over backyards and cross country
•Main roads preferred over side streets
•Commercial corridors preferred over residential
•Most direct route preferred (fewest angles in the route)

In October of 2010, letters were sent to 1,250 property owners near one of the ten suggested route options inviting them to attend one of three meetings. Comments collected from those who owned property and lived in the area were used to refine the decision matrix to identify the least objectionable route. Public input solicited at these meetings was used to identify public concerns associated with the proposed line routes and assign "Importance Factors" and "Weighting Factors" to be included in the decision matrix to ensure concerns identified by residents, during these meetings, were properly addressed in the selection of route options. Factors most commonly cited as being important to residents included the potential loss of property value, health and safety concerns, and environmental impacts.

To represent the "Importance Factors" in the decision matrix values from 10 to -10 were assigned to the detailed attributes of the evaluation criteria reviewed at the September 2009 Council work session. For example:

Because of the public's concern over property value, an "Importance Factor" of minus ten (-10) was assigned to houses within 0-100 feet of a proposed line route while a minus eight (-8) was assigned to

houses within 100-200 feet of a proposed line route. Because proximity of a house to one of the proposed routes is viewed negatively, the -10 assigned to houses within 100 feet of a route is given more influence on the results of the matrix than that of the -8 assigned to houses within 100-200 feet.

To represent the "Weighting Factors" in the decision matrix percentages from 5% to 40% were assigned to the evaluation criteria categories, such as "Costs" with a value 40%, to relate them to the public's comments and concerns. The least objectionable route for any particular category, as determined by the sum of the attributes for that particular category for that particular route, is assigned the entire percentage for that category. Lesser routes are assigned a fraction of that percentage based upon the sum of their attributes. For example:

Because of the public's concern over property value, the "Weighting Factor" for category "Buildings and other facilities near line (distance)" was assigned a value of 35% while category "Transmission line characteristics" was assigned a value of 5%. This gives the "Buildings and other facilities near line (distance)" category more influence on the results of the matrix than that of the "Transmission line characteristics" category.

This matrix was shared with the City Council at an April 2011 Council meeting. At this meeting the extension to SEGA's contract was approved and a similar route study was started for what is now known as Option B.

Details on Decision Matrix for Option B:

An open house meeting was held in October 2011 at Gentry Middle School to present all of the potential transmission line route alternatives for Option B prepared by SEGA, Inc. to the public. All PROPERTY OWNERs along any of the ten routes for Option A and the eight routes for Option B were notified of the Interested Parties meeting in September 2011. Letters were sent to 4,308 property owners. Input gathered from the public at this meeting was used to identify public preferences and concerns associated with the proposed line routes and to weight a new decision matrix. This matrix was utilized as a tool to rank all the presented alignment alternatives based on public input identified at the public meetings and to identify the public's preferred route of each transmission line for Option B.

Based on the public feedback received at the open house meetings for the Option B alignments, the evaluation criteria categories from the Option A matrix changed to the following:
- Proximity to residences
- Proximity to schools
- Costs
- Environmental concerns
- Proximity to businesses
- Proximity to recreation areas

The "Weighting Factors" for these categories changed values from Option A and were renamed "Public Feedback Rankings", as percentages, similar to the Option A matrix.

With the Option B matrix an additional factor was introduced known as the "Normalizing Factor" due to the rural nature and the proximity of the MKT trail to some of the proposed route alternatives. Also, the matrix utilized total lineal feet instead of number of instances for proximity to schools, proximity to environmental concerns, and proximity to recreation areas.

For proximity to residences and businesses, instances were counted and then multiplied by a "Normalizing Factor" to achieve a more uniform lineal feet comparison. As a result, each residence would impact the decision matrix exactly the same as every other residence, and likewise for businesses. This is to prevent under-representation of a cluster of several residences with relatively small properties, and over-representation by single residences with several thousand feet of affected property. All residences, whether they are 50 or 2,000 lineal feet contribute 200 feet towards the decision matrix.

The matrix calculates line preference ratings by adding the lineal feet of instances, multiplying that number by an "Importance Factor" and then by the "Public Feedback Rankings". For example: one house 0-100 feet from a proposed route would receive 200 lineal feet of instance, and that number would be multiplied by the "Importance Factor" (-10) and then by the "Public Feedback Rankings" (30%). So the total score of one house 0-100 feet is 200 x -10 x 30% = -600.

In August of 2012, the results of the Option B matrix along with a staff suggestion of Option B-2 were presented to the City Council. Because the decision matrix used to evaluate Option B alternatives was modified slightly from the one used in the evaluation of Option A alternatives, it is not useful to compare the numerical results of Option B to the numerical results of Option A.

Details on Decision Matrix for Selecting an Option:

In November 2012, a final Interested Parties meeting was held to gather feedback on whether Option A, B or B-2 was most preferable. 4,246 letters were sent out to property owners near any of the 18 suggested route options and they were urged to fill out an online survey. In January 2013 a letter was sent to 39,500 Columbia Water & Light electric customers urging them to take the survey regarding this project since it involved the reliability of their electric system and they would be paying for the project through their electric rates. 1,585 individual surveys were received representing 4% of Columbia Water & Light electric customers. The results of the survey were utilized to create a final decision matrix.

Based on the results of the survey the evaluation criteria categories for the final matrix changed to the following:
- Proximity to Residences
- Proximity to Day Cares, Schools, Churches, Hospitals, Nursing Homes
- Proximity to Environmental concerns
- Proximity to Recreation Areas
- Proximity to Businesses
- Costs

Two additional evaluation criteria categories, Reliable Electric Service and Longest Term Solution were included to help determine the least objectionable engineering solution for Options A, B and B-2. "Public Feedback Rankings" for this matrix were taken directly from the survey responses. Ranked in order, the "Public Feedback Rankings" are as follows:
16.2% - Reliable Electric Service
15.3% - Longest Term Solution
12.6% - Costs
12.5% - Proximity to Residences
11.8% - Proximity to Environmental concerns

11.7% - Proximity to Recreation Areas
11.3% - Proximity to Day Cares, Schools, Churches, Hospitals, Nursing Homes
8.6% - Proximity to Businesses

Similar to the matrices used for Options A and B an "Importance Factor" was also used with values from 10 to -10 and were assigned to the detailed attributes of the evaluation criteria. As with the Option B matrix a "Normalizing Factor" was used for proximity to residences and businesses. The "Normalizing Factor" is used to equally weight large estate homes with more standard size single family homes along the proposed routes. Each home is counted within the given setback and then that number is multiplied by the "Normalizing Factor", which was the average linear home property width along the routes. This weighting system better represented the impact to home owners. Example:

Option X has 10 homes within 100 feet of the route that have a property width of 200 linear feet each. Option X has a total of 2,000 linear feet of single family homes along Option X. The normalizing factor linear feet would also be 2,000 feet (10 homes X 200 feet/home = 2,000 feet).

Option Y has 3 estate homes within 100 feet of the route that have a property width of 1,000 feet each. Option Y has a total of 3,000 linear feet of single family homes along Option Y. The normalizing factor linear feet would be 600 feet (3 homes X 200 feet/home = 600 feet).

If only looking at linear footage of homes within 100 feet of the routes, Option X would be the better option even though it impacts 7 more homes. The normalizing factor approach shows that Option Y is the better option as far as affecting the fewest number of homes.

In calculating the results for each attribute of the Proximity to Residences and Proximity to Businesses evaluation criteria categories, the number of incidences multiplied by the "Normalizing Factor" multiplied by the "Importance Factor" multiplied by the "Public Feedback Ranking" equals the value for that attribute. An example for Houses within 0-100 feet of option B-2 along the McBaine to Perche Blue Line route as presented in the matrix is as follows:
Number of incidences (Houses) = 22
"Normalizing Factor" for houses = 200
"Importance Factor" Houses within 0-100 feet of line = -10
"Public Feedback Ranking" for Proximity to residences = 12.5%
Value = 22*200*-10*.125= -5500

Each attribute for a particular evaluation criteria category is calculated in a similar fashion. The attributes are then summed for a total for a given route. An example of the Proximity to Residences evaluation criteria category for the McBaine to Perche Blue Line route as presented in the matrix is as follows:
Houses 0-100 = -5,500
Houses 100-200 = -7,875
Multi-Family 0-100 = -5,000
Multi-Family 100-200 = -4,375
Total = -22,750

Each particular evaluation criteria category is summed to get the total for that evaluation criteria category. An example of the Proximity to Residences evaluation criteria category for Option B-2, the totals for the McBaine to Perche (Blue Line) route is added to the Mill Creek to Grindstone (Yellow

Line) and then is added to Mill Creek to Hinkson Creek (Red Line) as presented in the matrix is as follows:
McBaine to Perche (Blue Line) = -22,750
Mill Creek to Grindstone (Yellow Line) = 0
Mill Creek to Hinkson Creek (Red Line) = 0
Combined Total for the Proximity to Residences evaluation criteria category for Option B-2 = -22,750

Combined Totals for each evaluation criteria (excluding Cost, Reliable Electric Service and Longest Term Solution) categories are then summed for a Total Lineal Feet Public Impact score.

Costs are then used to calculate the Cost as a Negative Percent Impact of Total Line Feedback score. In the example for Option B-2, the total cost for the three lines is $11,267,466. This is 94% of the most expensive solution of $11,970,936 (Option A). 0.94 (94%) is then used as the Cost Comparison Adjustment. The Cost Comparison Adjustment is multiplied by the Public Feedback Ranking (12.6% for Cost) to get the Cost Comparison Adjustment Applied to Public Feedback of 0.119. The Cost Comparison Adjustment Applied to Public Feedback is then multiplied by the Average Lineal Feet Feedback Impact to get the Cost as a Negative Percent Impact of Total Line Feedback = -4,907. To get the Adjusted Cost Comparison total, the Total Lineal Feet Feedback Impact of -30,621 is added to the -4,907 to end up with -35,528.

In regards to the most reliable solution, there can only be one route. Similarly, there is only one route that is the longest-term solution. Therefore, if a route option is not the most reliable or is not the longest lasting alternative, then a factor of zero is applied. In the route selection matrix, Option A is the most reliable and will serve Columbia's needs for the longest term. Option B and B-2 are assigned a zero.

Decision Matrix Summary:

The decision matrix(ices) were developed to select the best routes for Option A and Option B by collecting feedback from those living within 250 feet of any of the 18 proposed routes. Although the selection matrix was used to compare Option A, B and B-2, it was not meant to be THE deciding factor for the City Council since the engineering solutions for Option A, B and B-2, are fundamentally different.

NERC Requirements and Electric Load Reliability:

The electric substation and transmission lines in the southern part of Columbia are being built for two reasons. One is to meet required federal reliability standards set by the North American Electric Reliability Corporation (NERC). The other is to reliably meet growing electric demand, which utilities refer to as "load."

NERC Requirements - The North American Electric Reliability Corporation (NERC) is a not-for-profit international regulatory authority whose mission is to assure the reliability of the bulk power system in North America. NERC develops and enforces reliability standards; annually assesses seasonal and long-term reliability; monitors the bulk power system through system awareness; and educates, trains, and certifies industry personnel. NERC sets standards for all transmission level utilities, which includes Columbia Water & Light, for planning their transmission infrastructure to assure a reliable nation-wide electric transmission grid. Columbia Water & Light must assess contingencies – loss of transmission system elements due to storms, accidents, sabotage, etc. – that could lead to an overload of other transmission system elements. NERC rules require Columbia Water & Light to plan and prepare for

future contingencies, as well as the consequences of each contingency. Columbia Water & Light's Engineering Division performed simulations to determine in what year a single contingency event could adversely affect the City of Columbia's electrical grid for transmission route Option's A, B, and B2.

The base model used for the simulations is the year 2020 summer model. This model was selected because it represents the most demanding load conditions and the most up to date transmission element data. To estimate future effects, all Columbia Water & Light loads were linearly increased based on the estimated annual summer load. The study assumed that all of the City's generation was available. Median load growth was estimated at 1.25%, which is a decrease from the 2% growth rate seen before the recession. Load growth could potentially return to the historic level of 2% as there are still undeveloped areas and constant redevelopment of existing areas within the Columbia Water & Light electric service territory.

Columbia's 161 and 69 kV transmission systems provide the transmission needs for the City of Fulton and University of Missouri-Columbia (MU) and are outlined in existing agreements. This project has no impact for the City of Fulton and its existing agreement. The current MU agreement allows for up to 40 megawatts of un-firm electric capacity for use by MU. MU generally meets its needs through their own local power plant. Under the current agreement, if MU imports electricity and there is not enough capacity available, MU would need to take corrective action like starting generation or shedding load. In planning for the future MU is requesting firm electric capacity of up to 60 megawatts or more delivered through the Columbia 69 kV system beginning in 2021. This firm capacity allows delivery through the Columbia system without MU having to add generation or shed load in the event of a first contingency event.

First Contingency Issues - A condition where a single contingency causes an overload of another transmission system element to more than 100% of its rating violates NERC standards. Model simulations suggest that first contingency overloads for Option A begin occurring in 2045 both with and without MU's firm capacity request. Because Option B continues to load the 69 kV system, simulations show that first contingency overloads begin occurring in 2036, without accounting for MU's firm capacity request. If MU's firm capacity request is accounted for, Option B model simulations show that first contingency overloads already appear in 2020. This means that Option B is NO LONGER a viable solution as it is currently proposed and accounting for MU's firm capacity request will require additional upgrades to the 69 kV system with Option B. If MU were to have a firm import capacity of 60 megawatts, Option A gives enough flexibility that no transmission system elements get overloaded in the foreseeable future. Option B however would NOT be an adequate long-term solution and import capacity and more transmission upgrades would need to be constructed in the near future.

Second Contingency Issues - Sometimes there is more than one contingency at a time such as an accident or storm causing two transmission system elements to go offline. These are referred to as "second contingencies." The modeling shows that if Option B is implemented, there are more than four times the number second contingencies that would result in an overload than if Option A were implemented. [See below] NERC rules allow Columbia Water & Light to shed electric load to handle second contingencies. This is what is referred to as rolling blackouts. In addition, second contingency problems could potentially become more pronounced in later years. Only year 2020 was modeled to determine second contingencies. In planning for second contingencies, the community needs to decide what type of risk to the reliability of the system is acceptable.

Both options result in meeting NERC's rules for single contingency planning; however, Option A would provide for the City's needs for substantially longer than Option B.

Electric System Reliability - The second reason the City needs a new substation and transmission lines is to reliably meet growing electric demand, which utilities refer to as "load." Electricity is different than other commodities because there is not a way to store large amounts of electricity. The electric supply needed at any one point in time has to be available where and when it is needed. Also, the electrical needs of a medical facility, for instance, are very different from those of a neighborhood. According to the City of Columbia's Community Development Department, the growth outlook for 2016 is for continued build out of existing planned and subdivided areas, with a strong focus on home building in the south region of Columbia and mixed use in the downtown. The subdivisions of Thornbrook, Creek Ridge, and Steeplechase Estates have been identified as areas of continued development. See Projecting Future Infrastructure map from the 2015 Annual Infrastructure Report in the appendix.

Both Options provide an electric load serving source in south Columbia in the form of the Mill Creek Substation. Option A puts the load on the 161 kV system. Option B puts the load on the 69 kV system. The transformer loading of the Grindstone, Hinkson Creek and Perche Creek substations is currently at critical levels. In designing a reliable electric system, capacity must be reserved to pick up system loading from other areas of the city in case high loads and/or problems with the distribution system occur. For this reason it is recommended that substations with two transformers not be loaded more than 50% and substations with three transformers not be loaded more than 66.6%. Historical loading is listed below.

Year	Grindstone: 3 Transformers	Hinkson Creek: 3 Transformers	Perche Creek: 2 Transformers
2007	41.5%	67.6%	61.8%
2010	44.7%	68.6%	64.4%
2015	48.6%	64.2%	72.0%

The new Mill Creek Substation is planned to add capacity for meeting electric load serving reliability. Option A is projected to provide transmission support of the new substation needs until 2045 independent of the MU's firm capacity request. Because Option B continues to load the 69 kV system the new substation and MU's future needs will have to share the limited available 69KV system capacity. If MU's future needs are not considered, then Option B is projected to meet electric load reliability needs until 2036.

Option A

- Satisfies NERC requirements for first contingency problems until 2045
- Has 22 second contingency issues in 2020 modeling that could require load shedding, commonly referred to as rolling blackouts
- Preserves existing 69 kV transmission system capacity for future reliability concerns and load growth
- Supports planned 75 MW of distribution capacity, expandable to

Option B

- Satisfies NERC requirements for first contingency problems until 2036
- Has 93 second contingency issues in 2020 modelling that could require load shedding, commonly referred to as rolling blackouts
- Requires transmission upgrades and improvements to address future reliability concerns and load growth
- Supports 60 MW of distribution capacity, additional distribution capacity will

249 MW
• 161 kV Substation close to where electric load is needed

require future transmission upgrades
• 69 kV Substation close to where electric load is needed

Funding:

As of December 2015, $7.3 million has been encumbered on the substation and transmission project. The largest portion of this is for engineering design on line route studies, surveying, soil sampling, utility locates and determining pole locations. The cost for this work totals approximately $3.3 million and is detailed as follows:

Description	$ Encumbered	$ Invoiced (Dec 2015)
Route Study	$155,000	$155,000
(60%)Transmission Line Design	$3,054,626	$1,722,948
Surveying	$7,500	$7,500
Geotechnical work	$18,400	$8,115
Utility Locating	$104,515	$104,515
TOTAL	$3,340,041	$1,998,078

In addition to engineering design, equipment procurement began after the bond was approved and funding appropriated to this project. The cost for this work totals approximately $4.0 million and is detailed as follows:

Description	$ Encumbered	$ Invoiced (Dec 2015)
161 kV Substation structures and equipment	$757,647	$0
Protective relays	$10,314	$5,157
13.8 kV Switchgear	$631,852	$0
161 kV Transformers	$1,086,510	$0
Land Acquisition	$1,500,180	$1,500,180
Communication lines and equipment	$42,498	$42,498
TOTAL	$4,029,001	$1,547,835

In the November 16, 2015 report to Council it was estimated that $5.6 million of the encumbered funds would be lost and would need to be re-budgeted. Since that time staff has analyzed its current contracts, worked with equipment vendors and reviewed invoicing for this project. This is reflected in the numbers above. It is estimated that $1.9 million of the $3.3 million for engineering design and $1.1million of the $4.0 million for 161 kV substation equipment would be lost if Option B is selected. Based on staff's revised numbers reflected above, it is estimated that $3.0 million would be lost if Option B or B-2 is selected. More money would need to be budgeted to re-do the preliminary engineering work to determine the pole structure locations for any other options selected. Based on the current contract for preliminary engineering design at least $3.0 million would be necessary. It is also important to note that starting over with a new route would delay the project by as much as two to three years.

An April 7, 2015 election was passed to fund electric system improvements associated with Option A. The transmission line route along Providence/Route K was not included in the bond issue project list. At this time the combination of the Mill Creek-Grindstone, Mill Creek-Perche lines provide the best cost/benefit value. The Mill Creek-McBaine line does provide future benefits and will be constructed with future revenue based on the following considerations:

• When modeling of the Mill Creek load shows an interconnection problem caused by transmission outages.
• When development of this line is needed to mitigate financial impacts on Columbia's energy flow leaving the MISO transmission area.
• If a 69 kV connection at Mill Creek substation is needed.
• If a Columbia Water & Light load serving substation south of the Mill Creek substation is needed.
• To enhance the reliability of the local bulk electric system.

Any changes to the transmission line route would impact the estimated financing needed. According to the Finance Department, changing to Option B will not impact the bonds sold for electric system improvements. Columbia voters, however, were given Option A as the description about the transmission line project being funded. Changing to Option B may degrade voter confidence for future bond issue.

Real Estate Impact:
National studies have been conducted to investigate the effect of transmission lines on property values. Findings indicate that there is a relatively small impact to property values attributed to the high voltage transmission line proximity, and that these effects tend to dissipate over time. Where these effects tend to be most pronounced is on vacant lands as opposed to improved properties. Overall, the general interpretation of these studies is that the presence of transmission lines is apparently not given sufficient weight by buyers and sellers of real estate to have a consistent, material impact on property values. As part of the land acquisition process of this project, the city intends to conduct a current regional High Voltage Transmission Line Study to assist in concluding the easement valuations for properties that will be affected by the Mill Creek Transmission Line Project.

Linear feet of different types of zoning for each transmission line route option are listed below. MP, OP zoning classifications have been included in the commercial footages and PUD zoning have been included in residential footages.
Option A: Agricultural - 17,600, Commercial- 23,760, Residential - 36,160
Option B: 161kV Line - Agricultural - 56,000, Commercial - 2,600, Residential- 24,000,
Option B-2: 69kV Line - (modeled as extension from existing infrastructure path) Agricultural - 2,200, Commercial - 10,500, Residential - 2,000

Electric and Magnetic Fields:

Electric and Magnetic Fields (EMF) are generated by the flow of electrons. Electric fields are established between points of different voltages and are measured in volts per meter. Magnetic fields are generated by electrons flowing in a conductor and are measured in milligauss. EMF are generated by electric lines as well as many other common household items.

According to the Environmental Protection Agency, "Much of the research about power lines and potential health effects is inconclusive. Despite more than two decades of research to determine whether elevated EMF exposure, principally to magnetic fields, is related to an increased risk of childhood leukemia, there is still no definitive answer. The general scientific consensus is that, thus far, the evidence available is weak and is not sufficient to establish a definitive cause-effect relationship."

Concerns were raised by citizens about the EMF from the 161 kV transmission line. The EMF drops over distance. Higher pole structures reduce the EMF more than shorter poles or placing the lines underground. Placing the lines over the center of the roadway also increases distances from

buildings near the transmission route. There are 137 buildings within 100 feet of the transmission line. (Breakdown by zoning: Agricultural – 4, Commercial – 19, Residential – 114).

Structures, Easements and Foundations:

The overall goal of building a transmission line that is safe for the public has many facets. One major factor is the material used for the transmission structures. Steel was selected for the pole material because of its outstanding track record for being reliable in not only the electric utility industry but virtually all other industries where strength and cost are important.

Steel structures are engineered with tight tolerances and specifications resulting in a reliable product. Using steel structures, the design was able to incorporate increased heights while not limiting the span length. Steel also allowed for the structures to be designed with long davit arms to hang the wires away from private property. Increasing the height of the structure provides additional clearance from wires for utility crews as well as others working around the line while it is energized.

Another benefit of raising the transmission line is the reduction of EMF's at the ground level due to EMF magnitude decreasing over distance. Wire clearances for wood and steel pole transmission lines are listed in Table 1 as well as shown in Figure 3. Increasing the height of wood poles is possible however at the expense of span length thus increasing the total quantity of structures.

Another item that was considered in the design of the transmission line was aesthetics. While aesthetics are subjective and sometimes difficult to gain consensus on, there are a couple of main principles that can be followed. One major principle is the line of sight of those in their vehicles driving down the street as well as the line of sight of someone inside of a building looking outside. Increasing the height of the structures and raising the minimum clearance of the wires allows for the line to be out of sight to an extent.

Easements are required for the transmission line anywhere there are structures as well as wire overhang (including when the wire is displaced by wind) over private property. The current design of the transmission line takes into account already existing utility easements where possible. This reduces the overall easements required for the construction of the transmission line.

The typical structure configuration for single circuit portions of the line were revised from the original rendering to incorporate davit arms to hang the wires out toward the roadway reducing overhang on the properties. Figure 2 shows a typical steel structure with the davit arms hanging out over the roadway. On a typical day with calm winds, the wires will hang over public road ROW. On days where the wind is gusting up to 90 mph (per IEEE NCES-C2), the wires, with few exceptions, will blow only over (within) the utility easement. Areas where the wires blow out past an existing easement are limited in quantity and will require additional easement to be purchased.

Another item that can impact the property is the size of the foundation on the particular property. Table 2 shows a preliminary count of approximate structure types and their respective foundation sizes for the transmission line. As shown in the table, approximately seventy-three percent of the structures are expected be tangent (no line angle) structures with a foundation diameter of approximately 3-5 feet. Another eleven percent of the structures on the line will be small angles with a foundation diameter of approximately 5-6 ft. Only two percent of the structures are expected to have foundation diameters larger than 8-ft. Figure 1 shows steel and wood poles side by side. While steel pole foundations will be larger than the wood pole itself, at line angle and deadends, wood

poles will require guy wires to support the structures. These structures have guy wires extending from the poles a length of approximately 60-80-ft. Figures 4 and 5 show a comparison of a wood vs steel angle structure.

Fiscal Impact

Short-Term Impact: Partial funding for Option A was secured in a bond issue in April 2015 of which $36.1 million was designated for this project. The City has encumbered over $7 million for land acquisition, engineering design and equipment. $1.9 million (may increase for invoicing still in process) for engineering design specific to Option A and a portion of the $1.1 million for transformers specific to the 161 kV substation would be lost if Option B is selected. Long-Term Impact: Option A solves the need for additional transmission capacity until 2045. Depending on future substation capacity needs, including the request from MU, Option A will not require any additional transmission upgrades for the forseeable future. Depending on future substation capacity needs, including the request from MU, Option B will require additional funding for transmission upgrades in the near future.

Vision & Strategic Plan Impact

Vision Impacts:
Primary Impact: Primary, Secondary Impact: Secondary, Tertiary Impact: Tertiary

Strategic Plan:
Primary Impact: Primary, Secondary Impact: Secondary, Tertiary Impact: Tertiary

Comprehensive Plan Impacts:
Primary Impact: Primary, Secondary Impact: Secondary, Tertiary Impact: Tertiary

Legislative History

Date	Action
09/21/2009	Work session for criteria of determining routes
02/21/2010	Project overview at work session
03/2010	Approved acquiring substation property
11/22/2010	Work session: review of public comments/EMF/undergrounding
02/2011	Report to Council re: feedback to determine route
04/18/2011	Report to Council re: feedback to determine route
04/18/2011	Council authorizes change to engineering contract for Option B
08/1/2011	Report on eight proposed routes for Option B
08/20/2012	Report on Option B feedback, staff suggested Option B-2
05/20/2013	Report to Council with review of public feedback

06/13/2013	Work session w/ complete history of project
07/1/2013	Public Hearing to determine final route
01/20/2015	Work session to review website, hotline & other communication
11/16/2015	Report to Council on project history & request for 2nd public hearing on route

Suggested Council Action

Following the Public Hearing, direct staff to continue transmission line design work using the Option A route plan.