KENTUCKY UTILITIES COMPANY

Response to Attorney General's Initial Data Requests for Information
Dated November 13, 2018

Case No. 2018-00294

Question No. 196

Responding Witness: Lonnie E. Bellar

Q-196. Reference the Bellar testimony, pp. 35-45, wherein he discusses the Companies' transmission system. With regard to the Companies' Transmission System Improvement Plan ("TSIP"), provide copies of any and all cost benefit analyses the Companies may have conducted regarding alternatives to the projects and methods the Companies intend to pursue.

A-196. See attached for the Alternatives Considered section of the TSIP project Investment Proposals. Consistent with the Companies' Accounting Policy 650 – Capital – Additions and Retirements Policy, an Investment Proposal is required for all capital projects greater than $750k. Accounting Policy 650 – Capital – Additions and Retirements Policy and Procedures was provided as an attachment to the response to PSC 1-8. Some of the information requested is confidential and proprietary and is being provided under seal pursuant to a petition for confidential protection.

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Investment Proposal

Investment Proposal for Investment Committee Meeting on: February 24, 2015

Project Name: Ghent 345kV Control House

Total Expenditures: $2,748k (Including $250k of Contingency)

Project Number(s): 131338

Business Unit/Line of Business: Transmission Substations Protection & Controls

Prepared/Presented By: Brent Birchell – Manager Protection & Controls

Executive Summary

This project is part of an overall plan to upgrade the protection and control (P&C) equipment for Ghent 345kV substation. During the first part of the plan, implemented in 2013-2014, a new 345kV control house was purchased and commissioned for the addition of two new 345/25kV auxiliary transformers for the Ghent Plant, as several P&C panels had to be added and the existing control house did not have the space to accommodate these new panels. The new control house was sized to accommodate the future relocation of the existing P&C equipment, which consists primarily of electromechanical relays located in the original control house.
This project will implement the second part of the overall plan. This proposed project will move the electro-mechanical relays from the old control house and replace them with micro-processor-based technology in the new control house to improve the reliability of the Bulk Electric System (BES) and enhance the Louisville Gas & Electric and Kentucky Utility (LKE) Smart Grid asset portfolio. With the implementation of microprocessor relays, all buses, transformers and lines will have redundant protection and more reliable digital high-speed protection will be implemented on three of the four 345kV lines.

The total cost of this project will be $2,748k. The 2015 spending was approved by the RAC in the 1+11 forecast. $1,800k was included in 2015 through 2018 in the 2015 BP for this project. The additional spending over the BP in 2016 will be funded by LRTU-16 ($830k) and LRELAY-16 ($296k) and in 2017 will be funded by 144117 Alcalde Control House. The estimated total project figure includes a 10% contingency.

The IP estimate is higher than the amount in the BP. Since creating cost estimates for BP purposes, a closer review of the project produced the following items that affected the estimate:

- It is proposed to replace all of the existing control cables to the plant (the BP estimated only accounted for replacement of a portion of the cables). Additional cable will also be installed for redundant station service. ($190k)
- The cost of a Digital Fault Recorder (DFR) was not accounted for in the original estimate. ($160k)

- The complexity and length of the project will add project management and other labor costs for coordination with the following ($550k)
    - Generator outages, interconnecting utilities, and major customers
    - Interfaces with generator protection
    - A concurrent project in the 138kV switchyard.
    - P&C design so construction coordinates with items above.

Background
A previous project (139210), completed in 2014, installed a new control house for the expansion of the 345kV substation bus, to accommodate auxiliary transformer feeds to the Ghent Plant. The new control house was designed not only to provide space to accommodate the new panels for that project, but also to accommodate replacement of the electromechanical P&C equipment in the existing 345kV control house.

The scope of this project includes moving all the 345kV P&C equipment to the new control house and replacing them with microprocessor relays, as there are several concerns with the existing relays and aging AC and DC Distribution infrastructure. The electromechanical relays are becoming obsolete, and replacement parts are difficult to find. The complexity associated with testing of the electromechanical relays, required by North American Electric Reliability Corporation (NERC) standards, would be significantly reduced by installing microprocessor relays.

The current design of the P&C equipment does not provide redundant protection for all transmission equipment in the substation. The existing bus and transformer protection only consist of a single level of protection utilizing electromechanical relays. With the implementation of microprocessor relays, all buses, transformers and lines will have redundant protection. Also, the new equipment will provide improved reliability, increased functionality, engineering access, and disturbance event reporting. Three of the transmission lines currently have Directional Comparison Blocking (DCB) for one level of protection which utilizes Power Line Carrier (PLC) equipment and electromechanical relays. DCB protection is undesirable with today's available protection systems as it is prone for mis-operations and requires annual testing and calibration. With the implementation of microprocessor relays on all transmission lines the DCB schemes can be retired and digital high speed protection can be utilized.

Furthermore, the new control house will replace the aging physical structure of the existing facilities and facilitate implementation of measures to comply with NERC critical infrastructure protection (CIP) physical and electronic security standards.

The original 345kV control house will remain as it houses part of the DC distribution and cable routing infrastructure for the 138kV switchyard. Electromechanical components and relays will be scrapped, and any existing microprocessor relays will be returned to stock.

- **Alternatives Considered**
  Recommendation – It is recommended that the P&C equipment currently located in the older 345kV control house be retired and new microprocessor protection systems be installed in the new 345kV control house.
  NPVRR: ($000s) $3,313k

  Do Nothing – This option is not recommended as the existing electromechanical equipment is aging and replacement parts are becoming obsolete. In addition, when two separate control houses are utilized for the protection of one substation (existing configuration), the P&C design, maintenance, troubleshooting and operation of the station significantly increase in difficulty. Also, with this alternative, redundant protection would not be implemented on the 345kV equipment that currently only has one level of protection.
  NPVRR: ($000s) $0k

  Next Best Alternative(s) – The next best alternative is to increase the time frame for this project from three years to four years. This is not recommended, as a longer period of time for moving of the P&C equipment would increase project management and other labor costs. Also, it would extend the state of transition where the P&C equipment is shared between two control houses. This condition would reduce the reliability of the protection schemes for the transmission equipment and generator feeds, as the additional auxiliary relays and cables between houses would add exposure to the equipment. Also, it would create a condition where personnel have to maintain and troubleshoot in two control houses, increasing related costs and the chance of human error.
  NPVRR: ($000s) $3,469k

Project Description

- **Project Scope and Timeline**

Description	Date
Project Approved	February, 2015
Engineering Started	March, 2015
Materials Ordered	January, 2016
Materials Received	March, 2016
Installation of Control Panels into New Control House	March, 2016
Commissioning of 942, 944 and 946 Bay	September/October, 2016
Commissioning of 922, 924 and 926 Bay	October/November, 2016
Commissioning of 904, 912 and 914 Bay	March, 2017
Commissioning of 932, 934 and 936 Bay	April, 2017
Commissioning of 954 and 964 Bay	May, 2017
Commissioning of North Bus	October, 2017
Commissioning of South Bus	November, 2017
Complete Removal of Existing Equipment	December, 2017

- **Project Cost**
  The total cost of this project will be $2,748k. The 2015 spending was approved by the RAC in the 1+11 forecast. $1,800k was included in 2015 through 2018 in the 2015 BP for this project. The additional spending over the BP in 2016 will be funded by LRTU-16 ($830k) and LRELAY-16 ($296k) and in 2017 will be funded by 144117 Alcalde Control House. The estimated total project figure includes a 10% contingency.

Economic Analysis and Risks

- **Bid Summary**
  Certain components of the project cost were estimated from budgetary proposals based on existing blanket contracts.
  Relay panels suppliers and external engineering resources are selected based on project-specific needs, including lead times and processes implemented for general engineering of the project. In this case, Systems Control supplied the recently installed control house and relay panels. Using the same supplier for the panels and additional control house infrastructure will present a reduced burden on engineering resources and benefit the project schedule.
  Burns & McDonnell (BMcD) will perform the Engineering, Procurement, and Construction Management (EPCM) role. BMcD has familiarity with LKE P&C designs and standards, and has recent experience engineering and managing projects at an LKE generation plant substation.
  Both Systems Control and BMcD are part of bid awards to provide substation control houses and EPCM services respectively, which were approved by the Investment Committee.
  Commissioning services will be performed by LKE technicians. Other equipment and labor will be bid out after preliminary engineering is complete.

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	2015	2016	2017	Post 2017	Total
1. Capital Investment Proposed	308	2,126	282	-	2,716
2. Cost of Removal Proposed	-	-	31	-	31
3. Total Capital and Removal Proposed (1+2)	308	2,126	313	-	2,748
4. Capital Investment 2015 BP	500	1,000	250	50	1,800
5. Cost of Removal 2015 BP	-	-	-	-	-
6. Total Capital and Removal 2015 BP (4+5)	500	1,000	250	50	1,800
7. Capital Investment variance to BP (4-1)	192	(1,126)	(32)	50	(916)
8. Cost of Removal variance to BP (5-2)	-	-	(31)	-	(31)
9. Total Capital and Removal variance to BP (6-3)	192	(1,126)	(63)	50	(948)

Financial Detail by Year - O&M ($000s)	2015	2016	2017	Post 2017	Total
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2015 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.5%
Capital Breakdown:	
Labor:	$100k
Contract Labor:	$971k
Materials:	$1,101k
Other:	$0k
Local Engineering:	$176k
Burdens:	$150k
Contingency:	$250k
Reimbursements:	($0k)
Net Capital Expenditure:	$2,748k

Financial Analysis - Project Summary ($000)	2015	2016	2017	2018	2019	Life of Project
Project Net Income	$ (4)	$ (23)	$ (25)	$ 9	$ 148	$ 3,237
Project ROE	-4.4%	-3.2%	-1.8%	0.6%	11.2%	10.1%

- **Assumptions**
  Coordination of outages will be based on planned unit outages and coordinated with plant personnel. Outages that may affect major customers will be coordinated with Operations and

Account Managers. All equipment replacements, including controls and cables to unit breakers, will be coordinated with plant personnel.

- **Environmental**
  This project does not require permitting and there are no known issues regarding air, water, waste, lead, or asbestos.

- **Risks**
  1. Inability to obtain outages may lengthen the project timeline and costs.
  2. As P&C equipment is transitioned to the new control house, there will be some risk to equipment that is in service. Such risks will be minimized by arranging the project schedule so that work is performed on transmission lines only when the adjacent generator is in a scheduled outage.
  3. There is a possibility of mis-operations on the BES due to aging electro-mechanical relays (PRC-004).
  4. The single level of bus and transformer protection (as currently designed) affects system reliability, as the failure of a non-redundant relay will result in remote breakers operating to clear a fault, resulting in the loss of more facilities and longer exposure to faults.

Conclusions and Recommendation
It is recommended that the Investment Committee approve the Ghent 345kV Control House project for $2,748k to enhance the reliability of the Transmission system.

Revised Capital Investment Proposal for Project 131338 Ghent 345kV Control House

Investment Proposal for Investment Committee Meeting on: October 26, 2016
Project Name: Ghent 345kV Control House
Total Approved Expenditures: $2,748k (approved February 24, 2015)
Total Revised Expenditures: $3,982k (an incremental value of $1,234k)
Project Number(s): 131338
Business Unit/Line of Business: Transmission Substations Protection & Controls
Prepared/Presented By: Brent Birchell – Manager Protection & Controls

Reason for Revision

The initial scope of this project was to move the electro-mechanical relays from the old 345kV control house at Ghent and replace them with micro-processor-based technology in the new 345kV control house at Ghent to improve the reliability of the Bulk Electric System (BES) and enhance the Louisville Gas & Electric and Kentucky Utility (LKE) Smart Grid asset portfolio. With the implementation of microprocessor relays, all buses, transformers and lines would have redundant protection and more reliable digital high-speed protection on three of the four 345kV lines.

Due to the issues described below, contract and company labor were initially underestimated:

- Panel installation and cable pulling of internal house wires were more involved than expected due primarily to the condition of the existing duct bank system between the plant and the substation.
- The complexity of commissioning and the outage sequence changed as bus outages moved from the end of the project to the beginning as a result of a change in compliance needs associated with the TPL standards.
- The general complexity of the commissioning with generation units and the overall project extended the field work as a result of outages being planned around generator outages.
- The oversight of design and engineering was not expected to be as involved.
- The firm performing engineering (Burns & McDonnell) significantly underestimated their labor required to engineer this project.

In addition, scope changes included the following:

- Two new sections of trench and conduit were required to route cables into the new control house, because the existing cable infrastructure didn't have the capacity for additional cables.
- Duke RTU and metering funding requirements changed from the initial project estimates. The additional CIP gateways and associated equipment were not defined in the original project estimate.

The total revised project cost is $3,982k (an incremental value of $1,234k) is included in the 2016 BP for $2,834k. The 2016 spending was approved by the RAC in the 9+3 forecast. The 2017 spending shortfall of $128k will be covered by project 131864 CIP-KU-2017.

Financial Summary ($000s):	**Approved**	**Revised**	**Explanation**
Discount Rate:	6.5%	6.5%	
Capital Breakdown:			
Labor:	$100k	$330k	Complexity of commissioning and outage sequence changed as bus outages moved from end of project to the beginning due to compliance. General complexity of project and commissioning with generation units. Oversight of design and engineering was not expected to be as involved.
Contract Labor:	$963k	$1,653k	The complexity of the project was greater than originally estimated. Labor associated with panel installation and cable pulling of internal house wires was more involved than expected. Labor associated with cables from the plant to the control house was significantly under estimated due to existing duct bank system between plant and substation.
Materials:	$1,101k	$1,334k	Duke RTUs and metering requirements changed from initial estimate. Additional CIP gateways and associated equipment were not defined in original estimate. Additional underground conduit systems were required for plant cables.
Other	$0	$16k	
Local Eng.:	$184k	$326k	
Burdens	$150k	$323k	
Contingency:	$250k	$0	
Net Capital	$2,748k	$3,982k	
Expenditure:			
NPVRR:	$3,313k	$4,815k	

Financial Detail by Year - Capital ($000s)	2015	2016	2017	2018	Post 2018	Total
1. Capital Investment Proposed	577	2,964	411			3,952
2. Cost of Removal Proposed			31			31
3. Total Capital and Removal Proposed (1+2)	577	2,964	441	-	-	3,982
4. Capital Investment 2016 BP	658	1,863	283	-	-	2,804
5. Cost of Removal 2016 BP	-	-	31			31
6. Total Capital and Removal 2016 BP (4+5)	658	1,863	314	-	-	2,834
7. Capital Investment variance to BP (4-1)	81	(1,101)	(128)	-	-	(1,148)
8. Cost of Removal variance to BP (5-2)	-	-	-	-	-	-
9. Total Capital and Removal variance to BP (6-3)	81	(1,101)	(128)	-	-	(1,148)

Financial Detail by Year - O&M ($000s)	2015	2016	2017	2018	Post 2018	Total
1. Project O&M Proposed						-
2. Project O&M 2016 BP						-
3. Total Project O&M Variance to BP (2-1)	-	-	-	-	-	-

The 2016 spending was approved by the RAC in the 9+3 forecast. The 2017 spending shortfall of $128k will be covered by project 131864 CIP-KU-2017.

Conclusions and Recommendation
It is recommended that the Investment Committee approve the revised Ghent 345kV Control House project for $3,982k to enhance the reliability of the Transmission system.

Approval Confirmation for Capital Projects Greater Than or Equal to $1 million:

The Capital project spending included in this Investment Proposal has been approved by the members of the LKE Investment Committee. Pursuant to the LKE Authority Limit Matrix, the signatures below are also required for approval of this Capital project spending request.

Kent W. Blake
Chief Financial Officer

Victor A. Staffieri
Chairman, CEO and President

Investment Proposal

Investment Proposal for Investment Committee Meeting on: February 24, 2015

Project Name: Tyrone Control House

Total Expenditures: $2,378k (Including $216k of Contingency)

Project Number(s): 131350

Business Unit/Line of Business: Transmission Substations Protection & Controls

Prepared/Presented By: Brent Birchell – Manager Protection & Controls

Executive Summary

The Tyrone generation facility currently houses the Transmission Protection and Controls (P&C) equipment for the 69kV bus. This facility has been decommissioned and demoliton of the plant building is currently set for 2020-2021. The protective equipment inside the building will be relocated and replaced by this project due to age, obsolescence, and reliability. By building a new control house, the P&C equipment for the 69kV substation will be centrally located in the substation switching area, affording the opportunity to upgrade the system to a reliable, digital protection scheme and further enhance Louisville Gas & Electric and Kentucky Utility's (LKE) Smart Grid portfolio of assets.

The total cost of this project will be $2,378k. The 2015 BP included a total of $1,500k, comprised of $1,000k in 2015 and $500k in 2016. The 2015 spending of $1,462k was approved by the 2015 1+11 RAC. The 2016 spending above plan of $415k will be covered by reductions to the Alcalde Control House project 144117. The current estimate is higher than the BP since subsequent detailed design review revealed that two new sets of 69kV Potential Transformers (PT's), their stands, and foundations, in addition to a new Station Service transformer, are required to power the control house, yard equipment, and digital protection schemes. Additionally, contract project management was not included in the original estimate, but existing workloads necessitate outsourcing this work. These details are outlined in the Financial Summary section.

Background
The Tyrone property includes a decommissioned generation facility, a 69kV bus connecting five lines, and a 138kV bus connecting three lines. The power plant building currently houses P&C equipment for the 69kV substation, batteries that provide DC for the 69kV and 138kV yard, and sump pumps to prevent lower-level flooding for the power plant. This proposal addresses the installation of a control house in the switchyard, which will house P&C equipment for the 69kV substation and merge the AC and DC distribution system for both the 69kV and 138kV substations. Removing the equipment located in the power plant building will allow for demolition of the building which is scheduled for 2020-2021.

The existing 69kV P&C equipment is composed of electromechanical relays. The new microprocessor based relays will provide improved reliability, increased functionality, and disturbance event reporting. Additionally, the Westinghouse Electromechanical HZ type relays (eighteen installed at this location) have been targeted by the Transmission P&C Department for priority replacement due to their high percentage of mis-operations and age. Throughout the early design phase, several key stakeholders have been identified and consulted, including the general manager and production manager of the Tyrone generation facility, a transmission substation construction engineer, team leader, inspector, engineer from Protection and Controls, and Environmental Affairs.

- **Alternatives Considered**
  Recommendation – It is recommended that all the P&C equipment, currently located inside the decommissioned power plant, be relocated to a new control house within the substation yard and all equipment be upgraded to microprocessor relays.
  NPVRR: ($000s) $2,956k

  Delay Project – Delaying this project for three years has less of an NPVRR but is not the recommended alternative for transmission system reliability and safety reasons. The relays associated with the existing control house have a known issue with misoperation. NERC CEO, Gerry Cauley, has identified the misoperation of protection systems as one of NERC's top priority reliability issues[1]. Additionally, this option is not recommended as housing the P&C equipment in an inoperable generation facility introduces risks for safety, maintenance, and troubleshooting as building conditions deteriorate.
  NPVRR: ($000s) $2,635k

Project Description

- **Project Scope and Timeline**
  - Installation of a new control house and relay panels.
  - Installation of cable trench to all breakers and substation equipment, along with connecting to existing cable trenches.
  - Installation of other substation expansion; such as fence, ground grid, and PTs.

[1] http://www.ferc.gov/CalendarFiles/20111208072453-Cauley, NERC, Panel.pdf

- Existing cables to the plant will be abandoned in place and disconnected from the substation hardware; with the exception of the facility's required legacy protection equipment.

Milestones	Date
Project Awarded	March 2015
Begin Engineering	March 2015
Purchase Control House	April 2015
Start Site Improvements	October 2015
Receive Control House, Begin Installation	March 2016
Start Installation of Station Service, Control Cables	April 2016
Start Connection, Commissioning of Existing Equipment to Control House	May 2016
Complete Connection, Commissioning of Existing Equipment to Control House	December 2016

- **Project Cost**
  The total cost of this project will be $2,378k. The 2015 BP included a total of $1,500k, comprised of $1,000k in 2015 and $500k in 2016. The 2015 spending of $1,462k was approved by the 2015 1+11 RAC. The 2016 spending above plan of $415k will be covered by reductions to the Alcalde Control House project 144117. The estimated total project figure includes a 10% contingency.

Economic Analysis and Risks

- **Bid Summary**
  Certain components of the project cost were estimated from budgetary proposals based on existing blanket contracts.

  The control house panels will be purchased under the existing control house blanket contract agreement. Relay panels suppliers and external engineering resources are selected based on project-specific needs, including lead times and processes implemented for general engineering of the project. In this case, Systems Control recently engineered and manufactured a house for LKE of the same size and design that we need for this project. This situation will present a reduced burden on company engineering resources and benefit the project schedule, as it will minimize lead times for engineering and state permits.

  Similarly, Worley Parsons will perform the Engineering, Procurement and Construction Management role. Worley Parsons has recent experience engineering projects for LKE and has familiarity with LKE substation designs.

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	2015	2016	2017	Post 2017	Total
1. Capital Investment Proposed	1,462	884	-	-	2,347
2. Cost of Removal Proposed		31	-	-	31
3. Total Capital and Removal Proposed (1+2)	1,462	915	-	-	2,378
4. Capital Investment 2015 BP	1,000	500	-	-	1,500
5. Cost of Removal 2015 BP	-	-	-	-	-
6. Total Capital and Removal 2015 BP (4+5)	1,000	500	-	-	1,500
7. Capital Investment variance to BP (4-1)	(462)	(384)	-	-	(847)
8. Cost of Removal variance to BP (5-2)	-	(31)	-	-	(31)
9. Total Capital and Removal variance to BP (6-3)	(462)	(415)	-	-	(878)

Financial Detail by Year - O&M ($000s)	2015	2016	2017	Post 2017	Total
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2015 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.5%
Capital Breakdown:	
Labor:	$133k
Contract Labor:	$624k
Materials:	$1,099k
Other:	$0k
Local Engineering:	$141k
Burdens:	$165k
Contingency:	$216k
Reimbursements:	($0k)
Net Capital Expenditure:	$2,378k

Financial Analysis - Project Summary ($000)	2015	2016	2017	2018	2019	Life of Project
Project Net Income	$ (17)	$ (15)	$ 46	$ 66	$ 122	$ 2,765
Project ROE	-4.4%	-1.5%	3.9%	5.8%	11.2%	10.2%

Spend (000's)	Construction	P&C	Total
Company Labor	$ 35	$ 98	**$ 133**
Contract Labor	$ 153	$ 472	**$ 624**
Materials	$ 181	$ 918	**$ 1,099**
Burdens	$ 67	$ 239	**$ 306**
Contingency	$ 44	$ 173	**$ 216**
Total	**$ 479**	**$1,899**	**$ 2,378**

- **Assumptions**
  Outages are assumed to be obtained within the requested timeframe. Also, Environmental Affairs will own and coordinate all necessary permitting and hazardous material reporting within the project timeline. KU Brown personnel will provide access to the facility and P&C equipment for integration of the new digital protection scheme. Finally, KU Brown personnel will maintain ownership of the out of service and auxiliary transformers currently located within the 69kV substation area.

- **Environmental**
  The Environmental Affairs group has identified three potential issues.

  The first is the floodplain. Parts of the substation are inside the 100 year floodplain. Therefore, any construction within this space would require a Stream Construction Permit from the Kentucky Division of Water, along with a local floodplain permit from Woodford County. The control house will not be in this flood plain.

  There is also a requirement to submit annual "Tier II" reports to state and local fire departments and Emergency Planning Commissions if hazardous chemicals are stored at sites in quantities greater than 10,000 lbs., or extremely hazardous substances are stored at sites in quantities greater than their Reportable Quantity (often 500 lbs.). Lead-acid batteries contain a sulfuric acid electrolyte which must be reported on Tier II reports if stored in a quantity greater than 500 lbs. Tyrone is already subject to Tier II reporting for a number of chemicals including their existing lead-acid batteries. Once the new control house batteries are installed, it is required that they be added to the Tyrone chemical inventory report. Fortunately, these permits, along with those for KY Division of Water, are provided with no cost.

  Finally, sites containing 1,320 gallons of oil or greater require a Spill Prevention Control and Countermeasures (SPCC) plan which includes, inspections, secondary containment to prevent oil releases from reaching waterways, and an accurate inventory of oil-containing equipment on–site. Tyrone's substations already have a quantity of oil over 1,320 gallons; therefore, a SPCC plan (combined for the two substations) currently exists. There are two potential-transformers which may need to be added to the site, depending on design specifications. If these structures contain 55 gallons of oil or greater, they will be added to the Tyrone SPCC inventory. The current secondary containment uses a combination of Strongwell berms and an oil-water separator; which will likely serve any new installed equipment. When the design is complete, these factors will be re-examined for confirmation of conformance.

- **Risks**
  - The risk of 'not doing this project' would be continued poor reliability of P&C equipment.
  - If the existing substation control equipment is not relocated to a new control house, the decommissioned power plant will require repair and continuous maintenance.
  - If the existing substation control equipment is not relocated to a new control house, and if the currently inoperable power plant were ever to be demolished, this equipment will need to be relocated at that time.

- Any required outages would need to be planned and coordinated with the construction efforts to avoid the risk of project timeline extension. Inability to obtain outages may lengthen the project timeline and costs.
- This project has a two year timeline; however, if this time is insufficient, daily operations will be able to continue until completion. This is, of course, assuming the legacy P&C equipment acts without incident, which is a primary cause for initiating this project.

Conclusions and Recommendation

It is recommended that the Investment Committee approve the Tyrone Control House project for $2,378k to facilitate relocation and upgrade of P&C equipment and improve the reliability of the transmission system.

Template for Revised Investment Proposal

Investment Proposal for Investment Committee Meeting on: N/A
Project Name: Tyrone Control House
Total Approved Expenditures: $2,378k (approved on 2/24/2015)
Total Revised Expenditures: $2,768k (an incremental value of $390k)
Project Number(s): 131350
Business Unit/Line of Business: Transmission Substations Protection & Controls
Prepared/Presented By: Brent Birchell – Manager Protection & Controls

Reason for Revision
This revision is requested for the Tyrone Control House project due to several factors. Initially, contract labor forecast was underestimated and was not updated upon receipt and awarding of bids from various contractors. Additionally, it was discovered that the 138kV control house's AC & DC power is fed from the power plant. Modifying the 138kV control house power source was not the initial scope of this project. New power cables will be necessary to feed the 138kV control house from the 69kV control house so as to remove all Transmission dependency on the power plant building.

In addition to the need for new power cables, the control house material was also underestimated and a change order was issued from the provider for standard changes identified during the engineering phase of the project. This materials and engineering change order was funded with a full reduction of contingency on this project ($215k).

Lastly, due to unexpected overtime work needed as the result of a delayed bus outage, company labor was also slightly underestimated.

Financial Summary

Financial Analysis - Project Summary ($000)	2015	2016	2017	2018	2019	Life of Project
Project Net Income	$ 51	$ 113	$ 114	$ 130	$ 124	$ 3,079
Project ROE	9.6%	8.4%	8.1%	9.2%	10.0%	9.8%

Financial Summary ($000s):	Approved	Revised	Explanation
Discount Rate:	6.5%	6.5%	
Capital Breakdown:			
Labor:	$133k	$175k	Fall 2016 costs initially underestimated and costlier overtime needed due to delayed bus outage
Contract Labor:	$624k	$931k	Initially underestimated and forecast not revised after receiving bids.
Materials:	$1,099k	$1,173k	Control house material underestimated by contractor, additional control cable needed to feed 138kV control house from the 69kV control house
Other	$0	$51k	
Local Engineering:	$141k	$249k	
Burdens	$165k	$189k	
Contingency:	$216k	$0	
Net Capital	$2,378k	$2,768k	
Expenditure:			
NPVRR:	$2,956k	$3,368k	

Financial Detail by Year - Capital ($000s)	2015	2016	2017	Post 2017	Total
1. Capital Investment Proposed	1,004	1,758			2,762
2. Cost of Removal Proposed		7			7
3. Total Capital and Removal Proposed (1+2)	1,004	1,764	-	-	2,768
4. Capital Investment 2016 BP	912	1,396			2,308
5. Cost of Removal 2016 BP					-
6. Total Capital and Removal 2016 BP (4+5)	912	1,396	-	-	2,308
7. Capital Investment variance to BP (4-1)	(92)	(362)	-	-	(454)
8. Cost of Removal variance to BP (5-2)	-	(7)	-	-	(7)
9. Total Capital and Removal variance to BP (6-3)	(92)	(369)	-	-	(460)

Financial Detail by Year - O&M ($000s)	2015	2016	2017	Post 2017	Total
1. Project O&M Proposed					-
2. Project O&M 2015 BP					-
3. Total Project O&M Variance to BP (2-1)	-	-	-	-	-

Conclusions and Recommendation
It is recommended that the Investment Committee approve the revised Tyrone Control House project for $2,768k to facilitate the relocation and upgrade of P&C equipment to improve the reliability of the transmission system.

Approval Confirmation for Capital Projects Greater Than or Equal to $1 million:

The Capital project spending included in this Investment Proposal has been approved by the members of the LKE Investment Committee. Pursuant to the LKE Authority Limit Matrix, the signatures below are also required for approval of this Capital project spending request.

Kent W. Blake	Victor A. Staffieri
Chief Financial Officer	Chairman, CEO and President

Investment Proposal

Investment Proposal for Investment Committee Meeting on: February 24, 2015

Project Name: KU Park Control House

Total Expenditures: $3,552k (Including $325k of Contingency)

Project Number(s): 132674

Business Unit/Line of Business: Transmission Substations Protection & Controls

Prepared/Presented By: Brent Birchell – Manager Protection & Controls

Executive Summary

The existing protection and control (P&C) equipment owned by Louisville Gas & Electric and Kentucky Utilities (LKE) and by Tennessee Valley Authority (TVA) for the substations adjacent to the decommissioned KU Park generating facility are currently located inside the retired power plant building. As the generation equipment in the building is no longer functioning, KU-Brown personnel has requested that the P&C equipment be removed from the building due to the building's deteriorating conditions. The scope of the project will also include relocation of TVA control equipment to an existing TVA control house on site.

The total cost of this project will be $3,552k, with $1,374k in 2015 and $2,177k in 2016. $1,500k had been budgeted in each of 2015 and 2016. The 2015 spending was approved by the RAC in the 2015 1+11 forecast. The 2016 funding in excess of the BP will be covered by KRELAY-16 ($510k) and LRELAY-16 ($167k). The total cost includes TVA's estimated cost of $2,625k of which LKE will only be responsible for $1,313k. The estimated total project figure includes a 10% contingency. The proposed total cost is higher than the budgeted amount due to the increased cost of the TVA portion of work. TVA's estimate was originally $2,000k (of which LKE would pay $1,000k) so there is an increase of $313k. The remaining $239k is due to developing a more detailed scope of work after preliminary site visits.

Background

The KU Park facilities include a power plant building and the LKE and TVA substations. The power plant building houses P&C equipment for both substations, in addition to equipment that was needed for the operation of the now decommissioned generation equipment. KU-Brown personnel operate and maintain a sump pump system to prevent lower-level flooding that would damage relays. Therefore, to completely abandon the building and maintenance activities, the P&C equipment must be removed from the building and relocated to a different location.

As removal of P&C equipment is a key component of the procedure to abandon the building, this proposal addresses the installation of a control house in the switchyard. The new control house will house AC and DC distribution and protection & control panels that will replace the

equipment inside the power plant building. Also, as the existing P&C is composed of electromechanical relays which are subject to misoperation and for which parts are no longer available, P&C is using the relocation as an opportunity to upgrade the equipment with new microprocessor-based relays which will provide improved reliability, increased functionality, and disturbance event reporting.

The scope of the project will also include relocation of TVA control equipment to an existing TVA control house. This portion of the project will be engineered, managed, and executed by TVA. Under Section 6 of the Interconnection Agreement between KU and TVA dated September 1, 1944, LKE is obligated to pay for ½ of TVA's cost to relocate their facilities.[1]

- **Alternatives Considered (1 –Recommendation, 2 –Do nothing, 3 –Next Best Alt)**
  Recommendation – It is recommended that the P&C equipment currently located in the retired power plant building be relocated to a new control house out in the substation yard and that the equipment be upgraded to microprocessor-based relays. The scope of the project will also include relocation of TVA control equipment to an existing TVA control house on site.

  NPVRR: ($000s) $4,330k

  Do Nothing – This option is not advisable as the location of the P&C equipment within the retired power plant building is rapidly deteriorating and poses various safety concerns for Kentucky Utilities personnel.

  NPVRR: ($000s) $0k

  Next Best Alternative(s) – The next best alternative is to reconfigure transmission lines to the Pineville 192 Substation and install protection and control panels inside the existing Pineville control house. This alternative requires considerable bus work, substation equipment addition, and line re-work so that three lines could be moved into the Pineville substation. Under this alternative, we would not add an additional control house at KU Park, thus eliminating the task of maintaining that asset. However, it does not improve other maintenance activities, as it would still leave some equipment in the flood plane at KU Park and also add substation assets at Pineville 192 Substation. This option would cost upwards of $3,818k (including TVA costs). This alternative is not recommended due to its higher cost.

  NPVRR: ($000s) $4,660k

Project Description

- **Project Scope and Timeline**
  - Installation of a new control house and relay panels.

[1] In the event the Company, during the term of this agreement, determines to enlarge or re-arrange its plant or facilities in such manner that the maintenance of Authority's said facilities at their present location will constitute an interference, Authority will forthwith upon receipt of written demand from the Company for it so to do, remove said facilities to other places on Company's property as designated by the Company, and the net cost of such relocation shall be divided equally between the parties. From Section 6, page 4 of the "Agreement For Interconnection and Sale of Power between Tennessee Valley Authority and Kentucky Utilities Company", Dated September 1, 1944.

- Installation of station service to sump pump, control house, and distribution equipment.
- Installation of above-ground cable trench to all breakers and substation equipment.
- Installation of other substation expansion such as fence and ground grid.
- Removal of existing cables to equipment inside plant building.
- Relocation of TVA equipment to existing switchyard building (by TVA).

Milestones	Date
Begin Engineering	February, 2015
Purchase Control House	April, 2015
Start Site Improvements	September, 2015
Receive Control House, Begin Installation	November, 2015
Start Installation of Station Service, Control Cables	November, 2015
Start Connection of Control House & Relaying to Existing Breakers & Commissioning of Breakers & Relays	February, 2016
Complete Commissioning of Breakers & Relays	June, 2016
Complete Removal of Cables to Plant Building	July, 2016
Start Relocation of TVA Equipment to Switchyard Control House (by TVA)	January, 2016
Complete Relocation of TVA Equipment to Switchyard Control House (by TVA)	December, 2016

- **Project Cost**
  The total cost of this project will be $3,552k, with $1,374k in 2015 and $2,177k in 2016. $1,500k had been budgeted in each of 2015 and 2016. The 2015 spending was approved by the RAC in the 2015 1+11 forecast. The 2016 funding in excess of the BP will be covered by KRELAY-16 ($510k) and LRELAY-16 ($167k). The total cost includes TVA's estimated cost of $2,625k of which LKE will only be responsible for $1,313k. The estimated total project figure includes a 10% contingency. The proposed total cost is higher than the budgeted amount due to the increased cost of the TVA portion of work. TVA's estimate was originally $2,000k (of which LKE would pay $1,000k) so there is an increase of $313k. The remaining $239k is due to developing a more detailed scope of work after preliminary site visits.

Economic Analysis and Risks

- **Bid Summary**
  Certain components of the project cost were estimated from budgetary proposals based on existing blanket contracts.

  The control house will be purchased under the existing control house blanket contract agreement. Control panels suppliers and external engineering resources are selected based on project-specific needs, including lead times and processes implemented for general engineering of the project. In this case, Systems Control has recently engineered and manufactured a house for LKE of the same size and design that we need for this

project. This situation will present a reduced burden on company engineering resources and benefit the project schedule, as it will minimize lead times for engineering and state permits.

Worley Parsons will perform the Engineering, Procurement, and Construction Management (EPCM) role. Worley Parsons has recent experience with LKE substations and has performed the design for several projects.

Both Systems Control and Worley Parsons are part of bid awards to provide substation control houses and EPCM services respectively, which were approved by the Investment Committee. Other equipment and labor will be bid out after preliminary engineering is complete.

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	**2015**	**2016**	**2017**	**Post 2017**	**Total**
1. Capital Investment Proposed	1,368	2,058	-	-	3,426
2. Cost of Removal Proposed	6	119	-	-	125
3. Total Capital and Removal Proposed (1+2)	1,374	2,177	-	-	3,552
4. Capital Investment 2015 BP	1,384	1,366	-	-	2,750
5. Cost of Removal 2015 BP	116	134	-	-	250
6. Total Capital and Removal 2015 BP (4+5)	1,500	1,500	-	-	3,000
7. Capital Investment variance to BP (4-1)	16	(692)	-	-	(676)
8. Cost of Removal variance to BP (5-2)	110	15	-	-	125
9. Total Capital and Removal variance to BP (6-3)	126	(677)	-	-	(551)

Financial Detail by Year - O&M ($000s)	**2015**	**2016**	**2017**	**Post 2017**	**Total**
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2015 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.50%
Capital Breakdown:	
Labor:	$196k
Contract Labor:	$2,064k
Materials:	$638k
Other:	$0k
Local Engineering:	$113k
Burdens:	$216k
Contingency:	$325k
Reimbursements:	($0k)
Net Capital Expenditure:	$3,552k

Financial Analysis - Project Summary ($000)	2015	2016	2017	2018	2019	Life of Project
Project Net Income	$ (16)	$ (36)	$ 16	$ 58	$ 182	$ 4,033
Project ROE	-4.40%	-2.80%	0.90%	3.40%	11.20%	10.00%

Spend (000's)	Construction	P&C	TVA	Total
Company Labor	$ 82	$ 113	$ -	**$ 196**
Contract Labor	$ 272	$ 479	$ 1,313	**$ 2,064**
Materials	$ 72	$ 566	$ -	**$ 638**
Burdens	$ 118	$ 210	$ -	**$ 329**
Contingency	$ 56	$ 138	$ 131	**$ 325**
Total	**$ 601**	**$1,506**	**$ 1,444**	**$ 3,552**

- **Assumptions**
  Assumptions are that requested outages will be obtained within the requested timeframe. It is also assumed that Generation Services will lead and manage any decommissioning of equipment inside the power plant building.

- **Environmental**
  This project does not require permitting and there are no known issues regarding air, water, waste, lead, or asbestos.

- **Risks**
  - If the existing substation control equipment is not relocated to a new control house, the power plant building would require repair and continuous maintenance. There are also various safety issues related to the continual use of the retired power plant facility.
  - Any required outages would need to be planned and coordinated with the construction efforts to avoid the risk of project timeline extension. Inability to obtain outages may lengthen the project timeline and costs.
  - The construction and some outages have to closely be coordinated with TVA's project schedule. Any delays in TVA's project may affect this project and increase its timeline and costs.

Conclusions and Recommendation
It is recommended that the Investment Committee approve the KU Park Control House project for $3,552k to facilitate relocation and upgrade of P&C equipment and improve the reliability of the transmission system.

Investment Proposal Project 134198 Canal-Del Park Conductor Replacement

Investment Proposal for Investment Committee Meeting on: July 31, 2018

Project Name: Canal-Del Park Conductor Replacement

Total Expenditures: $8,089k
Total Contingency: $737k (10%)

Project Number(s): Transmission Lines - 134198
Distribution Operations – 157697

Business Unit/Line of Business: Transmission Lines/Distribution Operations

Prepared/Presented By: John Doll/Adam Smith

Executive Summary

The proposed project is to replace 2.84 miles of overhead transmission line conductor that is over 60 years old and beyond its expected useful life. Performance of this line has diminished, with the most recent wire failure occurring in 2011 from a failed static. Over 3,700 customers with a peak load over 11 MVA are served by the facilities being replaced, with the largest customer being Reynolds Foil, Inc. This project will improve reliability, maintain system integrity, and reduce the risk of failures and unplanned transmission interruptions to the Del Park, Falls City, Shawnee, and Vermont areas of Louisville, Kentucky.

A Transmission System Improvement Plan was submitted as support in the 2016 Rate Case, outlining programs and projects aimed at reducing the risk of failure, avoiding extended sustained outages, and limiting costly emergency repairs. The programs submitted with the plan were selected to ensure long-term system integrity and modernize the transmission system to avoid degradation of performance over time due to aging infrastructure. Replacement of overhead wires beyond or approaching their expected useful lives were included as part of the Transmission System Improvement Plan to replace aging infrastructure.

Transmission Lines plans to replace the 2.84 mile 69kV line between the Canal and Del Park substations with aluminum conductor steel-reinforced (ACSR) conductor and the deteriorating 3/8" HS static wire will be replaced with optical ground wire (OPGW). In addition, sixty-seven (67) wood structures will be replaced with new steel structures, two (2) lattice towers will be replaced with new steel structures, and seven (7) existing steel structures will remain. Distribution Operations will transfer distribution equipment along this route from the existing to new transmission structures.

The total project cost is $8,089k ($6,805k Transmission Lines, $1,284k Distribution Operations). This project was included in the 2018 Business Plan (BP) for $3,500k, with estimated spend of $200k in 2018, $2,663k in 2019, and $637k in 2020. This was a preliminary

estimate based on "per mile" costs for similar past projects. This estimate did not include the installation of eight drilled shaft foundations or the replacement of a double circuit lattice tower within the constrained space near the Canal substation. The need for this work was determined only after a detailed engineering analysis. Additionally, multiple adjustments in the alignment were made to facilitate construction and improve the configuration of this circuit for future accessibility and maintenance, including minimizing the footprint of the circuit within railroad right of way.

The current total project cost is $8,089k, with estimated spend of $662k in 2018, $6,808k in 2019, and $619k in 2020. The 2018 spend was approved by the RAC in the 6+6 forecast. The 2019-2020 spend is consistent with the proposed 2019 BP.

Background
The existing 2.84 mile section of 69kV line between Canal and Del Park contains aging 4/0 copper conductor which dates back to 1955 and has experienced diminishing performance in recent years. Similar copper conductors with 60+ years of service life often have sections with broken conductor strands and significant corrosion at the clamps where the conductor attaches to the structure. Furthermore, multiple static and cross arm failures have occurred in recent years, causing significant damage to the already brittle and aged wire. The most recent event occurred in 2018 due to a cross arm failure.

Due to the condition of this line, there is risk for additional failures that will expose the transmission network to further unscheduled outages. The following pictures are representative of the 4/0 conductor, static, and cross arm conditions on sections of this line.

The first picture shows conductor damaged by a static failure, there are multiple instances of this along this circuit. The second picutre depicts a fractured crossarm and is representative of most structures along this route.

The aging conductor will be replaced with aluminum conductor steel-reinforced (ACSR) conductor and the deteriorating 3/8" HS static wire will be replaced with OPGW (optical ground wire). In addition, new steel structures will be installed in place of existing wood structures. A Comprehensive Visual Inspection was completed on this line in 2016. From this inspection, two

(2) structures were found to be in need of replacement. The two (2) structures found during inspection will be addressed as part of this project.

In January of 2018, the transmission project was opened for detailed design. The detailed engineering identified underground utilities at strategic locations along the route to facilitate structure placement and foundation design. Soil borings were also taken to provide geotechnical reports to support design of the drilled shaft foundations. In addition, plats were provided for the properties adjacent to the railroad to assist with easement acquisition and permitting. The transmission line design was provided to all departments involved for comment and review.

Additional easements are required along the southernmost section of this circuit, namely the three spans closest to the Del Park substation. The existing structures are double circuited wood poles. This configuration will be replaced with steel poles on davit arms which allow for necessary energized working clearances in the future, and proper separation between conductors. Additional separation from the existing wood pole structures is required to allow the existing circuits to remain energized while this work is performed. In order to achieve this, the new alignment must be shifted to the north, beyond the existing easement. The Real Estate and Right of Way department indicates the easement acquisition is feasible and likely.

Furthermore, easements will be acquired for seven spans paralleling 32nd street between Alford Avenue and Rowan Street. Accessing this section of the circuit is difficult due to the proximity to the railroad right of way to the east and housing to the west. Homeowners have fenced in several properties in this section and have severely limited access to both transmission and distribution facilities as well as third party attachments. Easements at this location would grant LG&E improved access and allow construction and maintenance activities to be performed without requiring permission from the railroad.

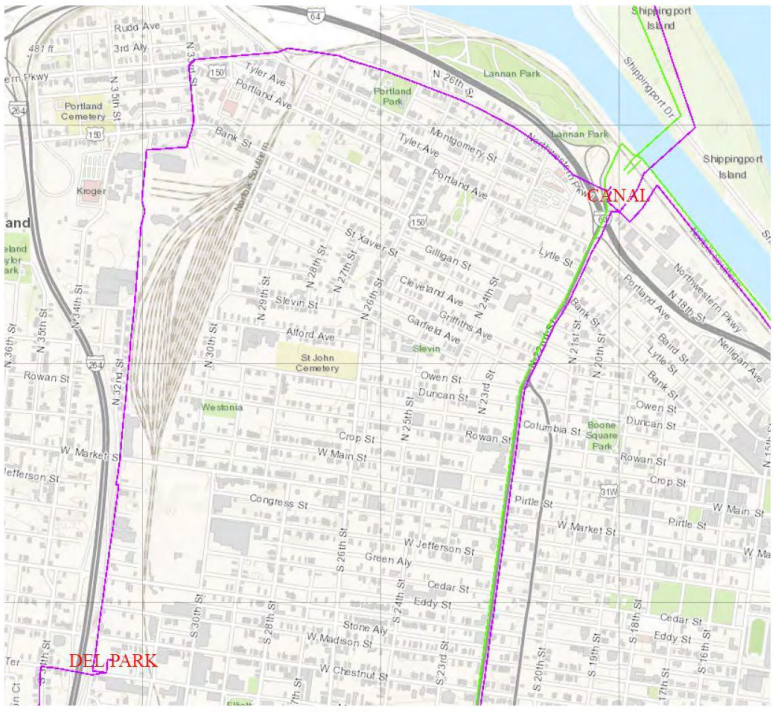
This project also includes a supporting project from Distribution Operations. Distribution Operations plans to transfer distribution equipment from the existing to new transmission structures.

- **Alternatives Considered**
    1. Recommendation: NPVRR: ($000s) $9,575
       The recommendation is to replace 2.84 miles containing 4/0 copper with new ACSR conductor, and the existing 3/8" static wire with new OPGW. In addition, 67 wood structures will be replaced with new steel structures, two lattice towers will be replaced with new steel structures, and seven existing steel structures will remain.

    2. Alternative #1: Do Nothing NPVRR: ($000s) N/A
       This option is not advisable as this line is nearing the end of its useful life and puts Transmission at risk of not being able to accomplish the objectives established as part of the Transmission System Improvement Plan that was filed as support in the 2016 Rate Case and assumed the completion of this project. These objectives include reducing the risk of failure, avoiding an extended sustained outage, and costly emergency repairs.

3. Alternative #2 – Construct Alternate Route: NPVRR: ($000s) $9,740
   The next best alternative would be to construct a new 2.5 mile transmission line which would provide an alternate route beginning at structure 1 and would parallel the line along different roadways for 2.5 miles. Constructing a new route would require the purchase of 2.5 miles of new right of way that customers may not be willing to sell. Selecting a new route for this alternative would likely cause project delays and result in community concerns and opposition over the new route.

Project Description
Recommendation – Canal-Del Park Conductor Replacement Facility Map



- **Project Scope and Timeline**
  Transmission Lines Project Description – Project 134198
  The Transmission Lines project involves the upgrade of 2.84 miles of existing conductor with ACSR and existing static wire with OPGW between the Canal and Del Park 69kV line. This project also involves the replacement of 67 existing wood structures with new steel structures, and the replacement of two lattice towers.

Transmission Lines Project Scope and Timeline

Design Start	January 2018
Design Complete	June 2018
Space reserved for steel pole production with manufacturer	July 2018
Materials Delivered	January 2019
Construction Start	April 2019
Facility In-Service	July 2019
Permit Close Out / Project Completion	February 2020

Distribution Operations Project Description – Project 157697
Distribution Operations plans to transfer distribution equipment to the new transmission structures. In addition, Distribution Operations plans to replace existing cross-arms, LB switches, transformers and capacitor banks.

Distribution Operations Project Scope and Timeline

Design Start	February 2018
Design Complete	January 2019
Materials Ordered	1st Quarter 2019
Materials Delivered	1st Quarter 2019
Construction Start	1st Quarter 2019
Construction Finish	December 2019

- **Project Cost**

	Transmission Lines	Distribution Operations	Total
Total 2018	$662k	$0k	$662k
Total 2019	$5,524k	$1,284k	$6,808k
Total 2020	$619k	$0k	$619k
Contingency	10%	10%	

Economic Analysis and Risks

- **Bid Summary**
  Transmission Lines

Based on detailed engineering, Transmission Lines has estimated the material package for this project to be $868k. The project will utilize conductor, OPGW, custom steel structures, standard steel structures, and material. The OPGW will be purchased through AFL. The conductor will be competitively bid through normal Supply Chain processes. The line construction will be based on continuing contracts with our line contractors. B&B Electric, Davis H. Elliot, William E. Groves and Pike Electric are the four contractors awarded the Transmission Overhead Construction and Maintenance contract from the October 2011 Investment Committee (IC) meeting. The contract extension was re-approved by the IC in April of 2017.

Distribution Operations:

Distribution Operations line relocation will be performed by company labor (no bids required).

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	2018	2019	2020	Post 2020	Total
1. Capital Investment Proposed	662	5,352	619	-	6,632
2. Cost of Removal Proposed	-	1,457	-	-	1,457
3. Total Capital and Removal Proposed (1+2)	662	6,808	619	-	8,089
4. Capital Investment 2018 BP	200	2,047	637		2,885
5. Cost of Removal 2018 BP		616	-		616
6. Total Capital and Removal 2018 BP (4+5)	200	2,663	637	-	3,500
7. Capital Investment variance to BP (4-1)	(462)	(3,304)	18	-	(3,747)
8. Cost of Removal variance to BP (5-2)	-	(841)	-	-	(841)
9. Total Capital and Removal variance to BP (6-3)	(462)	(4,145)	18	-	(4,589)

Financial Detail by Year - O&M ($000s)	2018	2019	2020	Post 2020	Total
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2018 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Discount Rate: 6.59%
Capital Breakdown:

	148857 Trans Lines	157697 Dist Ops	Total
Labor	$341k	$0k	$341k
Contract Labor	$3,680k	$910k	$4,590k
Materials	$868k	$144k	$1,012k
Local Engineering	$904k	$84k	$988k
Burdens	$391k	$28k	$419k
Contingency	$619k	$118k	$737k
Other	$2k	$0	$2k
Reimbursements	$0	$0	$0
Net Capital Expenditure	$6,805k	$1,284k	$8,089k

- **Assumptions**
  Recommendation - This assumes that the 2.84 miles of existing conductor will be replaced with ACSR and the existing static wire will be replaced with OPGW. An outage must be obtained to complete the project and is scheduled for 2019. This also assumes that all highway and railroad crossing permits will be granted by the Kentucky Transportation Cabinet (KYTC), and associated railroads. It is anticipated that no customers will be out of service for the duration of this work.

  Alternative #1 – Do Nothing - This option is not advisable as this line is nearing the end of its useful life and puts Transmission at risk of not being able to accomplish the objectives established as part of the Transmission System Improvement Plan, that was filed as support in the 2016 Rate Case, which assumed the completion of this project. These objectives include reducing the risk of failure, avoiding an extended sustained outage, and costly emergency repairs.

  Alternative #2 – Next Best Alternative – This alternative assumes that a new 2.5 mile transmission line would be constructed. This option would require additional funding due to the need to purchase 2.5 miles of new right of way, in which the property owners may not be willing to sell. The impacts associated with this option would be more disruptive and have a larger negative impact on the community during construction.

- **Environmental**
  There are no known environmental issues regarding air, water, lead, asbestos, etc., associated with this project.

- **Customer Experience**
  A communication plan is being developed in coordination with the project proponents, corporate communications, and external affairs. This plan will be executed to limit the impacts to the community and businesses along the route.

- **Risks**
  - Without the proposed replacement of the existing wire in the Canal-Del Park 69kV line, the company risks increased exposure to line outages. The wire along the 2.84 miles has deteriorated over time, and is beyond its expected useful life. There have been notable failures in the conductor's 60 year service life. Unplanned outages are often time-consuming and costly when it comes to repairs.
  - The Louisville Metro Department of Public Works requires permits for lane closures and flagging. The permit application will be submitted prior to construction. Lane closure permits are typically obtained in a timely manner from this agency to support our projects.
  - This project requires an easement acquisition from Bethel United Ministries, Inc. This easement has been informally agreed upon and is currently being processed for formal execution.
  - A Norfolk Southern railroad permit is required for a line segment being constructed over an existing crossing. The permit application was submitted in June 2018.

- The local community may react negatively to the work and potential inconvenience of the project. A communication plan is being developed in coordination with the project proponents, corporate communications, and external affairs. This plan will be executed to limit the impacts to the community and businesses.

Conclusions and Recommendation
It is recommended that the Investment Committee approve the Canal-Del Park Conductor Replacement project for $8,089k to improve the reliability of the electric transmission system.

Approval Confirmation for Capital Projects Greater Than $2 million:

The Capital project spending included in this Investment Proposal has been approved by the members of the LKE Investment Committee. Pursuant to the LKE Authority Limit Matrix, the signatures below are also required for approval of this Capital project spending request.

Kent W. Blake Date	Paul W. Thompson Date
Chief Financial Officer	Chairman, CEO and President

Investment Proposal Project 135361 REL Lexington Plant-Pisgah 69kV Rebuild

Investment Proposal for Investment Committee Meeting on: October 26, 2016

Project Name: REL Lexington Plant-Pisgah 69kV Rebuild

Total Expenditures: $9,140k
Total Contingency: $712k (8%)

Project Number(s): 135361, 152826

Business Unit/Line of Business: Transmission

Prepared/Presented By: Chris Balmer – Director, Transmission Strategy & Planning

Executive Summary
The Lexington Plant-Pisgah Rebuild project is a transmission reliability project that will improve reliability for Lexington area customers by significantly reducing future outages primarily due to equipment failure and lightning strikes. This project is the last major project of a plan to address the reliability performance of this circuit.

The project will upgrade 2.58 miles of 69kV transmission line between the Lexington Plant substation and Versailles Road and add shield wire where it does not exist. Equipment, at or near the end of its expected useful life, will be replaced. Specifically, deteriorating copper conductor will be replaced by aluminum conductor steel-reinforced cable (ACSR) and more reliable steel structures will be installed in place of existing wood structures. The project will also include distribution underbuild work on the lower voltage distribution lines which are built below the higher voltage transmission lines and which are attached to the same transmission pole.

Approximately 6,050 customers are impacted by this section of line. Without this project, reliability to these customers will decline further as equipment failures are expected to continue and likely accelerate. Seven of the ten sustained outages since 2009 occurred on areas of the line this project addresses; five were caused by lightning and failed equipment and the two remaining causes were vegetation. This project will eliminate or minimize future outages with these root causes.

The total project cost is $9,140k ($8,590k Transmission, $550k Distribution). The Transmission project was included in the 2016 BP for $8,066k (all Transmission) based on a formula rate similar to that experienced on prior projects. Subsequent engineering, along with a change in scope to add shield wire and distribution underbuild work, increased the proposed total. The 2017 BP reallocated dollars to cover these additions, plus other projects were identified to cover the remaining shortfall. The project was included in the proposed 2017 Business Plan for $7,550k ($7,000k Transmission, $550k Distribution), the total for which was based on

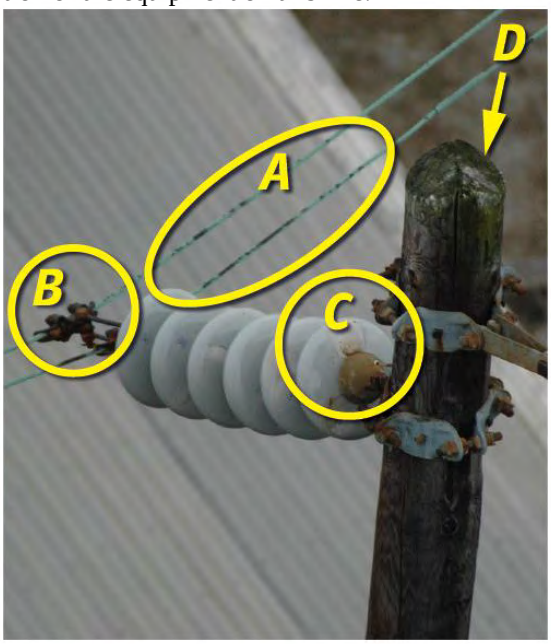
preliminary engineering, inclusive of distribution underbuild work, but which was prior to the decision to add 9,850 feet of shield wire at an additional cost of $1,645k and other small estimate changes. Projects 150687 Pocket to Pennington Gap pole replacement ($200k) and 151554 Hardin County to Hardinsburg pole replacement ($400k) were identified to cover the remaining shortfall in 2017 and project 148821 Floyd to Seminole static replacement to cover the remaining shortfall of $1,077k in 2018.

Background

The Lexington Plant-Pisgah transmission line is an 11.4 mile line that winds through downtown Lexington and ends at the Pisgah substation just west of Keeneland and the Lexington airport (see map below). This line has been the worst performing transmission SAIDI circuit since 2012 and serves over 13,000 customers. Customers served by this line have averaged about two hours of interruption per year since 2012.

Previously completed projects added a breaker at Parkers Mill and motor operated switches at the Parkers Mill tap point; however, about 6,050 remain impacted by the outdated line section between Lexington Plant and Versailles Road being addressed by this project. The project will significantly reduce future outages, primarily due to equipment failure and lightning strikes.

The following pictures of the line section between Lexington Plant and Versailles Road were taken in 2015. They represent the typical condition of the equipment on this line.



The picture on the left shows a broken strand of the existing copper conductor that will be replaced with new ACSR conductor. The picture on the right highlights evidence of equipment age and relibility risks of a typical structure predominant on this line section:

A. Indication of lightning strikes, which likely caused an outage and weakens integrity of the conductor. Conductor will be replaced and lightning strikes to the conductor will be minimized by new shield wire.
B. Corrosion of conductor clamps, which could lead to disconnection of conductor. Clamps will be replaced when new conductor is installed.
C. Indication of flashover caused by lightning strike that likely resulted in an outage and may be avoided with a new shield wire.
D. Deteriorating wood pole to be replaced by steel.

- **Alternatives Considered**

1. Recommendation: NPVRR: ($000s) $11,942k
   Upgrade and add new shield wire to targeted sections of the Lexington Plant-Pisgah transmission line.

2. Alternative #1: Do Nothing NPVRR: ($000s) $14,851k
   Line sectionalization of this circuit has been made, which will yield reliability improvements; however, sectionalization will not eliminate the event causes and continued outages from this section of line. By not rebuilding this section of line and adding shield wire where non-existent, customers will continue to have service interruptions that can be eliminated or minimized with this project. In addition, the copper conductor and other equipment on this section of line are at the end of their useful lives. Without the proposed project, the Company not only risks increased customer outages but unplanned repairs would be necessary on an as-needed basis. Likely repairs would include splicing the failed conductor back together. While the splice does reconnect the damaged wire, repairing the conductor does not address the poor mechanical condition of the wire. This alternative assumes one (1) failure repair would be needed during 2017, increasing by 0.25 repairs per year during 2018-2020, two repairs per year thereafter as the conductor continues to age, and full replacement in 2025. In addition, the NPVRR includes the cost of unserved energy of $0.8M per year each year that the wire needs repair until the full replacement is in service. Assuming 6,050 customers, 2.0 average hours of interruption during the last 5 years, and a cost of unserved energy of $17,200 per MWh, the total incremental cost of doing nothing would be $0.8M per year until full replacement is in service.

3. Alternative #2: Delay recommendation by 5 years NPVRR: ($000s) $14,499k
   Delay the recommendation by splicing the conductor as it fails until the fifth year when a full replacement is made. This alternative assumes one (1) failure repair would be needed during 2017, increasing by 0.25 repairs per year during 2018-2019, with full replacement of the conductor in year 2020. In addition, the NPVRR

includes the cost of unserved energy of $0.8M per year each year that the wire needs repair until the full replacement is in service. Assuming 6,050 customers, 2.0 average hours of interruption during the last 5 years, and a cost of unserved energy of $17,200 per MWh, the total incremental cost of delaying the recommendation by five years would be $0.8M per year until full replacement is in service.

Project Description

- **Project Scope and Timeline**
  The line construction will be based on continuing contracts from our line contractors. B&B, Elliot, Groves and Pike are the four contractors awarded the T&D Overhead Construction and Maintenance contract from the October 2011 Investment Committee meeting. The contract extension was re-approved by the IC in July of 2014. Construction is scheduled to begin in January of 2017 and be completed in March of 2018.

Project Milestones	
August 2016	Engineering and Design
November 2016	Lines Steel Poles Ordered
December 2016	Lines Steel Poles Delivered
January 2017	Line Construction Begins
May 2017	Distribution Construction Begins
November 2017	Lines Static Wire Ordered
December 2017	Lines Static Wire Received
December 2017	Distribution Construction Complete
January 2018	Lines Static Replacement Begins
March 2018	Line Construction Completed

A map of the Lexington Plant-Pisgah 69kV line targeted for reliability improvements is shown below. The blue line represents sections of line where the conductor and poles are being replaced, with a static wire being added. The red line represents sections of line where a static wire is being added and the poles are being replaced.
Total line length: 11.43 miles

- **Project Cost**
  The total project cost is $9,140k. The Transmission project was included in the 2016 BP for $8,066k based on a formula rate similar to that experienced on prior projects. Subsequent preliminary engineering, along with a change in scope to add static wire and distribution work, increased the proposed total. The project was also included in the proposed 2017 Business Plan for $7,550k, the total for which was based on preliminary engineering, inclusive of distribution work, but which was prior to the decision to add 9,850 feet of static wire at an additional costs of $1,645k and other small estimate changes. Historical and existing contract and purchasing agreements were used to estimate the cost of material and contract labor. This project includes an 8% contingency which is reasonable based on the level of detailed engineering, confidence in the cost of materials and contractors, and potential unknown risks such as weather delays, outage delays, reclamation, and structure access.

Economic Analysis and Risks

- **Bid Summary**
  Based on preliminary engineering, Transmission Lines has estimated the material package for construction of this project to be $1,260k. Distribution has estimated the material package for construction to be $107k. The steel structures will be purchased through our steel pole alliance partner, Trinity Meyer. Hardware will be purchased through Brownstown Electrical Supply. The line construction will be based on continuing contracts with our line contractors. Davis H. Elliot, Pike Electric, B&B Electric and William E. Groves are the four main contractors which have been awarded the T&D Overhead Construction and Maintenance contracts.

Material Cost Breakdown	
Material	**Cost**
Steel Poles	$613k
Wire	$568k
Hardware	$79k
Distribution	$107k
Total	$1,367k

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	**2016**	**2017**	**2018**	**Post 2018**	**Total**
1. Capital Investment Proposed	995	6,578	900	-	8,473
2. Cost of Removal Proposed	-	490	178		667
3. Total Capital and Removal Proposed (1+2)	995	7,067	1,077	-	9,140
4. Capital Investment 2016 BP	1,112	6,954	-	-	8,066
5. Cost of Removal 2016 BP	-	490	-	-	490
6. Total Capital and Removal 2016 BP (4+5)	1,112	7,444	-	-	8,556
7. Capital Investment variance to BP (4-1)	117	376	(900)	-	(407)
8. Cost of Removal variance to BP (5-2)	-	-	(178)	-	(178)
9. Total Capital and Removal variance to BP (6-3)	117	376	(1,077)	-	(584)

Financial Detail by Year - O&M ($000s)	**2016**	**2017**	**2018**	**Post 2018**	**Total**
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2016 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

The shortfall of the proposed amount as compared to the 2016 BP has been covered in the 2017 BP plus additional projects were identified to cover the remaining shortfall. The project was included in the proposed 2017 Business Plan for $7,550k ($7,000k Transmission, $550k Distribution). Projects 150687 Pocket to Pennington Gap pole replacement ($200k) and 151554 Hardin County to Hardinsburg pole replacement ($400k) were identified to cover the remaining shortfall in 2016 and project 148821 Floyd to Seminole static replacement to cover the remaining shortfall of $1,077k in 2018.

Financial Summary ($000s):

Discount Rate: 6.49%

Capital Breakdown:

Labor:	$349k
Contract Labor:	$5,717k
Materials:	$1,367k
Local Engineering:	$598k
Burdens:	$395k
Contingency:	$712k

Transportation	$2k
Reimbursements:	($0)
Net Capital Expenditure:	$9,140k

Financial Analysis - Project Summary ($000)	2016	2017	2018	2019	2020	Life of Project
Project Net Income	$ -	$ 242	$ 526	$ 449	$ 427	$ 9,280
Project ROE	0.0%	5.0%	8.5%	10.6%	10.0%	9.8%

Spend (000's)	Lines	Distribution	Total
Company Labor	$ 344	$ 5	**$ 349**
Contract Labor	$ 5,367	$ 350	**$ 5,717**
Materials	$ 1,260	$ 107	**$ 1,367**
Local Engineering	$ 539	$ 59	**$ 598**
Burdens	$ 368	$ 27	**$ 395**
Transportation	$ -	$ 2	**$ 2**
Contingency	$ 712	$ -	**$ 712**
Total	**$ 8,590**	**$ 550**	**$ 9,140**

- **Assumptions**
  - The proposed traffic control plans will be approved without significant modification by the city of Lexington.
  - The work will be conducted during normal working hours.
  - A railroad permit to move a section of line onto railroad property will be approved by Norfolk Southern.
  - Required outages to perform the work will be approved as planned.

- **Environmental**
  There are no known environmental issues regarding air, water, lead, asbestos, etc., associated with this project.

- **Risks**

1. Construction will be in a heavily congested area of Lexington with a number of underground utilities and other challenges.
   a. Working with External Affairs to notify appropriate elected officials. We also plan to work with Communications and Customer Service to develop and implement a Customer Experience plan for the project.
2. Relocation of a small section of line onto railroad property requires approval of a railroad permit.
   a. Their initial review of our plans has been approved and we do not expect delays at this time.

3. Transmission outages will not be approved when requested. This work will be completed in sections between switches to mitigate the risk.

Conclusions and Recommendation
It is recommended that the Investment Committee approve the REL Lexington Plant-Pisgah 69kV Rebuild project for $9,140k to improve reliability for Lexington area customers.

Approval Confirmation for Capital Projects Greater Than or Equal to $1 million:

The Capital project spending included in this Investment Proposal has been approved by the members of the LKE Investment Committee. Pursuant to the LKE Authority Limit Matrix, the signatures below are also required for approval of this Capital project spending request.

Kent W. Blake	Victor A. Staffieri
Chief Financial Officer	Chairman, CEO and President

Investment Proposal: Hardin County-Smith 345kV P2 Pole Replacements

Investment Proposal for Investment Committee Meeting on: August 26 , 2014

Project Name: Hardin County-Smith 345kV P2 Pole Replacements

Total Expenditures: $5,060k
Total Contingency: $460k (10%)

Project Number(s): 137745

Business Unit/Line of Business: Transmission Lines

Prepared/Presented By: Kelly Mefford

Executive Summary

The proposed project is to replace forty-one (41) wood structures on the Hardin County – Smith 345kV line with steel based on the results of a routine line inspection completed in 2011. The results of the inspection revealed that these poles should be classified as Priority Two (P2) structures, meaning that they could fail within 3-6 years following the inspection. As such, this proposal is to proactively replace them over the course of the next couple of years, prior to failure, to ensure the integrity and reliability of this line and to prevent outages resulting from such failures.

The alternative of replacing poles upon failure will result in much higher long term replacement costs due to mobilization of crews and the probable overtime work involved. This alternative also will have a negative impact on network reliability.

The total project cost of $5,060k is included in the 2014 Business Plan for $5,976k and is included in the 2015 Business Plan for $5,060k.

Background
Above ground pole inspections are performed by the company at defined intervals in order to discover problems that may impact the integrity and reliability of the Transmission System. During a routine climbing inspection of the Hardin County-Smith 345kV line in 2011, forty-one (41) structures were identified as P2 poles and determined to be in need of replacement in order to ensure the integrity and reliability of this line. There are 451 structures total on the Hardin County – Smith 345kV line.

- **Alternatives Considered (1 –Recommendation, 2 –Do nothing, 3 –Next Best Alt)**
  1. Recommendation: NPVRR: $6,625k
  2. Do Nothing: NPVRR: $11,906k
     The alternative of do nothing would result in replacing poles upon failure, which would result in a much higher long term replacement cost and have negative impact on network reliability.
  3. Next Best Alternative(s): NPVRR: $5,271k
     The next best alternative would be to replace the P2 poles with wood structures in the same time frame. This alternative poses additional risk to the company. The inspection reports indicate that the majority of the structures were damaged by woodpeckers. Since woodpeckers are so common in this region, we would not be able to ensure the long term integrity and reliability of this line by replacing the P2 poles with wood structures. The manufacturer's recommended life span of a wood pole is 30-35 years whereas steel poles have a recommended life span of 90 years.

Project Description

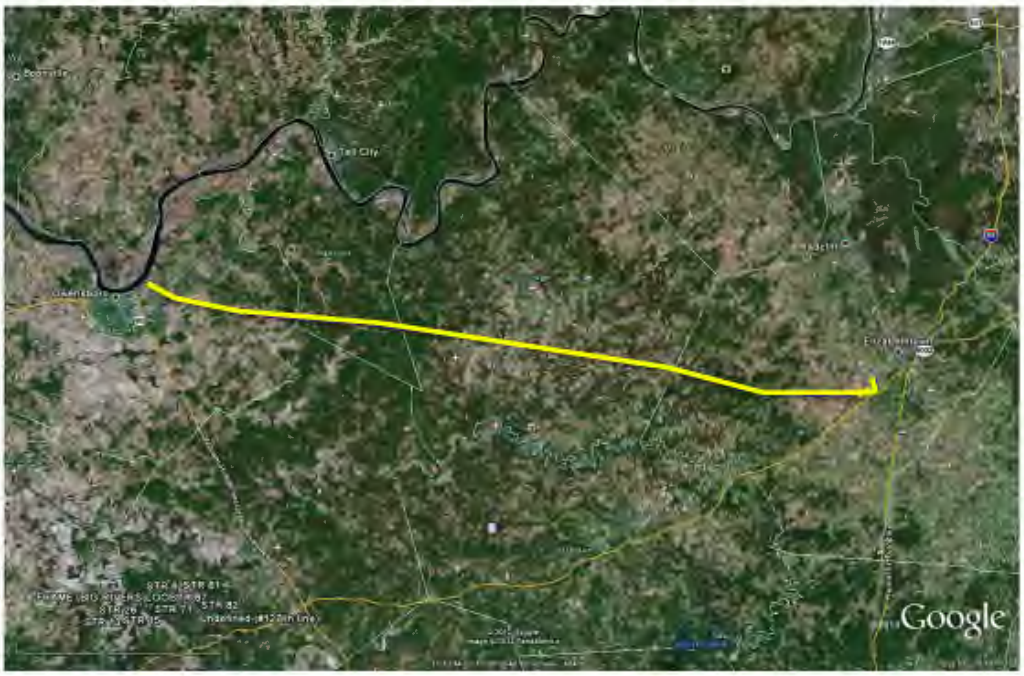
- **Project Scope and Timeline**
  The scope of work will consist of installing (41) steel H-frame structures and associated hardware and material, and the removal of (33) H-frame wood structures, (2) 3-pole wood structures and (6) 4-pole wood structures. Hardware and material will be purchased through Brownstown Electric Supply. The line construction will be based on continuing contracts from our line contractors. B and B, Elliot, Groves and Pike are the four contractors awarded the T&D Overhead Construction and Maintenance contract from the October, 2011 Investment Committee meeting. The contract extension was reapproved by the IC July 2014. Construction is scheduled to begin in January 2016 and to be completed in November 2018.

  The construction milestones for this project are provided below:

Construction Milestones	
September 2014	Engineering and Design
December 2014	Steel Pole Order Placed
February 2015	Fabrication of Steel Poles
June 2015	Steel Poles Delivered
January 2016	Line Construction Begins
November 2018	Line Construction Completed

A facility map of the Hardin County-Smith 345kV line constructed in 1971, shown below:

Line Length: 66 miles



- **Project Cost**
  Total project cost of $5,060k was included in the 2014 Business Plan for $5,976k and is included in the 2015 Business Plan for $5,060k. Historical and existing contract and purchasing agreements were used to estimate the cost of material and contract labor. Detailed engineering analysis lowered the cost of labor and material from the original estimate.

Economic Analysis and Risks

- **Bid Summary**
  Based on preliminary engineering, Transmission Lines have estimated the material packages for construction of this project to be $1,867k. The steel structures will be purchased through our current alliance contract with Thomas and Betts. Hardware and material will be purchased through Brownstown Electrical Supply. The line construction will be based on continuing contracts with our line contractors. Davis H. Elliot, Pike Electric, B&B Electric and William E. Groves are the four contractors which have been awarded the T&D Overhead Construction and Maintenance contracts.

Transmission Lines Material Cost Breakdown	
Material	Cost
Steel Poles	$1,640k
Hardware	$227k
Total	$1,867k

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	**2014**	**2015**	**2016**	**Post 2016**	**Total**
1. Capital Investment Proposed	-	2,080	701	1,882	4,663
2. Cost of Removal Proposed	-	-	97	300	397
3. Total Capital and Removal Proposed (1+2)	-	2,080	798	2,182	5,060
4. Capital Investment 2014 BP	5,559	-	-	-	5,559
5. Cost of Removal 2014 BP	417	-	-	-	417
6. Total Capital and Removal 2014 BP (4+5)	5,976	-	-	-	5,976
7. Capital Investment variance to BP (4-1)	5,559	(2,080)	(701)	(1,882)	896
8. Cost of Removal variance to BP (5-2)	417	-	(97)	(300)	20
9. Total Capital and Removal variance to BP (6-3)	5,976	(2,080)	(798)	(2,182)	916

The proposed amounts by year match the 2015 BP.

Financial Summary ($000s):

Discount Rate:	6.50%
Capital Breakdown:	
Labor:	$113
Contract Labor:	$2,066
Materials:	$1,867
Local Engineering:	$332
Burdens:	$222
Contingency:	$460
Reimbursements:	($0)
Net Capital Expenditure:	$5,060

Financial Analysis - Project Summary ($000)	**2014**	**2015**	**2016**	**2017**	**2018**	**Life of Project**
Project Net Income	-	(36)	(49)	103	91	5,562
Project ROE	0.0%	-6.5%	-3.7%	5.7%	3.9%	10.2%

- **Assumptions**
  Alternative 2 - the cost of this alternative would be almost double due to overtime labor charges and the cost to mobilize and demobilize the construction crews.
  Alternative 3 – the cost of this alternative assumes the cost of wood poles is 71% of the cost of steel poles.

- **Environmental**
  There are no known environmental issues regarding air, water, lead, asbestos, etc., associated with this project.

- **Risks**
  Without the proposed replacement of the P2 poles on the Hardin County to Smith 345kV line, the company risks unplanned outages and increased costs of repairs in emergency situations. The Hardin County to Smith 345kV line is very difficult to get an outage on because it is critical to network reliability and North-South power flows through Kentucky.

Conclusions and Recommendation
It is recommended that the Investment Committee approve the Hardin County-Smith 345kV P2 priority pole replacement project for $5,060k to maintain system integrity, reliability, and to prevent failures and unplanned outages.

Investment Proposal

Investment Proposal for Investment Committee Meeting on: March 28, 2018

Project Name: Lexington Underground

Total Expenditures: $14,937k
Total Contingency: 10%

Project Number(s): Transmission Lines - 139696
Transmission Substation – SU-000247
Distribution Operations – 156381
Distribution Substation – 156378, 156380, and 156384
Telecom – IT0193L, and IT0193K

Business Unit/Line of Business: Transmission Lines/Transmission Substation/Distribution Operations/Distribution Substation/Telecom

Prepared/Presented By: Terry Snow/Adam Smith

Executive Summary

The proposed project is to replace two underground transmission circuits that are over 45 years old and are beyond their expected useful life. Performance of these facilities has diminished, with the most recent failure occurring in 2012 from a failed splice. Over 7,000 customers with a peak load of almost 57 MVA in the downtown Lexington area are served by the facilities being replaced. These customers include the University of Kentucky, Lexington-Fayette Urban County Government (LFUCG), Lextran, Lexington Police Station, Rupp Arena, several large hotels, banks, churches, and many more business and commercial customers in the downtown area. This project will improve reliability, maintain system integrity, and reduce the risk of failures and unplanned transmission interruptions to downtown Lexington.

A Transmission System Improvement Plan was submitted as support in the 2016 Rate Case, outlining programs and projects aimed at reducing the risk of failure, avoiding extended sustained outages, and limiting costly emergency repairs. The programs submitted with the plan were selected to ensure long-term system integrity and modernize the transmission system to avoid degradation of performance over time due to aging infrastructure. Replacement of underground transmission lines in downtown Lexington was included as part of the Transmission System Improvement Plan to replace aging infrastructure.

Transmission Lines plans to replace the existing 69kV underground transmission lines serving the Race Street, Vine Street, West High Street, and University of Kentucky Medical Center substations. The scope of work includes installation of 1.94 miles of new 69kV underground transmission line and creates a separate interruptible circuit to the University of Kentucky Medical Center substation.

This project also includes supporting projects from Transmission Substation, Distribution Substation, Distribution Operations, and Telecom. Transmission Substation plans to expand the Race Street substation to support the separate interruptible circuit to the University of Kentucky Medical Center substation. Distribution Substation plans to replace the existing stone retaining wall at Vine Street and expand the West High Street substation to accommodate the installation of the new underground transmission lines. Similarly, Distribution Operations will relocate underground distribution facilities at the Vine Street substation to accommodate the installation of the new underground transmission lines. Telecom also plans to install fiber optic telecommunication cable along the new transmission underground duct system, providing connectivity to the West High Street substation.

The project was included in the 2018 Business Plan (BP) with estimates of $16,561k. Estimated spend included $458k in 2017, $7,915k in 2018, and $8,188k in 2019. As the scope, timing and certainty of work has evolved, the estimates have been further refined. The current total project cost is $14,937k, with actuals of $585k in 2017, estimated spend of $7,462k in 2018 and $6,890k in 2019. 2018 spend was approved by the RAC in the 2+10 forecast.

Background
Kentucky Utilities (KU) plans to replace two (2) 69kV underground electric transmission circuits presently serving Vine Street Substation and the West High Street underground dip in Lexington, Kentucky. The existing ductbank system was built using "Orangeburg" pipes that are known for collapsing and failing over time. Due to this type of construction, utilizing the existing ductbank system to install new cables is not feasible. During the existing underground system's 45+ year life, there have been notable failures. Both in 1981 and 2012, a custom-made, hand-taped, T-splice failed at the Vine Street tap point of the Race Street – University of Kentucky Medical Center 69kV line (see Figure 1 below). There have also been failures of the underground terminations at the Vine Street substation.

The bulk dielectric strength of the cable insulation degrades as the cable system ages, and this can be accelerated by water ingress, insulation contaminants, and voids in the insulation. The exact way in which the insulation degrades will depend on many factors such as voltage, thermal stress, maintenance, system age, cable system technology, and environment.[1] Aging models quantifying the impacts from these factors are theoretical, and are still being developed by the industry. The Electric Power Research Institute (EPRI) Underground Transmission Systems Reference Book (2007) suggests the typical life of an underground cable is estimated to be 40 years. Substantial improvements have been made in materials, cable designs, and manufacturing methods since the early 1970's that improve production quality and reduce the likelihood of insulation degradation. These changes have been embraced by the industry particularly for XLPE cables to the extent that higher operating stress cables (thin walls) have been accepted alternatives since the early 2000's.

[1] Rick Hartlein and Nigel Hampton, *Diagnostic Testing of Underground Cable Systems* (NETRAC; 2010)

Figure 1: Failed underground splice from 2012

The existing 1500kcmil aluminum cable circuits, one routed west to West High Street Substation and the other east then north to Race Street Substation with existing T-Splice to riser pole at Rose Street, will be replaced with three new 69kV underground circuits. This project will route two new circuits from Race Street Substation, one terminating at Vine Street and the other terminating at a riser pole at Rose Street before transitioning to overhead and going to the University of Kentucky Medical Center Substation. This will eliminate the T-Splice and provide a separate interruptible circuit to University of Kentucky Medical Center. A third circuit will be routed between the substations at Vine and West High Streets. The short West High Street underground dip will also be replaced between the station and a new riser pole. With this project, the reliability of the downtown Lexington 69kV underground system will be greatly improved with the reconfiguration of the system that eliminates the need for a T-splice. Removing this splice replaces a three terminal line with a pair of two terminal lines, providing improved reliability and additional operational benefits to the area. Furthermore, it improves reliability by adding a third feed into the Race Street substation.

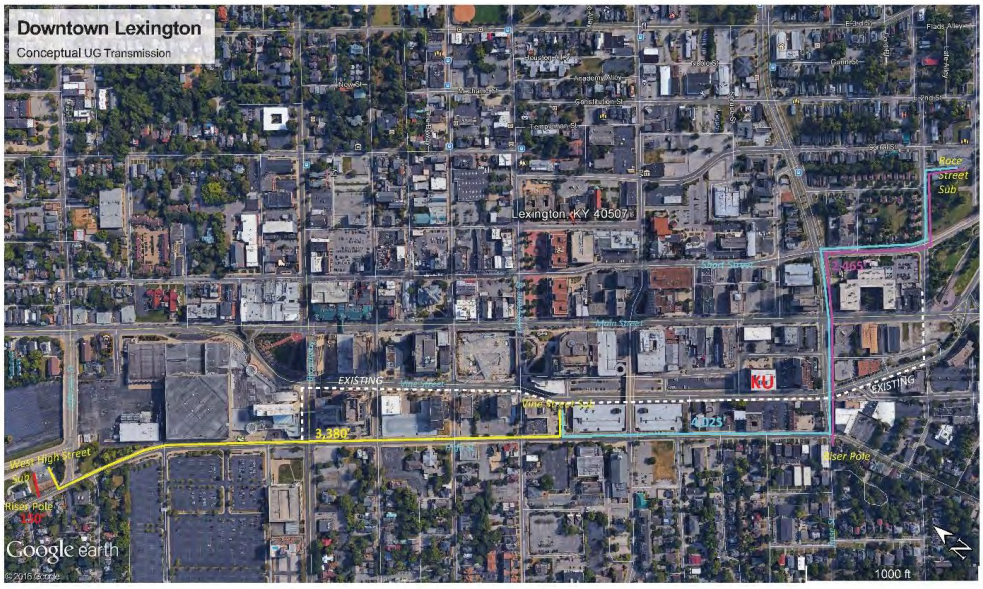
In February 2017, the transmission line engineering phase of this project was approved and initiated. KU partnered with AGE Engineering to complete the civil engineering, and USi to complete the electrical engineering aspects of this project. The engineering phase of the project consisted of a detailed subsurface utility investigation, determination of the preferred line route, cable ampacity studies, development of the construction drawings and specifications and the bidding of the underground construction and cable. The extensive subsurface investigation consisted of sixty-eight (68) vacuum excavations to verify the location of known utilities. Additionally, the top of bedrock was determined at ten locations along the route.

Addition of the separate circuit for the University of Kentucky Medical Center will require expansion at the Race Street Substation and include a breaker addition. The real estate purchase supporting this expansion and new 69kV underground feeds was completed in 2017 under a separate project (154503) in the amount of $135k.

- **Alternatives Considered**
  1. Recommendation: NPVRR: ($000s) $17,231
     As described in the current document.
  2. Alternative #1: Do Nothing NPVRR: ($000s) N/A
     This option is not advisable as this line is nearing the end of its useful life and puts Transmission at risk of not being able to accomplish the objectives established as part of the Transmission System Improvement Plan that was filed as support in the 2016 Rate Case and assumed the completion of this project. These objectives include reducing the risk of failure, avoiding and extended sustained outage, and costly emergency repairs.
  3. Alternative #2: Next Best Alternative NPVRR: ($000s) $17,987
     The next best alternative would be to route the underground cable down Vine Street in lieu of High Street. This is option would require additional funding, as the route has additional underground utilities to navigate and additional impacts to traffic. The traffic impacts associated with this option would be more disruptive and have a larger negative impact on the community during construction.

Project Description

Lexington Underground Layout



The solid lines (red, yellow, blue, and magenta) represent new transmission lines being installed as part of this project. The dashed line (white) represents the location where the existing underground transmission line deviates from the planned route.

The existing and proposed one line electrical diagrams are included in the Appendix for reference.

Transmission Lines Project Description – Project #139696
Below Grade Scope: The project involves (1) the construction of a new underground duct bank from Race Street Substation to West High Street Substation with route deviations to accommodate circuit terminations at Vine Street station and the Rose Street riser pole, (2) the design and placement of new underground to overhead transition riser poles at Rose Street and at West High Street, (3) the routing of the new circuits within the substation areas, (4) the removal (or abandonment) of the existing cables, riser assemblies and cable terminations, (5) the installation of new 69kV transmission cables and accessories and (6) field testing and commissioning. The scope of the underground work will consist of building approximately 1.45 miles of new 69kV ductbank with manholes, installing approximately 1.94 miles of 69kV underground cable, twenty-four (24) 69kV cable terminations, and eighteen (18) 69kV splices.

Above Grade Scope: The scope of the overhead transmission line work will consist of installing one (1) new steel riser pole at West High Street, and one (1) new steel riser pole at Rose Street, and the removal of the overhead lines along Northeastern Avenue and into the Race Street substation.

- **Electric Transmission Lines Project Scope and Timeline**

Design Start	February 2017
Design Complete	December 2017
Materials Ordered	April 2018
Materials Delivered	July 2018
Construction Start	April 2018
Construction Finish	October 2019

Transmission Substation Project Description – Project SU-000247
Transmission Substation plans to expand the Race Street substation to support the separate interruptible circuit to the University of Kentucky Medical Center substation being added as part of this project. This expansion includes site work, a breaker installation, and re-configuration of the existing bus work at Race Street. In addition, protection and control settings will need to be updated at Race Street, Vine Street, West High Street, and University of Kentucky Medical Center substations.

Below Grade Scope: Expand the Race Street Substation grounding grid (6,000 sq ft), fencing (720 ft), and Spill Prevention, Control, and Countermeasure (SPCC) protection to allow for a new 69kV breaker foundation. As part of the substation expansion, an additional site gate with drive access will be added. This project also requires demolition of a residential house and site clearing to accommodate the substation expansion and underground feeds into the station. The real estate purchase supporting this expansion was completed in 2017 under a separate project (154503).

Above Grade Scope: Update protection and control settings for four substations (Race Street, Vine Street, West High Street, and University of Kentucky Medical Center), which includes the installation of one new 69kV line position consisting of one (1) new breaker, six (6) new hook-

stick switches, the addition of two (2) underground riser structures, two (2) new gang-operated switches, re-configuring the existing bus work, and modification of the existing line-side connections at Race Street.

- **Transmission Substation Project Scope and Timeline**

Design Start	June 2017
Design Complete	June 2018
Materials Ordered	April 2018
Materials Delivered	May 2018
Construction Start	May 2018
Construction Finish	October 2019

Distribution Substation Project Description – Project 156378, 156380, and 156384
Distribution Substation plans to replace the existing stone retaining wall at Vine Street to accommodate the installation of the new underground transmission lines. In addition, expansion of the West High Street substation is needed to accommodate the underground feeds into the station.

The scope of work will be to support transmission in the replacement of existing underground cables feeding Vine Street substation by re-building the existing stone retaining wall (below grade) and raise the steel structure on 69V line (above grade). A small portion of land will be acquired that is directly next to the Vine Street Substation to allow for adequate space for construction. In addition, the existing transmission underground conductors feeding West High Street Substation will also be replaced. In order to accommodate the West High Street replacement, one side of the station fence will be expanded above grade, and below grade work will be performed to procure and install grounding for the fence expansion.

- **Distribution Substation Project Scope and Timeline**

Design Start	November 2017
Design Complete	April 2018
Materials Ordered	April 2018
Materials Delivered	April 2018
Construction Start	April 2018
Property Acquisition-Vine Street	May 2018
Construction Finish	December 2018

Distribution Operations Project Description – Project 156381
Distribution Operations will relocate underground distribution facilities at the Vine Street substation to accommodate the installation of the new underground transmission lines. In addition, distribution will use this opportunity to install distribution ducts in the transmission duct bank for future distribution circuits.

This scope of work includes replacement of 240 feet of 750 Al 3/c underground primary & 4/0 Cu neutral from Manhole #10 to Manhole #33 (ckts # 125 and # 1201) with 250 feet of 1000 Al

3/c 15kV JCN underground primary in the relocated distribution duct bank into the Vine Street Substation. Relocation of this distribution circuit will accommodate installation of the 69kV underground transmission feeds into the Vine Street substation. This work will also include the installation of eight (8) 12' x 6' x 7' distribution manholes, the installation of 2700 feet of (6) - 6" concrete-encased duct bank along East and West High Street from Mill Street to Rose Street, and the installation of 1500 feet of six (6) - 6" concrete-encased duct bank from East Main Street, along Elm Tree Lane, East Short Street, and Eastern Avenue to the Race Street substation. The distribution ducts follow sections of the transmission route and will share the duct bank with transmission. The High Street corridor and the area close to Vine Street Substation are likely to be developed in the future and it is highly likely the customers or developers will request underground. The desire is to have 12kV in that area by that time. The proposed developments and concerns are:

- A future upgrade or replacement of the YMCA is expected; development on the vacant land beside the post office is expected; also, there is the possibility of an expansion on top of the bus garage.
- Some of the conduits could be used to support the Town Branch project due to conflicts with existing circuits along Vine Street in front of the Bus Transit Garage.
- System Planning is researching options to eliminate the Vine Street 4kV substation. Although the details have not been worked out or finalized yet, it is highly likely there will need to be utilization of the future conduit installation in the vicinity of the Rose Street/High Street intersection and/or along High Street toward the YMCA in order to convert Vine Street Cir 0021 from 4kV to 12kV.
- Along the same lines, there has been some discussion regarding the retirement of the Vine Street 12kV substation. To accomplish this, a new substation site would likely be necessary. The parking lot located at 176-180 East High Street could be a possible option and could have access to a transmission circuit (when the transmission project is complete) and distribution conduits (if pursued as a part of the transmission project).
- The University of Kentucky may pursue plans along South Limestone from Good Samaritan Hospital to downtown and the possibility of needing these conduits to provide a new circuit to their development exists.
- Also of concern is the number of "orangeburg" conduits that have failed the downtown system and these new conduits could be used to support needed tie circuits.

- **Distribution Operations Project Scope and Timeline**

Design Start	August 2017
Design Complete	December 2017
Materials Ordered	April 2018
Materials Delivered	May 2018
Construction Start	August 2018
Construction Finish	February 2019

Telecommunications Project Description – Project IT0193L and IT0193K
Telecom plans to install fiber optic telecommunication cable along a new transmission underground duct system. This will provide connectivity to the West High Street substation and

increase the capacity between the Race Street, Vine Street, and University of Kentucky Medical substations. It will also provide additional redundancy to the Kentucky Utilities General Office at One Quality.

Below Grade Scope: The telecom scope includes approximately 7,500 feet of dielectric fiber cable installed along the underground duct system.

Above Grade Scope: Above grade work will include the installation of equipment cabinets/termination panels for the respective endpoints. Project resources will include both contract and internal labor for installation and testing.

- **Telecommunications Project Scope and Timeline**

Design Start	August 2017
Design Complete	May 2018
Materials Ordered West High-Vine	May 2018
Materials Delivered West High-Vine	July 2018
Construction Start West High-Vine	August 2018
Construction Finish West High-Vine	November 2018
Materials Ordered Vine-Race	November 2018
Materials Delivered Vine-Race	January 2019
Construction Start Vine-Race	August 2019
Construction Finish Vine-Race	October 2019

- **Project Cost**

	Transmission Lines	Transmission Substation	Distribution Substation	Distribution Operations	Telecom	Total
Total Cost	$10,857k	$1,350k	$1,319k	$1,286k	$125k	$14,937k
Contingency	9%	9%	10%	10%	10%	

Economic Analysis and Risks

- **Bid Summary**

  Transmission Lines:
  Based on detailed engineering and bids received for the underground cable and installation labor, Transmission Lines has estimated the underground cable and accessories package for this project is $675k and the construction package is $7,770k. The bids for the cable and construction packages have been evaluated and will be awarded to the successful bidders following internal processes upon project approval.

  Transmission Substation:
  Bids for this project will cover demolition of the house on Lot 162 and possible commissioning services for the Race Street Substation portion. Design documents have been

developed for the transmission substation work, providing a solid basis for the substation estimate.

Distribution Operations:
Underground distribution work for cable relocation will be performed by company labor (no bids required). Cost of distribution duct bank is included in the Transmission Line bid.

Distribution Substation:
Currently all projects have been estimated and bids will go out after the project is open and design completed if applicable.

Telecom:
There are not expected to be any telecom bid requirements for this project. The bulk of the materials and contract labor will be acquired under the authority of existing contracts.

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	2017	2018	2019	Post 2019	Total
1. Capital Investment Proposed	585	7,277	6,765	-	14,627
2. Cost of Removal Proposed	-	185	125	-	310
3. Total Capital and Removal Proposed (1+2)	585	7,462	6,890	-	14,937
4. Capital Investment 2018 BP	458	7,915	8,188	-	16,561
5. Cost of Removal 2018 BP	-	-	-	-	-
6. Total Capital and Removal 2018 BP (4+5)	458	7,915	8,188	-	16,561
7. Capital Investment variance to BP (4-1)	(127)	638	1,423	-	1,934
8. Cost of Removal variance to BP (5-2)	-	(185)	(125)	-	(310)
9. Total Capital and Removal variance to BP (6-3)	(127)	453	1,298	-	1,624

Financial Detail by Year - O&M ($000s)	2018	2019	2020	Post 2020	Total
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2018 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Discount Rate: 6.58%
Capital Breakdown:

	139696 Trans Lines	SU-000247 Trans Subs	156378 Dist Subs	156380 Dist Subs	156384 Dist Subs	156381 Dist Ops	IT0193 IT0193K Telecom	Total
Labor	$431k	$49k	$93k	$0	$33k	$67k	$0	$673k
Contract Labor	$4,462k	$739k	$345k	$0	$257k	$881k	$0	$6,684k
Materials	$3,516k	$306k	$18k	$181k	$20k	$7k	$0	$4,048k
Other	$14k	$1	$0	$0	$0	$23k	$112k	$150k
Local Engineering	$629k	$70k	$55k	$22k	$37k	$117k	$0	$930k
Burdens	$867k	$75k	$80k	$24k	$34k	$74k	$2k	$1,156k
Contingency	$938k	$110k	$59k	$23k	$38k	$117k	$11k	$1,296
Reimbursements	$0	$0	$0	$0	$0	$0	$0	$0
Net Capital Expenditure	$10,857k	$1,350k	$650k	$250k	$419k	$1,286k	$125k	$14,937k

- **Assumptions**
  Recommendation – This alternative assumes that the line outage will be available and that the work will be completed during this timeframe. This alternative also assumes that the City of Lexington and Kentucky Transportation Cabinet (KYTC) will approve a traffic control plan which will allow for lane closures from 6pm – 6am to support construction. During the design phase, KU worked closely with the City and KYTC to review this proposed construction project. Both the City and KYTC have given their verbal approvals regarding this project. However, the plan cannot be submitted for final approval until a contractor has been selected. Once the plans and permit applications have been submitted, the approval process should just be a formality.

- Alternative #1-Do Nothing – This option is not advisable as this line is nearing the end of its useful life and puts Transmission at risk of not being able to accomplish the objectives established as part of the Transmission System Improvement Plan, that was filed as support in the 2016 Rate Case, which assumed the completion of this project. These objectives include reducing the risk of failure, avoiding and extended sustained outage, and costly emergency repairs.

- Alternative #2 – Next Best Alternative – This alternative assumes that the underground cable would be routed down Vine Street in lieu of High Street. This is option would require additional funding, as the route is has additional underground utilities to navigate and additional impacts to traffic. The traffic impacts associated with this option would be more disruptive and have a larger negative impact on the community during construction.

- **Environmental**
  There are no known environmental issues regarding air, water, lead, asbestos, etc., associated with this project.

- **Customer Experience**
  In partnership with External Affairs, initial awareness and discussions with the City of Lexington regarding the project have occurred. Additionally, we have preliminary approval regarding lane closure permits and acceptable working hours from the City of Lexington. A communication plan is being developed to enhance the customer experience and community awareness regarding this project. In addition to the project proponents, corporate communications, external affairs, customer experience, major accounts, and the local business office have been engaged to provide input and feedback on the plan. Customer experience training is also planned for the successful underground contractor.

- **Risks**
  - The existing underground cable is over 45 years old and beyond the expected design life of 40 years per the Electric Power Research Institute. There have been notable failures during the existing underground system's life. Both in 1981 and 2012, a custom-made, hand-taped, T-splice failed at the Vine Street tap point of the Race Street – UK Med Center 69kV line. There have also been failures of the underground terminations at the Vine Street substation. Without completion of the proposed project, the company risks unplanned outages and increased cost of repairs in emergency situations.
  - A single underground transmission failure would leave one 45+ year old cable feeding approximately 1,600 customers at Vine Street for three (3) to five (5) weeks while the failure repairs were complete. A second underground failure during this time would leave no transmission feed into Vine Street. This would be especially concerning during summer and winter high load demand and have a direct impact many large customers, including Lexington-Fayette Urban County Government (LFUCG), Lextran, Lexington Police Station, and many more commercial customers.
  - This project involves building an underground ductbank through the oldest developed part of Lexington, KY. There is the inherent risk of construction being delayed due to the discovery of undocumented underground facilities. The detailed engineering phase included advanced ground penetrating radar and 68 subsurface utility vacuum excavations to limit the risk of delays associated with undocumented facilities.
  - The limestone retaining wall at the rear of the Vine Street substation will be a reliability risk during the construction phase. Proper shoring and bracing of the wall will need to be done to facilitate replacement with a properly engineered solution. In order to build the replacement wall, an easement will needed. The KY League of Cities has already granted an easement for the transmission line and has indicated they are willing to grant an easement for the wall.
  - Both existing transmission feeds into the Vine Street substation could potentially be out of service for 4-8 weeks to accommodate installation of the new underground feeds. Distribution Planning is reviewing options to move load from Vine Street to other stations to support this outage window. Similarly, Transmission is evaluating building a temporary line from Rose Street along High Street (on the University of Kentucky Medical Center circuit) to Vine Street to support the outage window.
  - The property owner for the parcel adjacent to Race Street is scheduled to vacate the property by March 31st. A delay in their move could impact the expansion at Race Street.

- Schedule delays may also occur if the city of Lexington or KYTC do not approve the recommended traffic control plan. Advance meetings were held with the city of Lexington and KYTC during the project design to discuss permitting and traffic control requirements. Both the City and KYTC have given their verbal approvals regarding this project. However, the plan cannot be submitted for final approval until a contractor has been selected. Once the plans and permit applications have been submitted, the approval process should just be a formality.
- The local community and businesses may react negatively to the work and potential inconvenience of the traffic plan. A communication plan is being developed in coordination with the project proponents, corporate communications, external affairs, customer experience, major accounts, and the local business office. This plan will be executed to limit the impacts to the community and businesses.

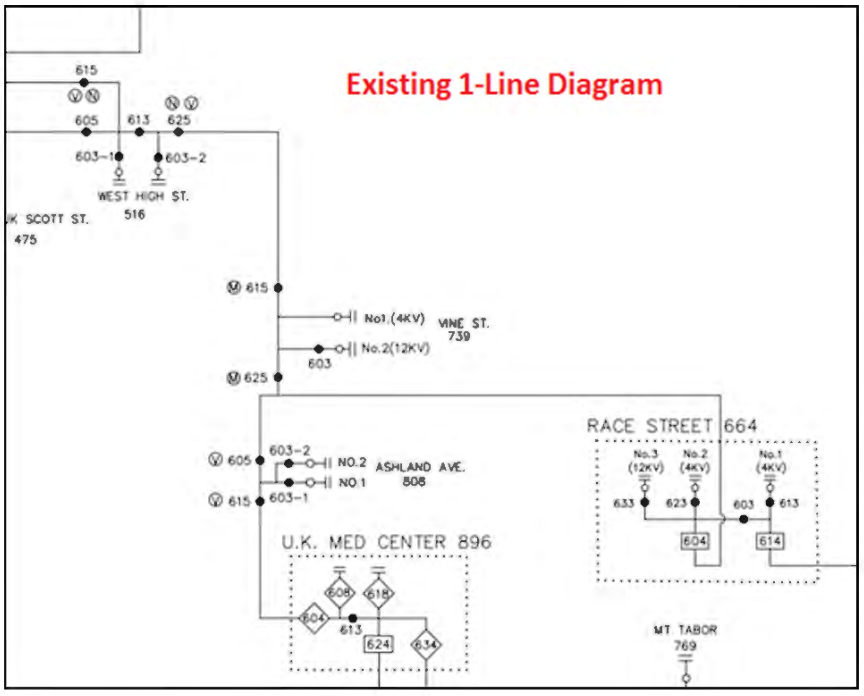
Conclusions and Recommendation
It is recommended that the Investment Committee approve the Lexington Underground project for $14,937k to maintain system integrity, reliability, and to prevent failures and unplanned outages.

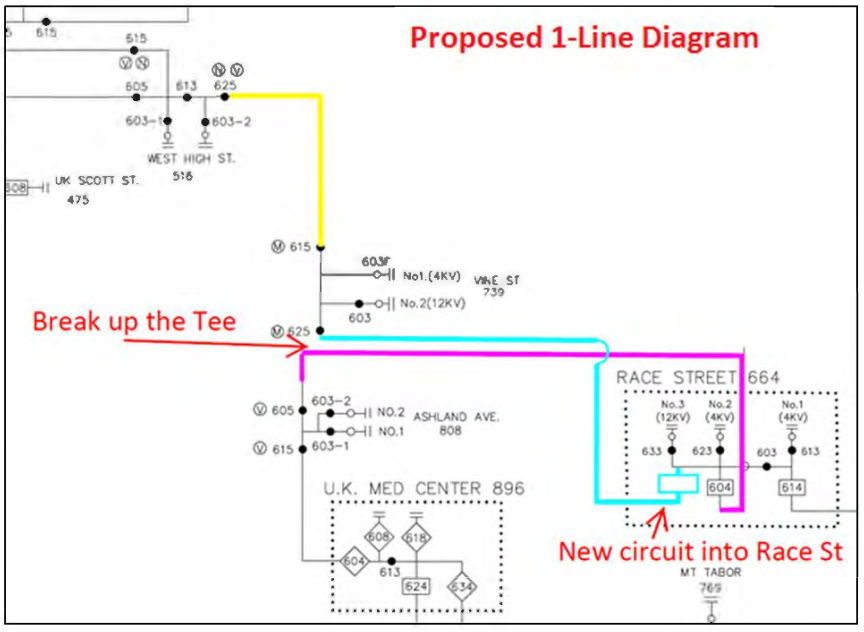
Approval Confirmation for Capital Projects Greater Than or Equal to $2 million:

The Capital project spending included in this Investment Proposal has been approved by the members of the LKE Investment Committee. Pursuant to the LKE Authority Limit Matrix, the signatures below are also required for approval of this Capital project spending request.

Kent W. Blake Date	Paul W. Thompson Date
Chief Financial Officer	Chairman, CEO and President

Appendix:


Existing 1-Line Diagram
615
605
613
625
603-1
603-2
WEST HIGH ST.
516
UK SCOTT ST.
475
615
No.1.(4KV)
VINE ST.
739
No.2(12KV)
603
625
605
603-2
NO.2
ASHLAND AVE.
808
NO.1
615
603-1
U.K. MED CENTER 896
608
618
604
613
624
634
RACE STREET 664
No.3 (12KV)
No.2 (4KV)
No.1 (4KV)
633
623
603
613
604
614
MT TABOR
769


Proposed 1-Line Diagram
615
605
613
625
603-1
603-2
WEST HIGH ST.
516
UK SCOTT ST.
475
615
603F
No.1.(4KV)
VINE ST
739
No.2(12KV)
603
625
Break up the Tee
605
603-2
NO.2
ASHLAND AVE.
808
NO.1
615
603-1
U.K. MED CENTER 896
608
618
604
613
624
634
RACE STREET 664
No.3 (12KV)
No.2 (4KV)
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614
New circuit into Race St
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769

Capital Investment Proposal

Investment Proposal for Investment Committee Meeting on: April 25, 2018

Project Name: PCH-Lynch Control House

Total Expenditures: $5,119k (Includes $465k (10%) Contingency)

Project Number(s): 144116

Business Unit/Line of Business: Transmission Substation Construction & Maintenance

Prepared/Presented By: Nel Ciurdar, Burns & McDonnell/Brent Birchell

Executive Summary

This project includes the replacement of (4) 69kV breakers, (8) 69kV disconnect switches, (4) sets of line arresters, the addition of (1) new 69kV U.S. Steel tie-breaker and (2) 69kV disconnect switches. This project also includes the replacement of the transmission control house at Lynch Substation, which will be installed uphill just outside the existing substation fence. This project is part of the existing Transmission System Improvement Plan (TSIP) and represents the aggregation of several system integrity programs into one holistic project.

The station has numerous cap and pin and hollow post insulators on the switches which are documented in the TSIP and the control house has relays (HZs & GCX-17s) that are slated for replacement due to poor performance and lack of parts. For additional information regarding material breakdown for replacement needs, see Appendix A.

This project was originally approved for $84k during July 2017 for preliminary engineering with the understanding that it would be presented to the Investment Committee for approval of full funding once detailed engineering was completed. During September 2017, the approval for preliminary engineering was increased to $227k. Based on the results of detailed engineering, the total cost of this project will be $5,119k with $93k in 2017, $600k in 2018, $3,272k in 2019, and $1,154k in 2020. This project was included in the 2018 BP for $227k in 2017, $600k in 2018, $1,350k in 2019 and $50k in 2020. The higher estimates for 2019 and 2020 will be addressed in the 2019 BP.

The higher estimate compared to the budget is due to the inclusion of four breakers that were budgeted in project SU-000014 ($1,000k), a fifth breaker that was added to improve reliability by reducing exposure related to an outage at the nearby US Steel substation, and higher than anticipated cost of installing the control house due to the limited space and grade of the terrain in the area.

Background

The (4) 69kV breakers 031-604, 031-614, 031-624, and 031-634 are vintage 1950's and 1960's breakers. In addition to age, these breakers have a history of maintenance issues. Routine testing of the breakers indicates that the dielectric ratings of the breakers have deteriorated, increasing the risk of failure. These breakers are in proximity to water, increasing the likelihood of oil reaching navigable water in the event of a catastrophic failure. These breakers have a direct impact on SAIDI and SAIFI if a failure were to occur due to the potential loss of customer load associated with these breakers.

In addition to the above criteria, these breakers are accessed via wooden decking due to their installed positions on a steeply inclining slope. Due to the slope and lack of space between breakers, replacement of these breakers under existing conditions is nearly impossible. As part of this proposed project, the wooden deck will be replaced with a steel maintenance platform that will allow installation and replacement of all 69kV breakers.

The (4) sets of line surge arresters are being replaced as part of a program due to the limited protection they provide.

The (8) 69kV switches with cap and pin and hollow post insulators are being targeted per the TRP insulator program "Replace Substation Insulators". These insulators have a known history of failures and will be removed from service. This targeted approach allows LKE to maximize the impact of these replacements, lower the number of in-service failures and minimize customer outages.

The substation control house currently houses transmission protection and control (P&C) equipment that is aging past the date of reasonable repair. Maintenance of said equipment is also becoming more difficult as replacement parts are difficult to find. By installing a new, pre-fabricated control house with microprocessor relays, the obsolete, aging equipment will be replaced with reliable, digital protective relays while also ensuring safe and reliable performance of the Transmission protection system. The new control house will include integrated relay panels, batteries, AC and DC systems, etc. for the protection of bus and lines within the Lynch substation. Due to the limited space and steep incline of the substation, installation of this new control house will be uphill from the existing substation near the drivepath.

Also included in this project scope is the optional addition of (1) 69kV breaker as a tie-breaker to the neighboring US Steel substation. Currently, without a bus-tie breaker a bus fault at the US Steel substation causes a bus outage at Lynch Substation. The addition of a bus-tie breaker would provide separation and increase the transmission reliability by reducing unnecessary exposure. This would include (1) breaker protection panel and associated cables. Additionally, the US Steel substation bus will no longer have independent protection once a tie breaker is installed, so a cost for a bus relay is included in this estimate.

For pictures of the substation today see Appendix A – Site Photos.
For site aerial photo and proposed general arrangement see Appendix A – Aerial Photo and General Arrangement.

Alternatives Considered

1. Recommendation: NPVRR: ($000s) $5,266
   It is recommended that the breakers, disconnect switches, arresters, and control house be replaced to reduce the potential risk to the Transmission system.

2. Alternative #1: NPVRR: ($000s) $8,194
   This option would involve installing a new greenfield substation and re-routing all 69kV lines and distribution equipment to a new location. See the alternate site in Appendix A

3. Do Nothing: NPVRR: ($000s) N/A
   This option is not advisable as it puts Transmission at risk of not being able to accomplish targets established as part of the Transmission Reliability Plan.

Project Description

- **Project Scope and Timeline**

Description	Date
Project Originally Approved for Preliminary Engineering	July 2017
Project Approved for additional Preliminary Engineering	September 2017
Full project funding requested	April 2018
Materials Ordered	October 2018
Materials Received	February – May 2019
Project Complete	December 2020

Project Cost

The total cost of this project will be $5,119k with $93k in 2017, $600k in 2018, $3,272k in 2019, and $1,154k in 2020. The estimated total project figure includes a 10% contingency. This contingency is reasonable based on the level of detailed engineering and is expected to cover uncertainty with the contract labor costs based upon variances that have been observed on past similar projects.

Economic Analysis and Risks

- **Bid Summary**
  Previously established blanket contract agreements will be utilized for related materials. Bids for any other necessary materials, as well as the below and above grade construction, will be sent out soon after project approval.

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	2017	2018	2019	Post 2019	Total
1. Capital Investment Proposed	94	600	3,133	1,154	4,981
2. Cost of Removal Proposed	-	-	138	-	138
3. Total Capital and Removal Proposed (1+2)	94	600	3,272	1,154	5,119
4. Capital Investment 2018 BP	227	600	1,300	50	2,177
5. Cost of Removal 2018 BP	-	-	-	-	-
6. Total Capital and Removal 2018 BP (4+5)	227	600	1,300	50	2,177
7. Capital Investment variance to BP (4-1)	133	0	(1,833)	(1,104)	(2,804)
8. Cost of Removal variance to BP (5-2)	-	-	(138)	-	(138)
9. Total Capital and Removal variance to BP (6-3)	133	0	(1,972)	(1,104)	(2,942)

Financial Detail by Year - O&M ($000s)	2017	2018	2019	Post 2019	Total
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2018 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Four of the breakers being installed were budgeted in 2019 for $1,000k under project SU-000014.

Financial Summary ($000s):
Discount Rate:
Capital Breakdown:

Labor:	$274k
Contract Labor:	$2,180k
Materials:	$1,384k
Other:	$67k
Local Engineering:	$337k
Burdens:	$413k
Contingency:	$465k
Net Capital Expenditure:	$5,119k

Assumptions
No major assumptions were included in the capital evaluation model. It is assumed material can be obtained in a timely manner.

- **Environmental**
  This project does not require permitting in order to install the new control house in a currently unused area. This project has potential asbestos issues in the existing control house which will be demolished. An environmental assessment will be completed in the early stages of the project. Environmental costs of $50k associated with demolishing the existing control house are included in this estimate. There are no known issues regarding air, water, waste, or lead. It is assumed the oil in the breaker, the breaker bushings, and the bushing potential devise are PCB free.

- **Risks**
  Completing the project involves risk related to high voltage substation construction work. Not completing the project decreases the reliability of Lynch substation. Delaying this project exposes our system to the continuing risk of impacts from other potential transmission failures.

Conclusions and Recommendation
It is recommended that the Investment Committee approve replacement of Lynch 69kV breakers, disconnect switches, insulators, arresters, and control house for $5,119k to enhance the reliability of the Transmission system.

Approval Confirmation for Capital Projects Greater Than or Equal to $2 million:

The Capital project spending included in this Investment Proposal has been approved by the members of the LKE Investment Committee. Pursuant to the LKE Authority Limit Matrix, the signatures below are also required for approval of this Capital project spending request.

Kent W. Blake Date	Paul Thompson Date
Chief Financial Officer	Chairman, CEO and President

Appendix A – Material Breakdown

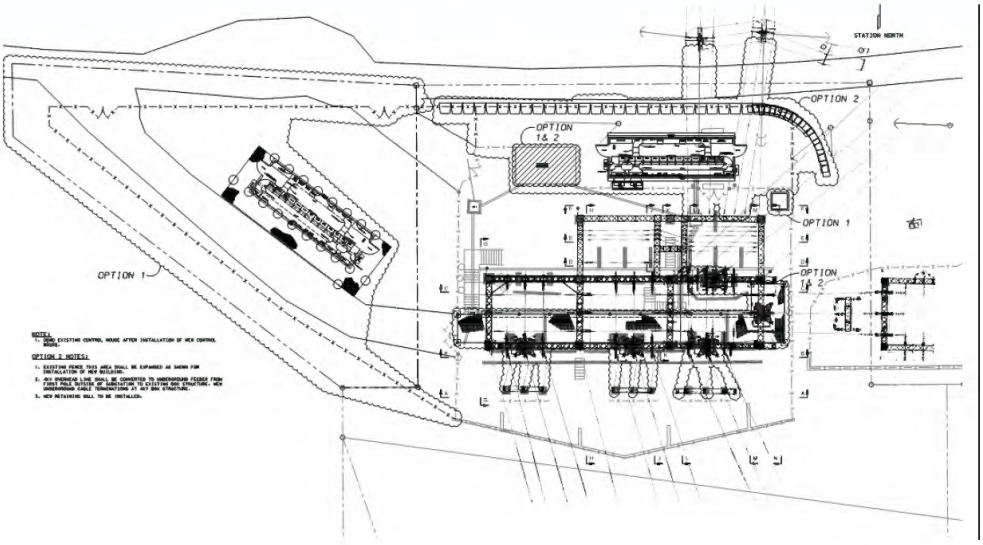
This project for the Lynch Substation is for proactive replacement of assets. All equipment being targeted for replacement under this project is part of the Transmission System Improvement Plan.

The project shall include:

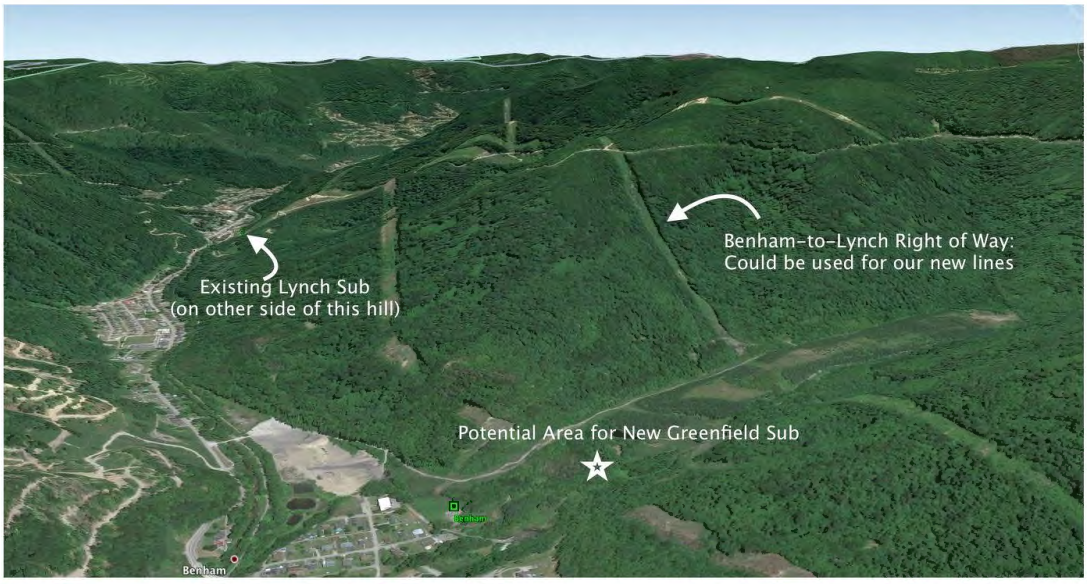
- Replace (4) 69kV breakers (031-604, 031-614, 031-624, and 031-634).
- Replace (4) sets of 69kV arresters (031-604, 031-614, 031-624, and 031-634).
- Replace (8) 69kV switches (031-604B, 031-604L, 031-614B, 031-614L, 031-624B, 031-624L , 031-634B, and 031-604L).
- Replace existing transmission control house with a new pre-fabricated control house.
- Install (1) 69kV breaker as a U.S. Steel bus-tie, with (2) breaker disconnect switches.

Site Photos

Aerial Photo and General Arrangement Drawing



Alternate Lynch Location.



Capital Investment Proposal

Investment Proposal for Investment Committee Meeting on: February 23, 2017

Project Name: Green River 69kV Control House

Total Expenditures: $3,931k (Includes $357k Contingency)

Project Number(s): 144118

Business Unit/Line of Business: Transmission Protection & Controls

Prepared/Presented By: Brent Birchell – Manager Protection & Controls

Executive Summary

Transmission protection and controls (P&C) equipment for the Green River 69kV substation yard is currently housed in the Green River generation plant building, which has been decommissioned. Demolition of the plant is currently scheduled for 2018-2019. As a result, a complimentary project (153861) has been created to eliminate all power feeds going into and out of the plant for the 161KV, 138KV and 69KV substations, and replace those feeds with a 69KV station service transformer and (2) separate distribution feeds. This complimentary project will allow for removal of the existing power plant in the 2018-2019 timeframe. Building a new control house will allow the P&C equipment to be relocated to the substation switchyard area and allow for the equipment inside the plant to be abandoned or salvaged, as appropriate, due to age and obsolescence of the assets. Additionally, the new relays will upgrade the system to a reliable, digital protection scheme.

The project was approved for $100k during 2016 for preliminary engineering with the understanding that the project would be presented for approval once detailed engineering was completed. The total cost of this project will be $3,931k, with $45k in 2016, $2,850k in 2017, and $1,036k in 2018. $3,933k of funding was included in the 2017 BP for this project, with $1,573k budgeted for 2017 and $2,360k budgeted for 2018. Since this project was accelerated to meet the demolition project schedule, the change in timing caused a budget variance in 2017 ($1,277k) which was approved by the RAC in the 2017 0+12 forecast. The estimated total project figure includes a 10% contingency. This contingency is expected to cover uncertainty with the contract labor costs and is based upon historical experience with similar projects.

Background
The Green River property includes a decommissioned generation facility (Green River Power Plant), a 69kV bus connecting eleven lines, a 138kV bus connecting ten lines, and a 161kV bus connecting six lines. The power plant building currently houses P&C equipment for the 69kV substation, batteries that provide DC for the 69kV yard, and sump pumps to prevent lower-level flooding for the power plant. Demolition of the plant is scheduled for 2018-2019. As a result, a complimentary project (153861) has been created to eliminate all power feeds going into and out of the plant for the 161KV, 138KV and 69KV substations equipment, and replace with a 69KV station service transformer and (2) separate distribution feeds. This complimentary project will allow for removal of the existing power plant in 2018-2019 timeframe.

This proposal addresses the installation of a control house in the switchyard, which will house P&C equipment for the 69kV substation. The scope of the project cost will include a new control house, foundations, cable pulling, yard equipment, and digital protection schemes. Additionally, new AC and DC distribution systems will be installed for the switchyard. Abandoning the equipment located in the power plant building will allow for demolition of the building. The new microprocessor based relays will also provide improved reliability, increased functionality, and disturbance event reporting.

- **Alternatives Considered**
    1. Recommendation NPVRR: $4,344k
       It is recommended that all the P&C equipment, currently located inside the decommissioned power plant, be relocated to a new control house within the substation yard and all equipment be upgraded to microprocessor relays.

    2. Alternative #1: Delay Project for two years NPVRR: N/A
       This project is required prior to the Green River Plant Demolition project which is currently planned to begin in 2018.

    3. Do Nothing NPVRR: N/A
       This project is required prior to the Green River Plant Demolition project.

Project Description

- **Project Scope and Timeline**

Milestones	Date
Project Originally Approved	August, 2016
Project Fully Approved	February, 2017
Order Control House	March, 2017
Install Control House Foundation	October 2017
Receive Control House	November, 2017
Start At Grade, Above Grade Construction	November , 2017
Start Connection, Commissioning of Existing Equipment to Control House	March, 2018
Complete Connection, Commissioning of Existing Equipment to Control House	June, 2018

- **Project Cost**
  The total cost of this project will be $3,931k, with $45k in 2016, $2,850k in 2017, and $1,036k in 2018. $3,933k of funding was included in the 2017 BP for this project. The estimated total project figure includes a 10% contingency. This contingency is expected to cover uncertainty with the contract labor costs and is based upon historical experience with similar projects.

Economic Analysis and Risks

- **Bid Summary**
  Certain components of the project cost were estimated from budgetary proposals based on existing blanket contracts.

  The control house panels will be purchased under the existing control house blanket contract agreement. Relay panels suppliers and external engineering resources are selected based on project-specific needs, including lead times and processes implemented for general engineering of the project. In this case, Systems Control recently engineered and manufactured a house for LKE of the same size and design that is needed for this project. This situation will present a reduced burden on company engineering resources and benefit the project schedule, as it will minimize lead times for engineering and state permits.

  Similarly, MESA will provide the engineering, procurement and construction management services under the existing EPCM contracts. MESA has recent experience engineering projects for LKE and has familiarity with LKE substation designs, including Green River Substation.

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	2016	2017	2018	Post 2018	Total
1. Capital Investment Proposed	45	2,850	1,036	-	3,931
2. Cost of Removal Proposed	-	-	-	-	-
3. Total Capital and Removal Proposed (1+2)	45	2,850	1,036	-	3,931
4. Capital Investment 2017 BP	-	1,556	2,360	-	3,916
5. Cost of Removal 2017 BP	-	17	-	-	17
6. Total Capital and Removal 2017 BP (4+5)	-	1,573	2,360	-	3,933
7. Capital Investment variance to BP (4-1)	(45)	(1,294)	1,323	-	(15)
8. Cost of Removal variance to BP (5-2)	-	17	-	-	17
9. Total Capital and Removal variance to BP (6-3)	(45)	(1,277)	1,323	-	2

Financial Detail by Year - O&M ($000s)	2017	2018	2019	Post 2019	Total
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2017 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.5%
Capital Breakdown:	
Labor:	$174k
Contract Labor:	$1,487k
Materials:	$1,497k
Other:	$1k
Local Engineering:	$232k
Burdens:	$183k
Contingency:	$357k
Net Capital Expenditure:	$3,931k

Expenditure Type	Protection	Construction	Total (000s)
Company Labor	$ 68	$ 106	$ 174
Contract Labor	$ 1,038	$ 449	$ 1,487
Purchased Materials	$ 1,346	$ 151	$ 1,497
Other	$ 1		$ 1
Local Engineering	$ 187	$ 45	$ 232
Burdens	$ 90	$ 93	$ 183
Contingency	$ 273	$ 84	$ 357
Total (000s)	$ 3,003	$ 928	$ 3,931

- **Assumptions**
  Outages are assumed to be obtained within the requested timeframe. Also, Environmental Affairs will own and coordinate all necessary permitting and hazardous material reporting within the project timeline. KU Green River personnel will provide access to the facility and P&C equipment for integration of the new digital protection scheme. Station service to the plant will be coordinated with the plant demolition project.

- **Environmental**

  Permitting – Based on the preliminary layout, the project location is not within floodplain or "Waters of the US" (wetlands, streams, etc.). Additionally, total disturbance size is expected to be less than 1 acre. Appropriate erosion controls will be installed and inspected as needed to comply with the Green River Best Management Practices Plan which includes a section addressing construction projects. No Land and Water (L&W) environmental permits are required based on current proposed location.

  Batteries –There is a requirement to submit annual "Tier II" reports to state and local fire departments and Emergency Planning Commissions if hazardous chemicals are stored at sites in quantities greater than 10,000 lbs. or extremely hazardous substances are stored at sites in quantities greater than their reportable Quantity (often 500 lbs.). Lead-acid batteries contain a sulfuric acid electrolyte which must be reported on Tier II reports if stored in a quantity greater than 500 lbs. Green River is already subject to Tier II reporting for a number of chemicals including existing lead-acid batteries.

  Oil-containing equipment –Sites that contain 1,320 gallons of oil or greater require a Spill Prevention Control and Countermeasures (SPCC) plan which includes, inspections, secondary containment to prevent oil releases from reaching waterways and an accurate inventory of oil-containing equipment on –site, among other requirements. Green River's substations already have a quantity of oil over 1,320 gallons, therefore already have a SPCC plan (combined for the 2 substations). There is a station service transformer which may need to be added to the site, depending on design specifications. If this equipment (or other additions) contain 55 gallons of oil or greater, they will be added to the SPCC inventory. These pieces of equipment would have to be added to the SPCC inventory. Secondary containment is a combination of the Strongwell berms, DGA berms and Oil Stop valves. Secondary containment for new equipment would most likely be provided by existing containment, however this should be confirmed based on the size and location of the equipment.

  Waste Considerations – Excess soil generated from areas outside of the substation footprint should either be re-used on-site or disposed of properly off-site. Excess soil generated from

inside the substation fence should be treated as "PCB-contaminated". Disposal should be arranged with Environmental Affairs. Additionally, other legacy items potentially present within the substation subsurface (cables/conduit connecting to the plant, etc.) will be addressed as needed.

- **Risks**
  - Required outages will be planned and coordinated with the construction efforts to avoid the risk of project timeline extension. Inability to obtain necessary outages may lengthen the project timeline and costs and also delay demolition of the plant.

Conclusions and Recommendation
It is recommended that the Investment Committee approve the Green River 69kV Control House project for $3,931k to support the demolition of the Green River Plant while maintaining the reliability of the transmission system.

Approval Confirmation for Capital Projects Greater Than or Equal to $2 million:

The Capital project spending included in this Investment Proposal has been approved by the members of the LKE Investment Committee. Pursuant to the LKE Authority Limit Matrix, the signatures below are also required for approval of this Capital project spending request.

Kent W. Blake	Paul W. Thompson
Chief Financial Officer	President and Chief Operating Officer

Investment Proposal

Investment Proposal for Investment Committee Meeting on: January 27, 2015

Project Name: Parkers Mill Breaker Addition

Total Expenditures: $1,838k ($167k of Contingency)

Project Number(s): 144364

Business Unit/Line of Business: Transmission Substation Reliability

Prepared/Presented By: Keith Yocum – Manager Transmission Reliability

Executive Summary

The Lexington Plant to Pisgah 69kV line feeds four Distribution stations (Parkers Mill, Kunkel, Trafton and Buchanan) which serve over 13,000 customers in total. The line is about 14 miles long and runs from east of downtown Lexington, through downtown and out to the western border of Fayette County. This line has been chronically underperforming the rest of the Transmission system from a SAIDI/SAIFI perspective and ranks first in SAIDI contribution for the last several years. The performance in 2014 has worsened with a total SAIDI of 4.72 minutes inclusive of Major Event Days (MED).

The proposed project will include the purchase and installation of two breakers and the associated protection and control equipment (including a control house) at Parkers Mill which will cut the transmission line outage exposure to zero for the 7,000 customers served from Parkers Mill. This would reduce the total customer line outage exposure of 13,000 customers at the four Distribution stations by almost 60%. The Parkers Mill station provides service to the Bluegrass Airport, Keeneland, KY American Water company, Lexington Fayette Urban County Government, 4 schools, and Beaumont Centre Circle commercial development.

The total cost of this project is forecasted to be $1,838k and was approved by the RAC in the 2015 0+12 forecast. All of the projected spend will take place in 2015. This project was included in the 2015 BP for $1,700k, with $1,600k in the Substations budget (Project 144364) and $100k in the Lines (Project 144166). The total cost of $1,838k includes a 10% contingency.

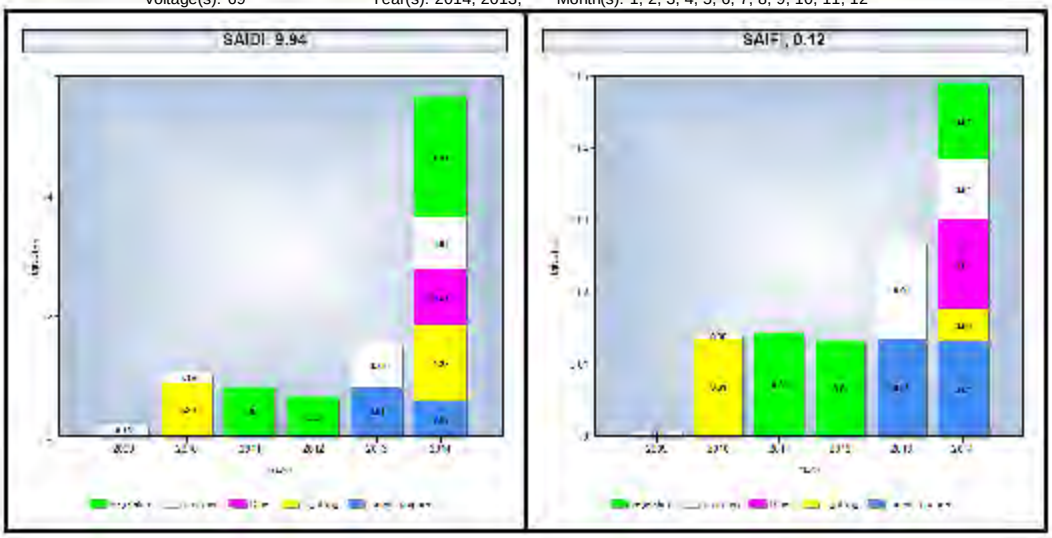
Background

The following chart shows the historical SAIDI/SAIFI for the Lexington Plant to Pisgah 69kV line inclusive of MEDs.

Transmission SAIDI/SAIFI Including MEDs

Lexington Plant to Pisgah 69 kV line

Voltage(s): 69 Year(s): 2014, 2013, Month(s): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

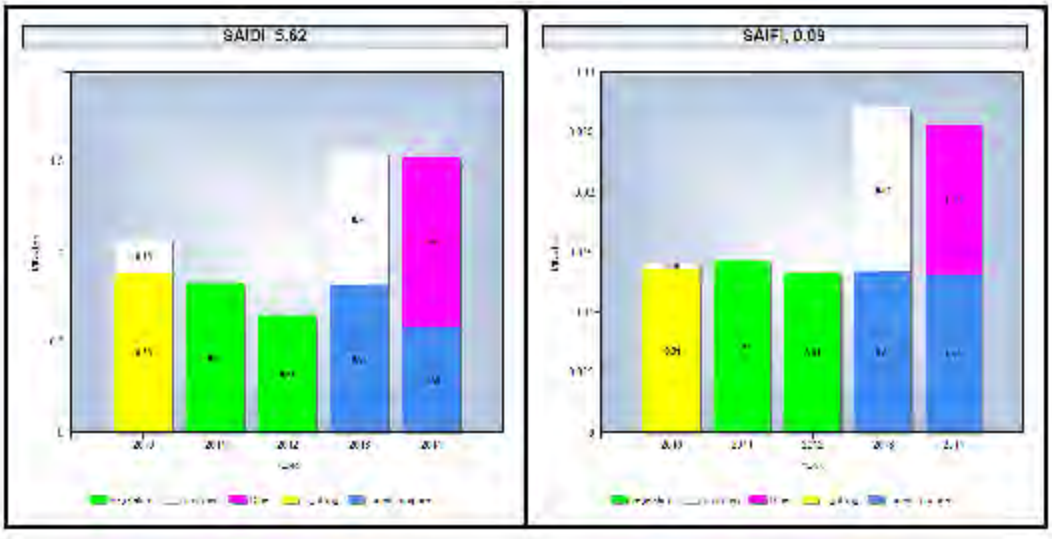


If you exclude Major Event Days, the numbers improve significantly (especially in 2014) as shown in the following graph. However, from a prioritization standpoint, Transmission believes that MEDs should be included unless they are a result of a low probability event such as a tornado outbreak, ice storm or other significant event.

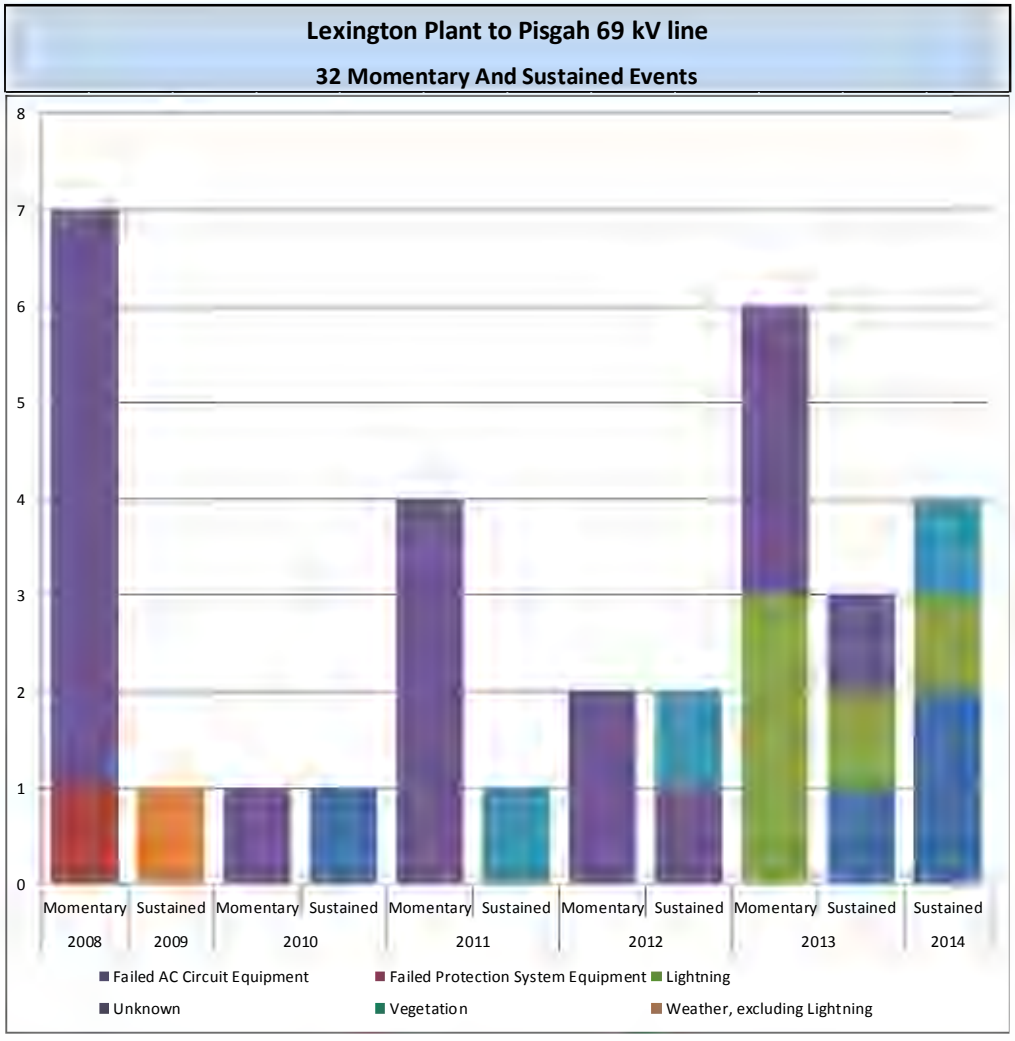
Transmission SAIDI/SAIFI Excluding MEDs

Lexington Plant to Pisgah 69 kV line

Voltage(s): 69 Year(s): 2014, 2013, Month(s): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12



There have been many relay events on this line in the last 5 years in addition to those resulting in a SAIDI impact. The following chart shows the quantity and cause code for this line.



The performance on this line has degraded significantly in 2014 and has been one of our worst performing circuits from a SAIDI perspective for several years. This line does not rank in the top 10 for MW-Mile exposure or MW-Mile² exposure but due to its continued poor performance, a project was developed to mitigate the SAIDI/SAIFI impacts.

The Lexington Plant to Pisgah line is nearly 14 miles long and runs from east of downtown Lexington, through downtown and out to the western border of Fayette County as shown in the

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picture from Google Earth below. The line serves over 13,000 customers with over 7,000 of them served from the Parkers Mill station.

A one-line diagram of the line is shown below along with nearby stations:

[redacted]

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The proposed project will add two breakers at Parkers Mill as shown in the following one-line depiction:

The addition of these two breakers will shield Parkers Mill from outage events on the rest of the line and provide a second source into the substation via the American Avenue to Higby Mill line. Based on historical events, these breakers would have reduced the Transmission SAIDI impact by more than 50% for the line and 100% for the Parkers Mill customers.

- **Alternatives Considered (1 –Recommendation, 2 –Do nothing, 3 –Next Best Alt)**
  Recommendation – Install two breakers at Parkers Mill which will reduce the line exposure for 7,000 customers to zero.
  NPVRR: ($000s) $2,307k

  Do Nothing – If nothing is done, the SAIDI/SAIFI impact will continue to degrade and customer satisfaction will be negatively impacted. This line will continue to be one of our worst performers.
  NPVRR: ($000s) $0k

  Next Best Alternative(s) – The next best alternative for this project would be to loop the feed into Parkers Mill from the Lexington Plant to Pisgah line and install 3 breakers at Parkers Mill. This will reduce the overall line exposure only slightly more than the recommended option for a much larger cost.
  NPVRR: ($000s) $6,798k

Project Description

- **Project Scope and Timeline**

Description	Date
Project Approved	February, 2015
Substation Construction Materials Ordered	March, 2015
Control House Ordered	March, 2015
Substation Construction Materials Received	June-July, 2015
Below Grade Work Begins	June, 2015
Below Grade Work Completed	July, 2015
Above Grade Work Begins	July, 2015
Control House Received	August, 2015
Above Grade Work Completed	September, 2015
Testing & Commissioning	September-October, 2015
Project Complete	October, 2015

- **Project Cost**
  The total cost of this project is forecasted to be $1,838k and was approved by the RAC in the 2015 0+12 forecast. All of the projected spend will take place in 2015. This project was included in the 2015 BP for $1,700k, with $1,600k in the Substations budget (Project 144364) and $100k (Project 144166) in the Lines. The estimated figure includes a 10% contingency.

Economic Analysis and Risks

- **Bid Summary**
  Bids for the necessary materials as well as the civil, below, and above grade work will be sent out early in 2015. The (2) 69kV breakers will be purchased under the existing breaker purchase agreement. The control house will also be purchased under the existing control house purchase agreement.

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	2015	2016	2017	Post 2017	Total
1. Capital Investment Proposed	1,791	-	-	-	1,791
2. Cost of Removal Proposed	47	-	-	-	47
3. Total Capital and Removal Proposed (1+2)	1,838	-	-	-	1,838
4. Capital Investment 2015 BP	1,700	-	-	-	1,700
5. Cost of Removal 2015 BP	-	-	-	-	-
6. Total Capital and Removal 2015 BP (4+5)	1,700	-	-	-	1,700
7. Capital Investment variance to BP (4-1)	(91)	-	-	-	(91)
8. Cost of Removal variance to BP (5-2)	(47)	-	-	-	(47)
9. Total Capital and Removal variance to BP (6-3)	(138)	-	-	-	(138)

Financial Detail by Year - O&M ($000s)	2015	2016	2017	Post 2017	Total
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2015 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.5%
Capital Breakdown:	
Labor:	$149k
Contract Labor:	$626k
Materials:	$633k
Other:	$0k
Local Engineering:	$101k
Burdens:	$162k
Contingency:	$167k
Reimbursements:	($0k)
Net Capital Expenditure:	$1,838k

Financial Analysis - Project Summary ($000)	2015	2016	2017	2018	2019	Life of Project
Project Net Income	$ (30)	$ (4)	$ 99	$ 97	$ 90	$ 2,159
Project ROE	-6.4%	-0.5%	11.2%	11.6%	11.2%	10.6%

Spend (000's)	Construction	P&C	Lines	Total
Company Labor	$ 46	$ 89	$ 14	**$ 149**
Contract Labor	$ 205	$ 238	$ 183	**$ 626**
Materials	$ 175	$ 411	$ 47	**$ 633**
Burdens	$ 80	$ 145	$ 38	**$ 263**
Contingency	$ 51	$ 88	$ 28	**$ 167**
Total	**$ 557**	**$ 972**	**$ 310**	**$1,838**

- **Assumptions**
  - The installation locations of substation equipment and control house will be inside of the Parkers Mill substation. Adequate drive access can be maintained with the proposed layout; therefore, no new land is required to be purchased for the substation.
  - Right of way changes are expected for the Transmission Lines work and it is assumed that this will be completed with minimum costs and no project delays.
  - The Transmission Substation estimate assumes new equipment will have a nominal 1200A continuous current rating with 40 kA fault interrupting ratings.
  - There are no special geotechnical or site conditions including rock removal, drainage, special foundation considerations, environmental or flooding mitigation related to the site in question.
  - Control house installation will be of typical cost, with no major obstacles to site entry.
  - The provided estimate assumes no modifications are necessary to the existing equipment that remains, including Distribution transformers, breakers, and RTU.
  - The requested outages will be attainable and assumes five days a week, eight hour day work schedule with no special construction requirements or costs to minimize required outages.
  - A ground grid or lightning protection study for the whole substation is not included in this estimate. Costs to expand the ground grid or lightning protection in the existing station to meet current standards or codes are not included in this estimate. The existing ground grid impedance to remote ground along with touch and step potential is assumed to be adequate and new grid is only installed in the substation expansion for touch and step potential concerns.

- **Environmental**
  This project does not require permitting and there are no known issues regarding air, water, waste, lead, or asbestos.

- **Risks**
  Without the addition of the breakers at Parkers Mill, we will continue to have the station exposed to the high frequency of outages and will most likely continue to have this line be our worst SAIDI offender.

Conclusions and Recommendation
It is recommended that the Investment Committee approve the Parkers Mill Breaker Additions project for $1,838k to enhance the reliability of the Transmission system and to address the poor SAIDI performance of the Lexington Plant to Pisgah 69kV line.

Investment Proposal for Investment Committee Meeting on: N/A

Project Name: REL-Parkers Mill 604 Breaker Addition

Total Approved Expenditures: $1,838k

Total Revised Expenditures: $1,989k

Project Number(s): 144364

Business Unit/Line of Business: Transmission Substation Reliability

Prepared/Presented By: Keith Yocum – Manager Transmission Reliability

Reason for Revision
The Parkers Mill 604 Breaker Addition project exceeded the AIP by $151K (8%). The overrun was primarily caused by adding the transfer bus which provides needed switching flexibility in the event of an outage at the substation but was missed in the original scope of work. It was expected that cost would be covered by project contingency, but contract labor was higher than original estimates.

Financial Summary ($000s):	**Approved**	**Revised**	**Explanation**
Discount Rate:	6.50%	6.50%	
Capital Breakdown:			
Labor:	$149k	$80k	More contract labor performed due to scope changes
Contract Labor:	$626k	$816k	Contract engineering and construction exceeded initial estimates Transfer bus and full transformer transfer capability added
Warehouse Materials:	$0	$37k	
Purchased Materials:	$633k	$695k	Additional switches, steel, bus work, and connectors
Other:	$0	$22k	Vehicle/food/travel/misc. charges
Local Engineering:	$101k	$203k	Additional burdens due to additional overall costs
Burdens:	$162k	$136k	
Contingency:	$167k	$0	
Reimbursements:	$0	$0	
Net Capital Expenditure:	$1,838k	$1,989k	
NPVRR:	$2,307k	$2,562k	

Financial Detail by Year - Capital ($000s)	2015	2016	2017	Post 2017	Total
1. Capital Investment Proposed	2,059	(100)	-	-	1,959
2. Cost of Removal Proposed	18	12	-	-	30
3. Total Capital and Removal Proposed (1+2)	2,077	(88)	-	-	1,989
4. Capital Investment 2016 BP	1,810	-	-	-	1,810
5. Cost of Removal 2016 BP	49	-	-	-	49
6. Total Capital and Removal 2016 BP (4+5)	1,859	-	-	-	1,859
7. Capital Investment variance to BP (4-1)	(249)	100	-	-	(149)
8. Cost of Removal variance to BP (5-2)	31	(12)	-	-	19
9. Total Capital and Removal variance to BP (6-3)	(218)	88	-	-	(130)

Financial Detail by Year - O&M ($000s)	2015	2016	2017	Post 2017	Total
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2015 BP	-	-	-	-	-
3. Total Project O&M Variance to BP (2-1)	-	-	-	-	-

Financial Analysis - Project Summary ($000)	2015	2016	2017	2018	2019	Life of Project
Project Net Income	$ (24)	$ 2	$ 95	$ 97	$ 102	$ 2,416
Project ROE	-4.4%	0.1%	9.5%	10.2%	11.2%	10.4%

Conclusions and Recommendation

It is recommended that the Investment Committee approve the revised Parkers Mill 604 Breaker Addition project for $1,989k to accommodate the additional costs associated with the change in scope of adding a transfer bus.

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Appendix A: Single Line Comparison

As existed in initial Investment Proposal:

As built:

These design changes provide much greater operational flexibility and restoration time compared to the initial layout. The transfer bus necessitated (6) additional switches, as well as additional steel, foundations, buswork, connectors, and associated construction labor and engineering costs.

Capital Investment Proposal

Investment Proposal for Investment Committee Meeting on: N/A

Project Name: REL-Cawood 604 Breaker Add

Total Expenditures: $869k (Including $79k of Contingency)

Project Number(s): 144632

Business Unit/Line of Business: Transmission Reliability Performance & Standards

Prepared/Presented By: Keith Yocum – Manager Reliability Performance & Standards

Executive Summary

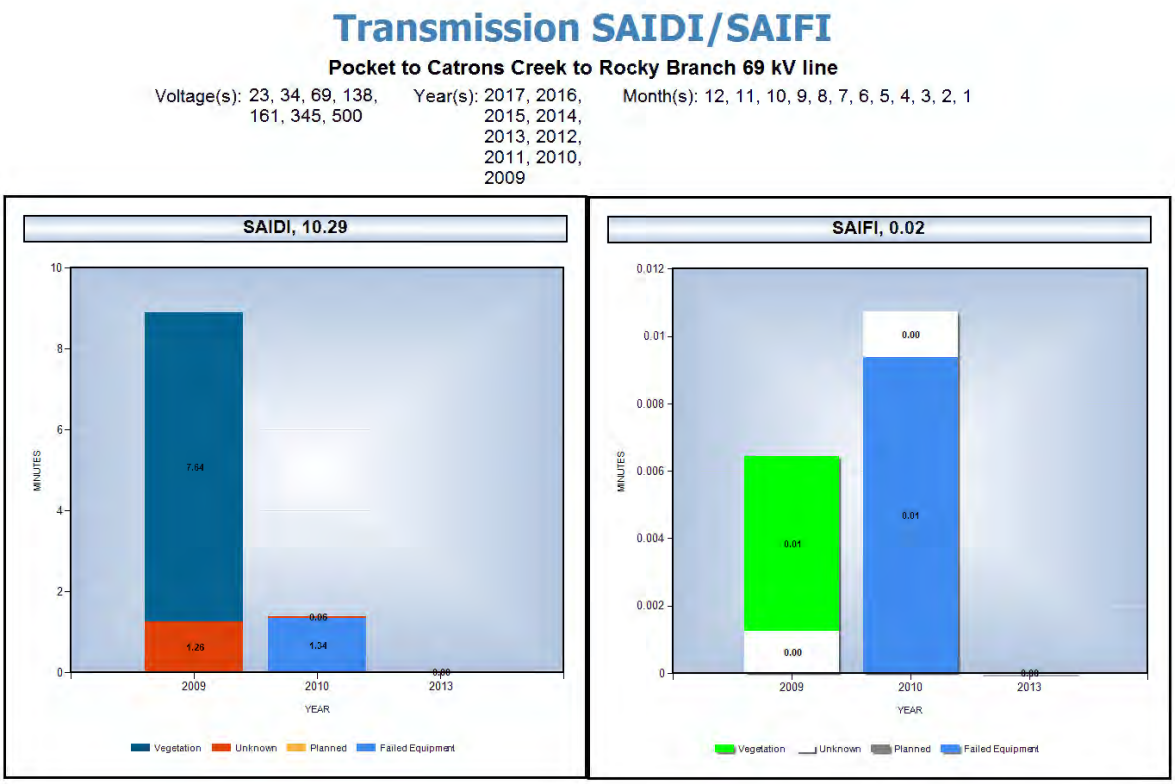
The Transmission Reliability Performance and Standards group identified the need for a breaker at the Cawood substation to reduce the System Average Interruption Duration Index (SAIDI) and the MegaWatt-Mile (MW-Mile is calculated by multiplying total miles of line exposure times the MWs served from the line) exposure on the Pocket to Catrons Creek to Rocky Branch 69 kV line. This line has significant MW-Mile exposure and has been a significant SAIDI contributor for Transmission.

The Pocket to Catrons Creek to Rocky Branch 69 kV line is 37.79 miles long and has 10 distribution transfomers tapped off of it which serve around 5,083 customers and 27.51 MW of load. A fault anywhere along this line will result in an outage on all 10 distribution stations. The placement of a breaker at Cawood will reduce MW-Mile exposure from 1040 to 491, a 52.8% reduction, resulting in only 47% as many customers losing power during a given fault. Diagram 1 include in Appendix A depicts the configuration for the Pocket to Catrons Creek to Rocky 69 kV line.

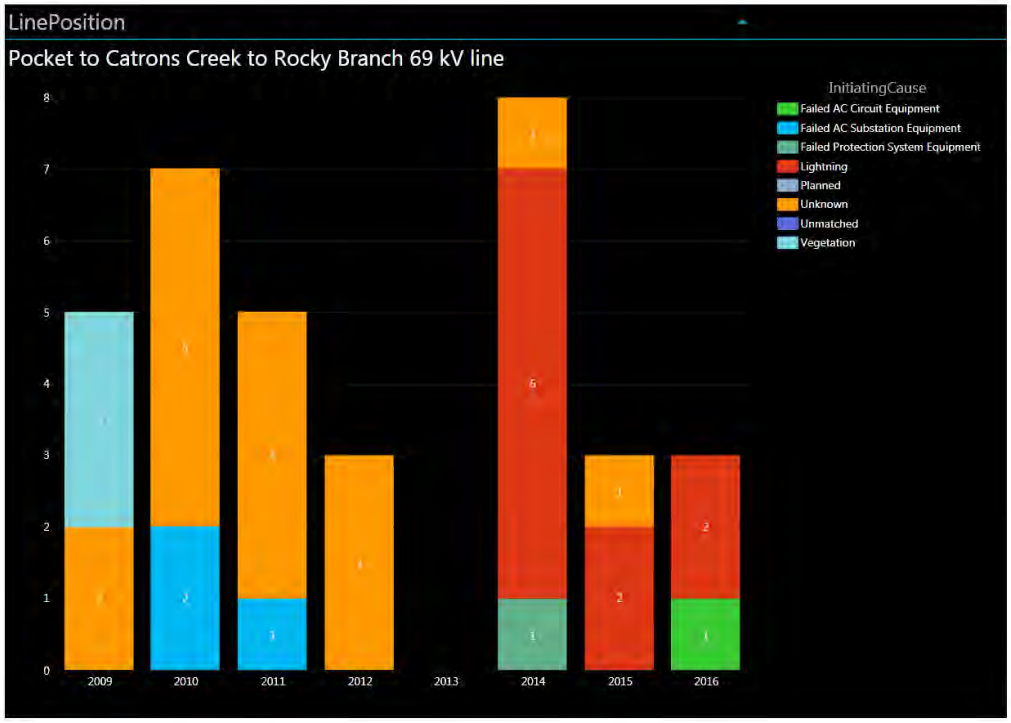
This project was initially opened for $100k to conduct preliminary engineering in an effort to better estimate the total funding needed to complete the project with the understanding that the cost of the full project would be presented for approval once those estimates were completed. The total cost of this project will be $869k with $62k in 2016 and $807k in 2017. The 2017 BP included $850k for this project with $100k in 2016 and $750k in 2017. The budgeted amount was estimated based on similar projects that have been previously completed and has been updated based on the preliminary engineering performed. The funding needed above the budget in 2017 is $57k. $35k of this was approved by the RAC 1+11 forecast. The remaining $22k was funded by a reduction in project #153706 (Earlington N Xfmr Rpl). The estimated total project figure includes a 10% contingency. This contingency is expected to cover uncertainty with the contract labor costs based upon variances that have been noticed on past similar projects.

Background
The Pocket to Catrons Creek to Rocky Branch 69 kV line was identified as a high MW-Mile exposure line. The line has also had about 1.4 minutes of SAIDI since 2010, but in 2009 there was an extended outage that resulted in almost 9 minutes of SAIDI. The 2009 event was excluded from reporting due to it being declared a Major Event Day (MED). The addition of this breaker will reduce the mileage exposure by half for all of the customers served by this line as Cawood is located in the approximate middle of the line. Therefore, for a given fault, only half as many customers will go out in the case with the breaker, as compared to the case without the breaker. This will also speed up restoration in that the line section requiring patrol will also be cut in half.

The chart below shows the historical SAIDI/SAIFI (including MED) for this line:



The following graph shows the number of relay events since 2009 and their associated cause codes.



- **Alternatives Considered**
  1. Recommendation: NPVRR: ($000s) $944 k
     It is recommended that a breaker be installed on the Pocket to Catrons Creek to Rocky Branch 69 kV line to limit the exposure of customers on a line that has historically had SAIDI issues. This recommendation assists Transmission in achieving the SAIDI targets established as part of the Transmission Reliability Plan (TRP), as well as reduces the number of customers that would otherwise experience a power outage during an event. In addition, this recommendation provides additional relay data to aid in restoring service quickly that includes information to help determine the cause and location of the event.

  2. Alternative #1: NPVRR: ($000s) $615k
     The next best alternative is to add an automated motor operated switch instead of a breaker in the substation steel at Cawood. An automated switch at Cawood would sectionalize the line and improve the restoration process, however, all customers on this line will continue to experience a power outage during an event. This option is

not advisable as this circuit has ranked in the top ten of MW-Mile (customer outage) exposure. These switches also will not provide the additional relaying event data that the breaker option will provide which helps in determining the cause and location of an outage. This option, although not the lowest cost alternative, is not recommended because it does not achieve all of the objectives of the project.

3. Do Nothing: NPVRR: N/A
   This option is not advisable as this circuit has ranked in the top ten of MW-Mile (customer outage) exposure and the current state of the line puts Transmission at risk of not being able to accomplish SAIDI targets established as part of the Transmission Reliability Plan which assumed the completion of this project.

Project Description

- **Project Scope and Timeline**

Description	Date
Project Initially Approved for preliminary engineering	September, 2016
Materials Ordered	November, 2016
Materials Received	January, 2017
Project Approved for Full Funding	March, 2017
Below Grade Work Begins	March, 2017
Below Grade Work Completed	April, 2017
Above Grade Work Begins	April, 2017
Above Grade Work Completed	May, 2017
Project Complete	June, 2017

- **Project Cost**
  This project was initially opened for $100k to conduct preliminary engineering in an effort to better estimate the total funding needed to complete the project with the understanding that the cost of the full project would be presented for approval once those estimates were completed. The total cost of this project will be $869k with $62k in 2016 and $807k in 2017. The 2017 BP included $850k for this project with $100k in 2016 and $750k in 2017. The budgeted amount was estimated based on similar projects that have been previously completed and has been updated based on the preliminary engineering performed. The funding needed above the budget in 2017 is $57k. $35k of this was approved by the RAC 1+11 forecast. The remaining $22k was funded by a reduction in project #153706 (Earlington N Xfmr Rpl). The estimated total project figure includes a 10% contingency. This contingency is expected to cover uncertainty with the contract labor costs based upon variances that have been noticed on past similar projects.

Economic Analysis and Risks

- **Bid Summary**
  Previously established blanket contract agreements will be utilized for related materials. Bids for any other necessary materials, as well as the below and above grade construction, will be sent out soon after project approval.

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	2016	2017	2018	Post 2018	Total
1. Capital Investment Proposed	62	807	-	-	869
2. Cost of Removal Proposed			-	-	-
3. Total Capital and Removal Proposed (1+2)	62	807	-	-	869
4. Capital Investment 2017 BP	100	750	-	-	850
5. Cost of Removal 2017 BP	-	-	-	-	-
6. Total Capital and Removal 2017 BP (4+5)	100	750	-	-	850
7. Capital Investment variance to BP (4-1)	38	(57)	-	-	(19)
8. Cost of Removal variance to BP (5-2)	-	-	-	-	-
9. Total Capital and Removal variance to BP (6-3)	38	(57)	-	-	(19)

Financial Detail by Year - O&M ($000s)	2016	2017	2018	Post 2018	Total
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2017 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.5%
Capital Breakdown:	
Labor:	$63k
Contract Labor:	$381k
Materials:	$232k
Other:	$0k
Local Engineering:	$50k
Burdens:	$64k
Contingency:	$79k
Net Capital Expenditure:	$869k

Spend (000's)	Construction	P&C	Telecom	Total
Company Labor	$ 39	$ 19	$ 5	**$ 63**
Contract Labor	$ 257	$ 122	$ 2	**$ 381**
Materials	$ 69	$ 153	$ 10	**$ 232**
Burdens	$ 67	$ 41	$ 6	**$ 114**
Contingency	$ 43	$ 33	$ 3	**$ 79**
Total	**$ 475**	**$ 368**	**$ 26**	**$ 869**

- **Assumptions**
  - Suppliers and contractors will meet reasonable and customary delivery dates for materials and services.

- The testing and validation for the operation of the new breaker is completed in the time frame scheduled for the project and not delayed due to the availability of resources. Delays could require additional mobilization costs for construction removal and cut-over to the new system.
- Telecommunications will install a new Verizon cellular communications at the site to provide communication for the new breaker.
- Construction costs are estimated and not based on bid pricing.

- **Environmental**
  This project does not require permitting and there are no known issues regarding air, water, waste, lead, or asbestos.

- **Risks**
  - Completing the project involves risk related to construction work within an operating substation. This project involves installing new underground conduits and reconfiguring the existing system.
  - If the breaker is not added, Transmission will continue to see negative SAIDI impacts associated with this line.

Conclusions and Recommendation

It is recommended that Management approve the Cawood Breaker Addition project for $869k to enhance the reliability of the Transmission system.

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Appendix A

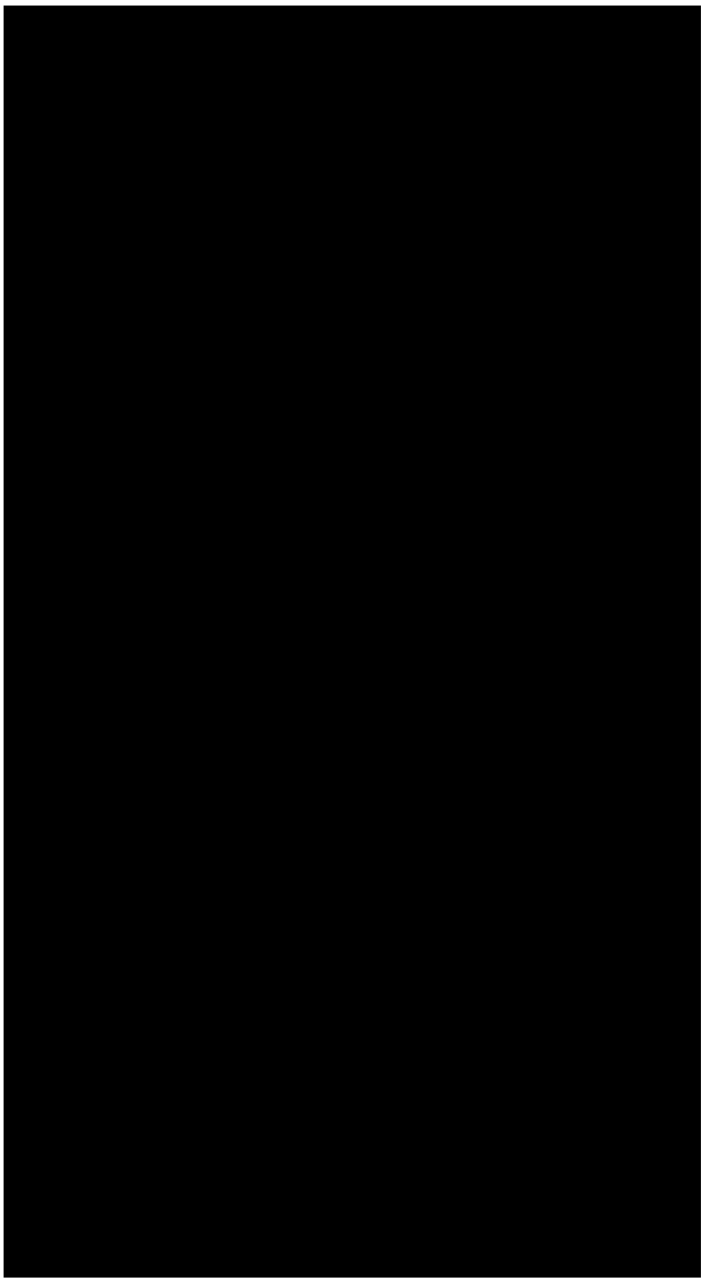


DIAGRAM 1

Capital Investment Proposal

Investment Proposal for Investment Committee Meeting on: N/A

Project Name: REL-FMC 604 Breaker Add

Total Expenditures: $1,350k (Including $121k of Contingency)

Project Number(s): 144634

Business Unit/Line of Business: Transmission Reliability Performance & Standards

Prepared/Presented By: Keith Yocum – Manager Reliability Performance & Standards

Executive Summary

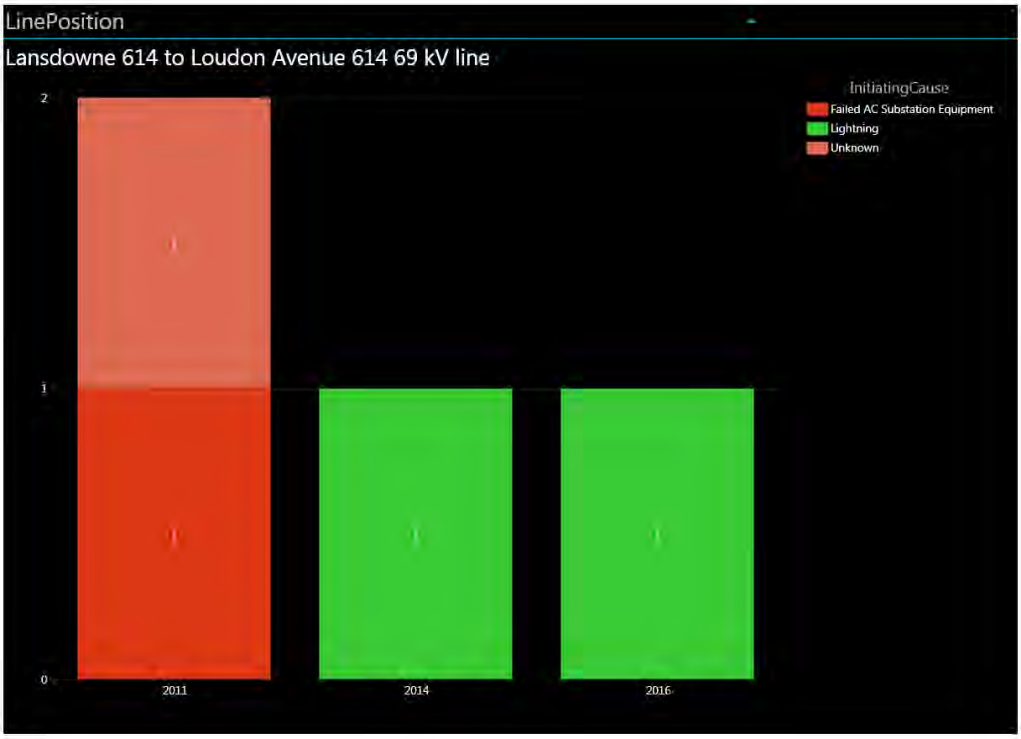
The Transmission Reliability Peformance and Standards group identified the need for a breaker at the FMC substation to reduce the MegaWatt-Mile (MW-Mile is calculated by multiplying total miles of line exposure times the MWs served from the line) exposure on the Lansdowne 614 to Loudon Avenue 614 69 kV line. This line has significant MW-Mile exposure and potential to adversely impact the System Average Interuption Duration Index (SAIDI).

The Lansdowne 614 to Loudon Avenue 614 69 kV line is 10.25 miles long and has 5 distribution transformers tapped off of it which serve around 14,909 customers and 110.25 MW of load. A fault anywhere along this line will result in an outage on all 5 distribution transformers. The placement of a breaker at FMC will reduce MW-Mile exposure from 1130 to 644, a 43.0% reduction, resulting in only 57% as many customers losing power during a given fault. Diagram 1 include in Appendix A depicts the configuration for the Lansdowne 614 to Loudon Avenue 614 69 kV line.

This project was initially opened for $100k during October 2016 to conduct preliminary engineering in an effort to better estimate the total funding needed to complete the project with the understanding that the cost of the full project would be presented for approval once those estimates were completed. The total cost of this project will be $1,350k in 2017. The 2017 BP included $850k for this project with $100k in 2016 and $750k in 2017. The budgeted amount was estimated based on similar projects that have been previously completed and has been updated based on the preliminary engineering performed. The funding needed above the budgeted amount in 2016 was addressed by the RAC during 2016. The funding needed above the budget in 2017 ($600k) was approved by the RAC in the 6+6 forecast. The estimated total project figure includes a 10% contingency. This contingency is expected to cover uncertainty with the contract labor costs based upon variances that have been noticed on past similar projects.

Background
The Lansdowne 614 to Loudon Avenue 614 69 kV line has some of the greatest MW-Mile exposure of any line in the Transmission system. This breaker will reduce the mileage exposure by roughly half for all of the customers served by this line as FMC is located in the approximate middle of the line. Therefore, for a given fault, fewer customers will go out in the case with the breaker, as compared to the case without the breaker. This will also speed up restoration in that the line requiring patrol will also be cut in half.

The following graph shows the number of relay events since 2010 and their associated cause codes.



- **Alternatives Considered**
  1. Recommendation: NPVRR: ($000s) $1,474k
     It is recommended that a breaker be installed on the Lansdowne 614 to Loudon Avenue 614 69 kV line to limit the exposure of customers on a line that has historically had SAIDI issues. This recommendation assists Transmission in achieving the SAIDI targets established as part of the Transmission Reliability Plan (TRP), as well as reduces the number of customers that would otherwise experience a power outage during an event. In addition, this recommendation provides additional relay data to aid in restoring service quickly that includes information to help determine the cause and location of the event.

2. Alternative #1: NPVRR: ($000s) $1,525k
   The next best alternative is to install the breaker within the existing substation which would require the relocation of the existing cap bank along with assocaited equipment. This would potentially require a longer outage duration, as well as limit any future expansion projects at the station due to the revised layout.

3. Do Nothing: NPVRR: N/A
   This option is not advisable as this circuit has ranked in the top ten of MW-Mile (customer outage) exposure and the current state of the line puts Transmission at risk of not being able to accomplish SAIDI targets established as part of the Transmission Reliability Plan which assumed the completion of this project.

Project Description

- **Project Scope and Timeline**

Description	Date
Project Initially Approved for preliminary engineering	October, 2016
Materials Ordered	November, 2016
Materials Received	April, 2017
Project Approved for Full Funding	July, 2017
Below Grade Work Begins	September, 2017
Below Grade Work Completed	October, 2017
Above Grade Work Begins	September, 2017
Above Grade Work Completed	October, 2017
Project Complete	December, 2017

- **Project Cost**
  This project was initially opened for $100k during October 2016 to conduct preliminary engineering in an effort to better estimate the total funding needed to complete the project with the understanding that the cost of the full project would be presented for approval once those estimates were completed. The total cost of this project will be $1,350k in 2017. The 2017 BP included $850k for this project with $100k in 2016 and $750k in 2017. The budgeted amount was estimated based on similar projects that have been previously completed and has been updated based on the preliminary engineering performed. The funding needed above the budgeted amount in 2016 was addressed by the RAC during 2016. The funding needed above the budget in 2017 ($600k) was approved by the RAC in the 6+6 forecast. The estimated total project figure includes a 10% contingency. This contingency is expected to cover uncertainty with the contract labor costs based upon variances that have been noticed on past similar projects.

Economic Analysis and Risks

- **Bid Summary**

Previously established blanket contract agreements will be utilized for related materials. Bids for any other necessary materials, as well as the below and above grade construction, will be sent out soon after project approval.

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	2016	2017	2018	Post 2018	Total
1. Capital Investment Proposed	-	1,345	-	-	1,345
2. Cost of Removal Proposed	-	5	-	-	5
3. Total Capital and Removal Proposed (1+2)	-	1,350	-	-	1,350
4. Capital Investment 2017 BP	100	750	-	-	850
5. Cost of Removal 2017 BP	-	-	-	-	-
6. Total Capital and Removal 2017 BP (4+5)	100	750	-	-	850
7. Capital Investment variance to BP (4-1)	100	(595)	-	-	(495)
8. Cost of Removal variance to BP (5-2)	-	(5)	-	-	(5)
9. Total Capital and Removal variance to BP (6-3)	100	(600)	-	-	(500)

Financial Detail by Year - O&M ($000s)	2016	2017	2018	Post 2018	Total
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2017 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.5%
Capital Breakdown:	
Company Labor:	$70k
Contract Labor:	$591k
Materials:	$395k
Other:	$0k
Local Engineering:	$92K
Burdens:	$81k
Contingency:	$121k
Net Capital Expenditure:	$1,350k

- **Assumptions**
  - Suppliers and contractors will meet reasonable and customary delivery dates for materials and services.
  - The testing and validation for the operation of the new breaker is completed in the time frame scheduled for the project and not delayed due to the availability of resources. Delays could require additional mobilization costs for construction removal and cut-over to the new system.
  - Telecommunications will install a new radio communications at the site to provide communication for the new breaker.
  - Construction costs are estimated and not based on bid pricing.

- **Environmental**
  This project likely does not require permitting for the substation expansion, and there are no known issues regarding air, water, waste, lead, or asbestos.

- **Risks**
  - Completing the project involves risk related to construction work within an operating substation. This project involves installing new underground conduits, reconfiguring the existing system, expanding the substation including grading, and making transmission line modifications into the expanded substation.
  - If the breaker is not added, Transmission will continue to see negative SAIDI impacts associated with this line.

Conclusions and Recommendation

It is recommended that Management approve the FMC Breaker Addition project for $1,350k to enhance the reliability of the Transmission system.

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Appendix A

DIAGRAM 1

Capital Investment Proposal

Investment Proposal for Investment Committee Meeting on: N/A

Project Name: REL-Stanford 604 Breaker Add

Total Expenditures: $983k (Including $89k of Contingency)

Project Number(s): 144636

Business Unit/Line of Business: Transmission Reliability Performance & Standards

Prepared/Presented By: Keith Yocum – Manager Reliability Performance & Standards

Executive Summary

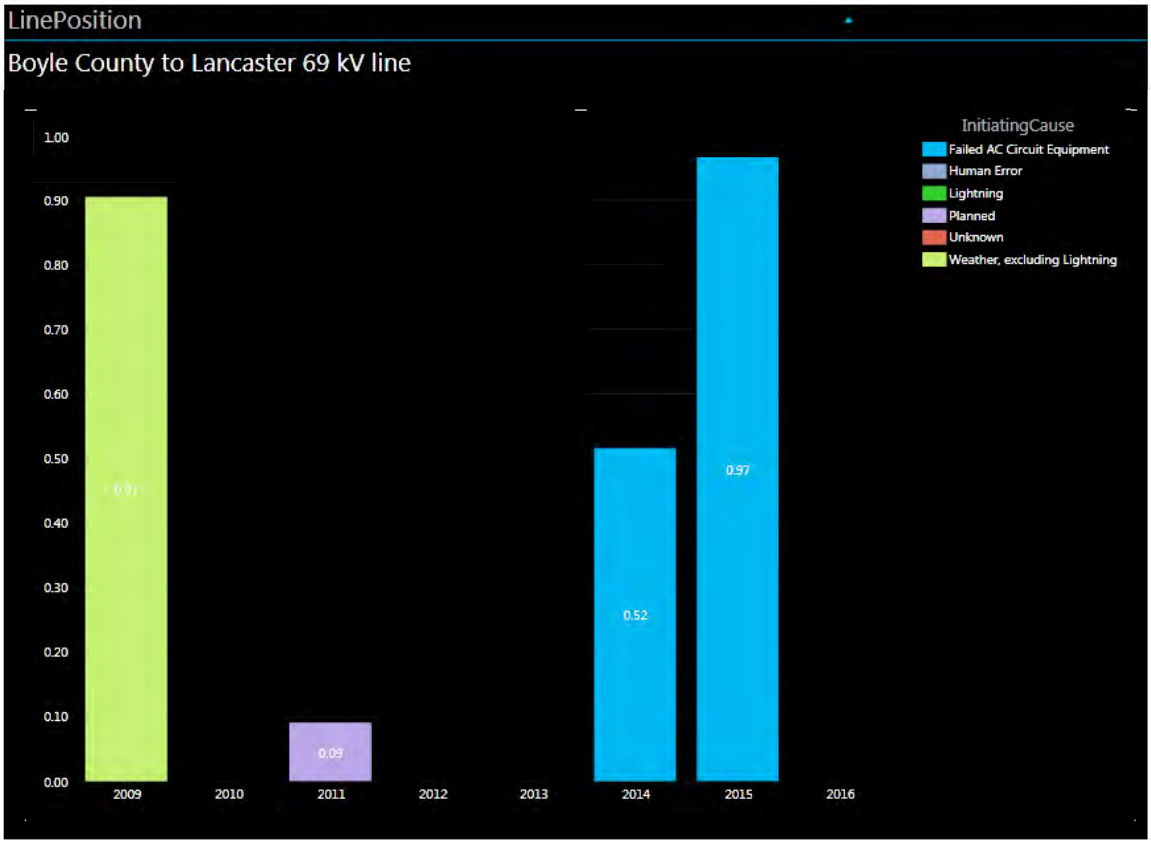
The Transmission Reliability Performance and Standards group identified the need for a breaker at the Stanford substation to reduce the System Average Interruption Duration Index (SAIDI) and the MegaWatt-Mile (MW-Mile is calculated by multiplying total miles of line exposure times the MWs served from the line) exposure on the Boyle County to Lancaster 69 kV line. This line has significant MW-Mile exposure and has been a significant SAIDI contributor for Transmission.

The Boyle County to Lancaster 69 kV line is 22.95 miles long and has 6 distribution transfomers tapped off of it which serve around 8,957 customers and 51.90 MW of load. A fault anywhere along this line will result in an outage on all 6 distribution stations. The placement of a breaker at Stanford will reduce MW-Mile exposure from 1191 to 610, a 48.8% reduction, resulting in only 51% as many customers losing power during a given fault. Diagram 1 include in Appendix A depicts the configuration for the Boyle County to Lancaster 69 kV line.

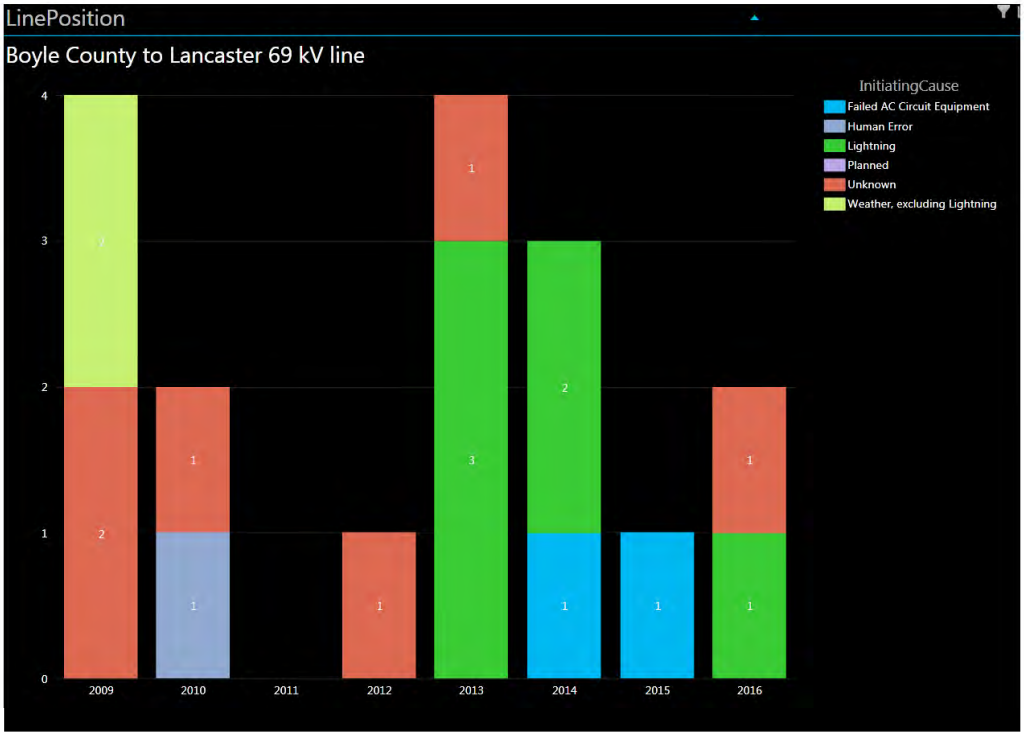
This project was initially opened for $250k to conduct preliminary engineering in an effort to better estimate the total funding needed to complete the project with the understanding that the cost of the full project would be presented for approval once those estimates were completed. The total cost of this project will be $983k with $44k in 2016 and $939k in 2017. The 2017 BP included $850k for this project with $100k in 2016 and $750k in 2017. The budgeted amount was estimated based on similar projects that have been previously completed and has been updated based on the preliminary engineering performed. The funding needed above the budgeted amount in 2016 was addressed by the RAC during 2016. The funding needed above the budget in 2017 ($133k) was partially approved by the RAC in the 3+9 Forecast ($130k) and the remainder ($3k) will be funded by a reduction in project KRTU-17. The estimated total project figure includes a 10% contingency. This contingency is expected to cover uncertainty with the contract labor costs based upon variances that have been noticed on past similar projects.

Background
The Boyle County to Lancaster 69 kV line has been a consistent high contributor to Transmission's SAIDI metric. This breaker will reduce the mileage exposure by half for all of the customers served by this line as Stanford is located in the approximate middle of the line. Therefore, for a given fault, only half as many customers will go out in the case with the breaker, as compared to the case without the breaker. This will also speed up restoration in that the line requiring patrol will also be cut in half.

The chart below shows the historical SAIDI/SAIFI (including MED) for this line:



The following graph shows the number of relay events since 2010 and their associated cause codes.



- **Alternatives Considered**
  1. Recommendation: NPVRR: ($000s) $1,080k
     It is recommended that a breaker be installed on the Boyle County to Lancaster 69 kV line to limit the exposure of customers on a line that has historically had SAIDI issues. This recommendation assists Transmission in achieving the SAIDI targets established as part of the Transmission Reliability Plan (TRP), as well as reduces the number of customers that would otherwise experience a power outage during an event. In addition, this recommendation provides additional relay data to aid in restoring service quickly that includes information to help determine the cause and location of the event.

  2. Alternative #1: NPVRR: ($000s) $615k
     The next best alternative is to add an automated motor operated switch in the steel on the Shelby City side of the Stanford tap. (There is already a project to add a motor to the switch on the Stanford North side of the tap.) This switch would sectionalize the

line and improve the restoration process, however, all customers on this line will continue to experience a power outage during an event. This option is not advisable as this circuit has ranked in the top ten of MW-Mile (customer outage) exposure. These switches also will not provide the additional relaying event data that the breaker option will provide which helps in determining the cause and location of an outage. This option, although not the lowest cost alternative, is not recommended because it does not achieve all of the objectives of the project.

3. Do Nothing: NPVRR: N/A
   This option is not advisable as this circuit has ranked in the top ten of MW-Mile (customer outage) exposure and the current state of the line puts Transmission at risk of not being able to accomplish SAIDI targets established as part of the Transmission Reliability Plan which assumed the completion of this project.

Project Description

- **Project Scope and Timeline**

Description	Date
Project Initially Approved for preliminary engineering	September, 2016
Materials Ordered	November, 2016
Materials Received	May, 2017
Project Approved for Full Funding	April, 2017
Below Grade Work Begins	May, 2017
Below Grade Work Completed	May, 2017
Above Grade Work Begins	May, 2017
Above Grade Work Completed	June, 2017
Project Complete	August, 2017

- **Project Cost**
  This project was initially opened for $250k to conduct preliminary engineering in an effort to better estimate the total funding needed to complete the project with the understanding that the cost of the full project would be presented for approval once those estimates were completed. The total cost of this project will be $983k with $44k in 2016 and $939k in 2017. The 2017 BP included $850k for this project with $100k in 2016 and $750k in 2017. The budgeted amount was estimated based on similar projects that have been previously completed and has been updated based on the preliminary engineering performed. The funding needed above the budgeted amount in 2016 was addressed by the RAC during 2016. The funding needed above the budget in 2017 ($133k) was partially approved by the RAC in the 3+9 Forecast ($130k) and the remainder ($3k) will be funded by a reduction in project KRTU-17. The estimated total project figure includes a 10% contingency. This contingency is expected to cover uncertainty with the contract labor costs based upon variances that have been noticed on past similar projects.

Economic Analysis and Risks

- **Bid Summary**
  Previously established blanket contract agreements will be utilized for related materials. Bids for any other necessary materials, as well as the below and above grade construction, will be sent out soon after project approval.

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	2016	2017	2018	Post 2018	Total
1. Capital Investment Proposed	44	939	-	-	983
2. Cost of Removal Proposed			-	-	-
3. Total Capital and Removal Proposed (1+2)	44	939	-	-	983
4. Capital Investment 2017 BP	100	750	-	-	850
5. Cost of Removal 2017 BP	-	-	-	-	-
6. Total Capital and Removal 2017 BP (4+5)	100	750	-	-	850
7. Capital Investment variance to BP (4-1)	56	(189)	-	-	(133)
8. Cost of Removal variance to BP (5-2)	-	-	-	-	-
9. Total Capital and Removal variance to BP (6-3)	56	(189)	-	-	(133)

Financial Detail by Year - O&M ($000s)	2016	2017	2018	Post 2018	Total
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2017 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.5%
Capital Breakdown:	
Labor:	$45k
Contract Labor:	$405k
Materials:	$337k
Other:	$0k
Local Engineering:	$60k
Burdens:	$47k
Contingency:	$89k
Net Capital Expenditure:	$983k

- **Assumptions**
  - Suppliers and contractors will meet reasonable and customary delivery dates for materials and services.
  - The testing and validation for the operation of the new breaker is completed in the time frame scheduled for the project and not delayed due to the availability of resources. Delays

could require additional mobilization costs for construction removal and cut-over to the new system.
  - Telecommunications will install a new radio communications at the site to provide communication for the new breaker.
  - Construction costs are estimated and not based on bid pricing.

- **Environmental**
  This project does not require permitting and there are no known issues regarding air, water, waste, lead, or asbestos.

- **Risks**
  - Completing the project involves risk related to construction work within an operating substation. This project involves installing new underground conduits and reconfiguring the existing system.
  - If the breaker is not added, Transmission will continue to see negative SAIDI impacts associated with this line.

Conclusions and Recommendation

It is recommended that Management approve the Stanford Breaker Addition project for $983k to enhance the reliability of the Transmission system.

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Appendix A

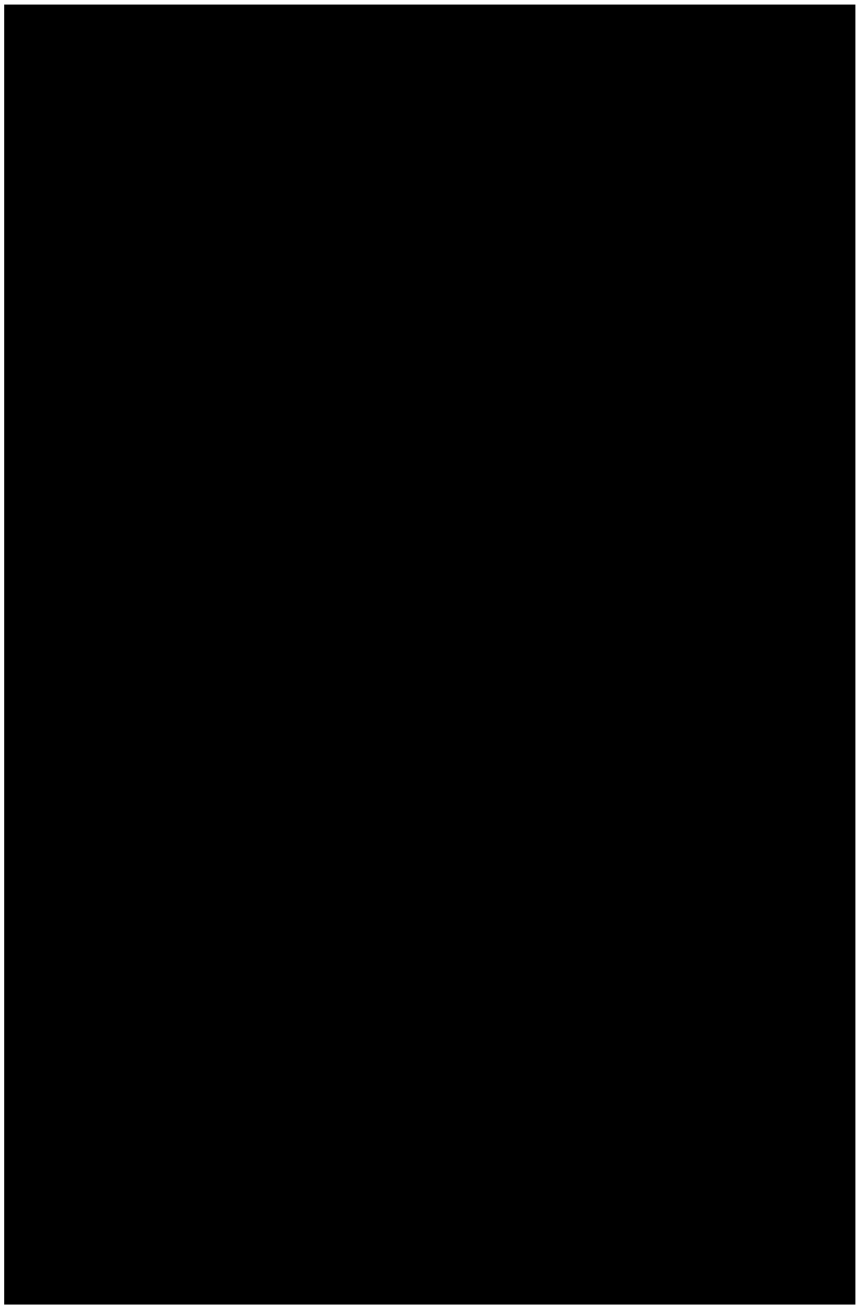


DIAGRAM 1

Investment Proposal 146982 Ghent-Blackwell Pole Replacement

Investment Proposal for Investment Committee Meeting on: April 27, 2016

Project Name: Ghent-Blackwell Pole Replacement

Total Expenditures: $2,093k
Total Contingency: $190k (10%)

Project Number(s): 146982

Business Unit/Line of Business: Transmission Lines

Prepared/Presented By: Terry Snow/Adam Smith

Executive Summary

The proposed project is to replace twenty-three (23) wood structures on the Ghent-Blackwell 138kV line with steel based on the results of a routine line inspection. As such, this proposal is to proactively replace them over the course of the next year, prior to failure, to ensure the integrity and reliability of this line and to prevent outages resulting from such failures.

The alternative of replacing poles upon failure will result in much higher long term replacement costs due to mobilization of crews back to the site each time one fails and the probable overtime work involved in replacing each during an emergency situation. This alternative would also have a negative impact on network reliability.

This project is included in the 2016 BP for $567k. The original scope of work included the replacement of fifteen (15) structures identified through inspections. Subsequent to the 2014 inspection, an additional eight (8) structures were identified to be in need of replacement. Also, due to the difficulty of obtaining an extended outage, the estimated cost to complete the project energized was added to the project cost. The current total project cost is $2,093k and was approved by the RAC in the 3+9 forecast.

Background
Above ground pole inspections are performed by the company at defined intervals in order to discover problems that may impact the integrity and reliability of the Transmission System. During a routine climbing inspection of the Ghent-Blackwell 138kV line in 2014, fifteen (15) structures were identified as priority poles. Subsequent to the 2014 inspection, an additional eight (8) structures were found and determined to be in need of replacement. All twenty three (23) structures need to be replaced in order to ensure the integrity and reliability of this line. There are 155 total structures along this 23.61 mile line. In addition to the (23) structures to be replaced on this project, there will be three (3) replaced concurrently on the Ghent-Blackwell NRP project (146983). These structures are located at various points along the entire length of the line.

- **Alternatives Considered (1 –Recommendation, 2 –Do nothing, 3 –Next Best Alt)**
  1. Recommendation: NPVRR: ($000s) $2,848k
     The recommendation is to replace the structures energized due to the difficulty in obtaining an extended outage. If the opportunity to complete the project de-energized would occur, we would pursue this option and it would reduce the NPVRR by $607k.
  2. Do Nothing: NPVRR: ($000s) $4,100k
     The alternative of do nothing would result in replacing poles upon failure, which would result in a much higher long term replacement cost due to contract crew mobilization and overtime costs. This cost was derived by an estimated percentage of failure over the next four years. The failure rate and costs may vary depending on environmental factors. This option would also have a negative impact on reliability.
     Next Best Alternative(s): NPVRR: ($000s) $3,652k
  3. The next best alternative would be to replace the poles with wood structures. The manufacturer's recommended life span of a wood pole is 30-35 years, whereas steel poles have a recommended life span of 90 years. This option assumes replacement of wood structures in 30 years and an escalation factor of 4% which is in line with market cost increases over the last 15 years.

Project Description

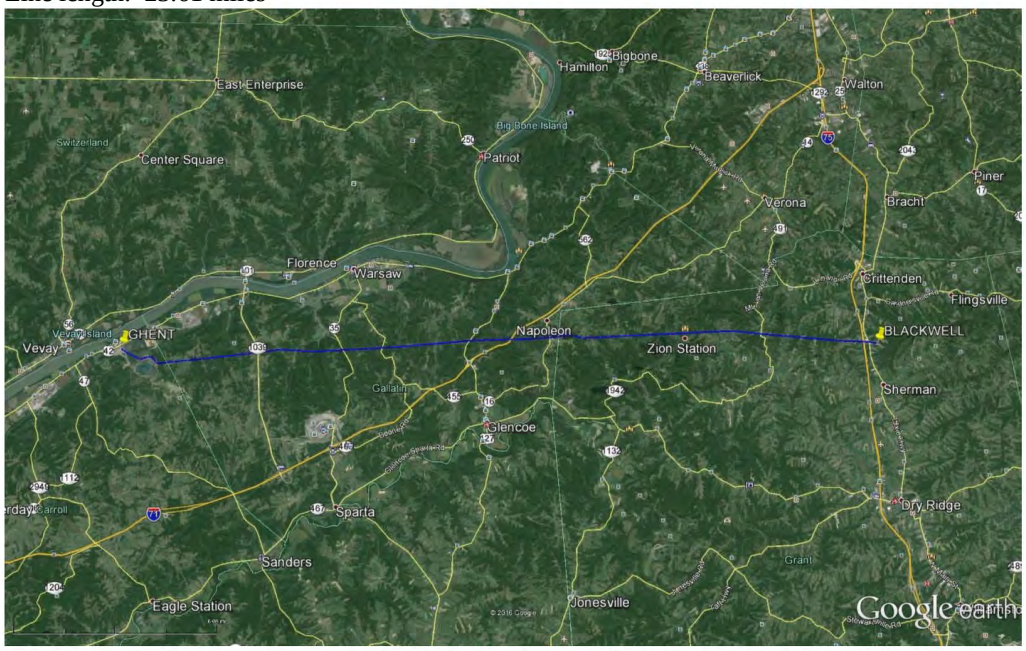
- **Project Scope and Timeline**
  The scope of work will consist of installing twenty-one (21) standard steel H-frame structures, one (1) 3-pole dead end structure, and 1 (1) 3-pole running corner and associated hardware and material, and the removal of (23) wood structures and associated hardware and material. The line construction will be based on continuing contracts from our line contractors. B&B, Elliot, Groves and Pike are the four contractors awarded the T&D Overhead Construction and Maintenance contract from the October 2011 Investment Committee meeting. The contract extension was re-approved by the IC in July of 2014. Construction is scheduled to begin in August of 2016 and to be completed in November of 2016.

  The construction milestones for this project are provided below:

Construction Milestones	
March 2016	Engineering and Design

April 2016	Steel Poles Ordered
July 2016	Steel Poles Received
August 2016	Line Construction Begins
November 2016	Line Construction Completed

A facility map of the Ghent-Blackwell 138kV line is shown below:
Line length: 23.61 miles



- **Project Cost**
  This project is included in the 2016 BP for $567k. The current total project cost is $2,093k and was approved by the RAC in the 3+9 forecast. Historical and existing contract and purchasing agreements were used to estimate the cost of material and contract labor. Due to the difficulty of obtaining an extended outage, the estimated cost to complete the project energized was added to the original project cost. This project includes 10% contingency to cover unexpected increases in cost due to weather, rocky soil, outage delays, reclamation, etc. 10% contingency is a standard assumption used across all of our projects and is calculated as a percentage of total burdened costs.

Economic Analysis and Risks

- **Bid Summary**
  Based on preliminary engineering, Transmission Lines has estimated the material packages for construction of this project to be $569k. This project will utilize standard and custom

steel structures. Hardware will be purchased through Brownstown Electrical Supply. The line construction will be based on continuing contracts with our line contractors. Davis H. Elliot, Pike Electric, B&B Electric and William E. Groves are the four main contractors which have been awarded the T&D Overhead Construction and Maintenance contracts.

Transmission Lines Material Cost Breakdown	
Material	**Cost**
Steel Poles	$490k
Hardware	$79k
Total	$569k

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	**2016**	**2017**	**2018**	**Post 2018**	**Total**
1. Capital Investment Proposed	1,844	-	-	-	1,844
2. Cost of Removal Proposed	250	-	-	-	250
3. Total Capital and Removal Proposed (1+2)	2,093	-	-	-	2,093
4. Capital Investment 2016 BP	450	-	-	-	450
5. Cost of Removal 2016 BP	117	-	-	-	117
6. Total Capital and Removal 2016 BP (4+5)	567	-	-	-	567
7. Capital Investment variance to BP (4-1)	(1,394)	-	-	-	(1,394)
8. Cost of Removal variance to BP (5-2)	(133)	-	-	-	(133)
9. Total Capital and Removal variance to BP (6-3)	(1,526)	-	-	-	(1,526)

Financial Detail by Year - O&M ($000s)	**2016**	**2017**	**2018**	**Post 2018**	**Total**
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2016 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.49%
Capital Breakdown:	
Labor:	$96k
Contract Labor:	$987k
Materials:	$569k
Local Engineering:	$140k
Burdens:	$111k
Contingency:	$190k
Reimbursements:	($0)
Net Capital Expenditure:	$2,093k

Financial Analysis - Project Summary ($000)	2016	2017	2018	2019	2020	Life of Project
Project Net Income	$10	$48	$98	$93	$89	$1,904
Project ROE	1.9%	4.5%	9.8%	9.8%	9.8%	9.3%

- **Assumptions**

  Recommendation – The cost of this alternative assumes that the line outage will not be available and the structure replacements will need to be completed with the 138kV line energized.

  Do nothing alternative – The cost of this alternative would be approximately 60% higher due to overtime labor charges and the cost to mobilize and demobilize the construction crews. These poles would fail and require replacement within the next four years.

  Next best alternative - The cost of this alternative assumes the cost of the wood poles is 51% of the cost of the steel poles, and that the wood poles would be replaced again in 30 years.

- **Environmental**
  There are no known environmental issues regarding air, water, lead, asbestos, etc., associated with this project.

- **Risks**
  Without the proposed replacement of the priority poles on the Ghent-Blackwell 138kV line, the company risks unplanned outages and increased cost of repairs in emergency situations. Inclement weather which affects site access and working conditions could increase the project cost and cause schedule delays. Schedule delays may also occur if the requested outage is not obtained to complete the scheduled work.

Conclusions and Recommendation
It is recommended that the Investment Committee approve the Ghent-Blackwell Pole Replacement project for $2,093k to maintain system integrity, reliability, and to prevent failures and unplanned outages.

Investment Proposal for Investment Committee Meeting on: June 29, 2016

Project Name: Mill Creek 4503 & 4503-33 Tie Breaker Replacements

Total Approved Expenditures: $920k

Total Revised Expenditures: $1,128k

Project Number(s): 147118

Business Unit/Line of Business: Transmission Substation Construction

Prepared/Presented By: Chris Talley – Manager Transmission Substation Construction

Reason for Revision

This project was originally approved in June 2015 for $920k to replace (2) 345kV circuit breakers at Mill Creek. The breakers that were changed out are tie breakers MC-4503 and MC-4503-33. Tie breakers are designed to tie different circuits together to enable one circuit to be fed off of another circuit's main breaker. These breakers needed replacement as several parts were needed, but the parts are no longer available because the manufacturer is no longer in business. The breakers were also in need of replacement due to leaking SF6 gas. This project must be revised to the amount of $1,128k ($208k increase). The original estimate for this project was based on similar work completed at the Mill Creek substation. The primary driver of the increased cost was the additional contract and company installation labor required due to the amount of conduit and control wiring. The physical configuration of the circuit breakers and the location of the control cabinets was different than what was assumed in the estimate which led to costs greater than what was anticipated in the estimate. The Corporate RAC approved the increase in the June 2016 meeting.

Financial Summary

Financial Summary ($000s):	Approved	Revised	Explanation
Discount Rate:	6.5%	6.5%	
Capital Breakdown:			
Labor:	$ 34	$ 77	
Contract Labor:	$ 190	$ 349	Cost of conduit and control wiring greater than anticipated
Materials:	$ 476	$ 502	
Other:	$ -	$ 6	
Local Engineering:	$ 87	$ 118	
Burdens:	$ 49	$ 76	
Contingency:	$ 84	$ -	
Reimbursements:	$ -	$ -	
Net Capital Expenditure:	$ 920	$ 1,128	
NPVRR:	$ 1,136	$ 1,389	

Financial Detail by Year - Capital ($000s)	2015	2016	2017	Post 2017	Total
1. Capital Investment Proposed	580	539	-	-	1,119
2. Cost of Removal Proposed	(3)	11	-	-	8
3. Total Capital and Removal Proposed (1+2)	578	550	-	-	1,128
4. Capital Investment 2016 BP	496	424	-	-	920
5. Cost of Removal 2016 BP	-	12	-	-	12
6. Total Capital and Removal 2016 BP (4+5)	496	436	-	-	932
7. Capital Investment variance to BP (4-1)	(85)	(115)	-	-	(199)
8. Cost of Removal variance to BP (5-2)	3	2	-	-	4
9. Total Capital and Removal variance to BP (6-3)	(82)	(113)	-	-	(195)

Financial Detail by Year - O&M ($000s)	2015	2016	2017	Post 2017	Total
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2016 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Conclusions and Recommendation
It is recommended that the Investment Committee approve the Mill Creek 4503 & 4503-33 TIE Breaker Replacements project for $1,128k to enhance the reliability of the Transmission system.

Approval Confirmation for Capital Projects Greater Than or Equal to $1 million:

The Capital project spending included in this Investment Proposal has been approved by the members of the LKE Investment Committee. Pursuant to the LKE Authority Limit Matrix, the signatures below are also required for approval of this Capital project spending request.

Kent W. Blake	Victor A. Staffieri
Chief Financial Officer	Chairman, CEO and President

Investment Proposal

Investment Proposal for Investment Committee Meeting on: N/A

Project Name: Mill Creek 4503 & 4503-33 TIE Breaker Replacements

Total Expenditures: $920k ($84k of Contingency)

Project Number(s): 147118

Business Unit/Line of Business: Transmission Substation Construction

Prepared/Presented By: Chris Talley – Manager Transmission Substation Construction

Executive Summary

The scope of this project includes the replacement of (2) 345kV circuit breakers at Mill Creek. The breakers that will be changed out are MC-4503 and MC-4503-33. These breakers must be replaced as several parts are needing replacement, but the parts are no longer available because the manufacturer is no longer in business. The breakers are also in need of replacement due to leaking SF6 gas.

The total cost of this project will be $920k and was approved by the 2015 5+7 RAC. No funding was included in the 2015 BP for this project. The estimated total project figure includes a 10% contingency.

Background
Inspection of the breakers identified several parts needing replacement as well as severe SF6 gas leaks; however, parts are no longer available because the manufacturer is no longer in business. It is critical that the remaining breakers be replaced to improve the reliability of Mill Creek Unit 2 and reduce the risk of damage to the unit from a breaker failure.

- **Alternatives Considered (1 –Recommendation, 2 – Next Best Alt, 3 – Do Nothing)**
  Recommendation – It is recommended to replace the MC-4503 and MC-4503-33 circuit breakers at Mill Creek. Parts from the breakers that are retired will be used to support other similar breakers that are still in service on the system.
  NPVRR: ($000s) $1,136k

  Next Best Alternative(s) – Replacing only one Mill Creek breaker at this time and replacing the other at a later date. This would result in continued SF6 leakage from the delayed breaker as well as the inherent risk of having Mill Creek Unit 2 connected to the transmission system by only one breaker for the duration of the second breaker's replacement.
  NPVRR: ($000s) $1,150k

  Do Nothing – This option is not advisable as the breakers currently in-service at Mill Creek have a significant history of maintenance issues and the parts necessary to alleviate these issues are no longer available. These breakers are also leaking SF6 gas, which requires additional maintenance activities as well.
  NPVRR: ($000s) ($52k)

Project Description

- **Project Scope and Timeline**

Description	Date
Project Approved	June, 2015
Materials Ordered	June, 2015
Materials Received	February, 2016
Below Grade Work Begins	March, 2016
Below Grade Work Completed	March, 2016
Above Grade Work Begins	April, 2016
Above Grade Work Completed	April, 2016
Project Complete	April, 2016

- **Project Cost**
  The total cost of this project will be $920k and was approved by the 2015 5+7 RAC. No funding was included in the 2015 BP for this project. The estimated total project figure includes a 10% contingency.

Economic Analysis and Risks

- **Bid Summary**
  The 345kV breakers will be purchased under the existing breaker purchasing agreement. Bids for any other necessary materials as well as the civil, below, and above grade work will be sent out in the fall of 2015.

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	2015	2016	2017	Post 2017	Total
1. Capital Investment Proposed	496	412	-	-	908
2. Cost of Removal Proposed	-	12	-	-	12
3. Total Capital and Removal Proposed (1+2)	496	424	-	-	920
4. Capital Investment 2015 BP	-	-	-	-	-
5. Cost of Removal 2015 BP	-	-	-	-	-
6. Total Capital and Removal 2015 BP (4+5)	-	-	-	-	-
7. Capital Investment variance to BP (4-1)	(496)	(412)	-	-	(908)
8. Cost of Removal variance to BP (5-2)	-	(12)	-	-	(12)
9. Total Capital and Removal variance to BP (6-3)	(496)	(424)	-	-	(920)

Financial Detail by Year - O&M ($000s)	2015	2016	2017	Post 2017	Total
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2015 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.5%
Capital Breakdown:	
Labor:	$34k
Contract Labor:	$190k
Materials:	$476k
Other:	$0k
Local Engineering:	$87k
Burdens:	$49k
Contingency:	$84k
Reimbursements:	($0k)
Net Capital Expenditure:	$920k

Financial Analysis - Project Summary ($000)	2015	2016	2017	2018	2019	Life of Project
Project Net Income	$ (6)	$ (7)	$ 13	$ 21	$ 47	$ 993
Project ROE	-4.40%	-2.00%	2.70%	4.90%	11.20%	10.20%

- **Assumptions**
  - There is no Transmission Lines work associated with this project
  - There will be no 4533 line relay upgrades associated with this project
  - The reaquested outages for construction will be granted. The labor estimate assumes 4 day/week, 10 hour/day work week with no special construction considerations to minimize the required outage window.
  - Costs to expand the ground grid or lightning protection in the entire station to meet current standards or codes are not included in this estimate. The existing ground grid impedance to remote ground along with the touch and step potential is assumed to be adequate. New ground grid is only installed in the affected substation expansion area for touch and step potential upgrade.
  - Suppliers and contractors will meet reasonable and customary delivery dates for materials and services.

- **Environmental**
  This project does not require permitting and there are no known issues regarding air, water, waste, lead, or asbestos.

- **Risks**
  Completing the project involves risk related to high voltage substation construction work. Not completing the project decreases the reliability of the Mill Creek Unit 3 generator. Project schedule assumes that the planned maintenance outage on Mill Creek Unit 3 will take place between 4/16/16 and 6/10/16 per the current schedule. Once we start this work, the unit will not be able to go online without at least one of the two breakers in service. If only one of the two breakers is available when the unit is brought back online, then it is possible that an inadvertent trip of either the 345kV BUS SEC B or or the 4532 Blue Lick line could cause Unit 3 to trip offline depending on which of the two breakers is in-service. This is due to the fact that it will lose connection with the Transmission System.

Conclusions and Recommendation
It is recommended that the project Mill Creek 4503 & 4503-33 TIE Breaker Replacements be approved for $920k to enhance the reliability of the Transmission system.

Investment Proposal 147313 Bardstown-Elizabethtown Pole Replacement

Investment Proposal for Investment Committee Meeting on: July 27, 2016

Project Name: Bardstown-Elizabethtown Pole Replacement

Total Expenditures: $2,896k
Total Contingency: $263k (10%)

Project Number(s): 147313

Business Unit/Line of Business: Transmission Lines

Prepared/Presented By: Nate Mullins/Adam Smith

Executive Summary
The proposed project is to replace eighty-seven (87) wood structures on the Bardstown-Elizabethtown 69kV line with steel, during a routine outage, based on the results of a routine line inspection.

This proposal is to proactively replace the structures over the course of the next year, prior to failure, to ensure the integrity and reliability of this line, and to prevent outages resulting from such failures. The alternative of replacing poles upon failure will result in much higher long term replacement costs due to mobilization of crews back to the site each time one fails and the probable overtime work involved in replacing each during an emergency situation. This alternative would also have a negative impact on network reliability.

The total project cost is $2,896k and was included in the 2016 Business Plan for $2,002k in 2017. The original scope of work included replacement of eighty-nine (89) structures identified through inspections based on an average structure cost. Subsequent to the plan, we identified the need to replace an existing line switch on a structure identified for replacement and updated the scope to include replacement of eighty-seven (87) structures. In addition, we accelerated the project to 2016 due to the condition of the structures. The updated estimate also included project specific costs related to access and terrain not included in the original estimate. This project was approved by the RAC in the 6+6 forecast.

Background
Above ground pole inspections are performed by the company at defined intervals in order to discover problems that may impact the integrity and reliability of the Transmission System. During routine climbing inspections of the Bardstown-Elizabethtown 69kV line, eighty-seven (87) structures were identified as priority poles and determined to be in need of replacement in order to ensure the integrity and reliability of this line. There are 556 total structures along this 38.93 mile line.

- **Alternatives Considered**
  1. Recommendation: NPVRR: ($000s) $3,940k
     The recommendation is to replace all eighty-seven (87) structures, and one (1) existing switch during a scheduled outage.
  2. Alternative #1: NPVRR: ($000s) $5,674k
     The alternative of do nothing would result in replacing the poles upon failure, which would result in a much higher long term replacement cost due to contract crew mobilization and overtime costs. This cost was derived by an estimated percentage of failure over the next four years. The failure rate and costs may vary depending on environmental factors. This option would also have a negative impact on reliability.
  3. Alternative #2: NPVRR: ($000s) $4,269k
     The next best alternative would be to replace the poles with wood structures. The manufacturer's recommended life span of a wood pole is 30-35 years, whereas steel poles have a recommended life span of 90 years. This option also assumes replacement of wood structures in 30 years and an escalation rate of 4% which is in line with market cost increases over the last 15 years.

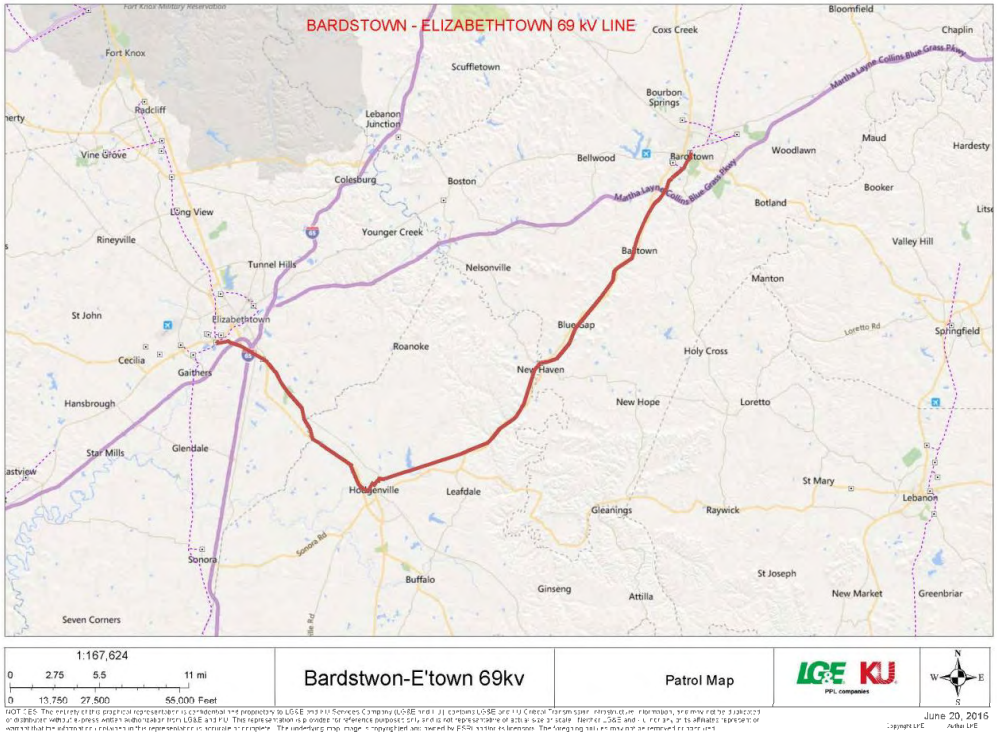
Project Description

- **Project Scope and Timeline**
  The scope of work will consist of installing sixty-two (62) single pole steel structures, twenty-one (21) standard steel H-frames, (2) steel 3 pole running corners, (1) steel 2 pole dead-end, (1) steel 3 pole dead end, one (1) in line one way switch, and associated hardware and material, and the removal of eighty-seven (87) wood structures, and associated hardware and material. The line construction will be based on continuing contracts from our line contractors. B&B, Elliot, Groves and Pike are the four contractors awarded the T&D Overhead Construction and Maintenance contract from the October 2011 Investment Committee meeting. The contract extension was re-approved by the IC in July of 2014. Construction is scheduled to begin in September of 2016 and be completed in December of 2016.

  The construction milestones for this project are provided below:

Construction Milestones	
April 2016	Engineering and Design
August 2016	Steel Poles Issued
September 2016	Line Construction Begins
December 2016	Line Construction Completed

A facility map of the Bardstown-Elizabethtown 69kV line is shown below:
Line length: 38.93 miles



- **Project Cost**
  The total project cost is $2,896k and was included in the 2016 Business Plan for $2,002k in 2017. This project was approved by the RAC in the 6+6 forecast. Historical and existing contract and purchasing agreements were used to estimate the cost of material and contract labor. This project includes a 10% contingency which is reasonable based on the level of detailed engineering, confidence in the cost of material and contractors, and potential unknown risks such as weather delays, rocky terrain, outage delays, reclamation, and structure access.

Economic Analysis and Risks

- **Bid Summary**
  Based on preliminary engineering, Transmission lines has estimated the material packages for construction to be $767k. This project will utilize stock steel structures, and associated hardware and material. The line construction will be based on continuing contracts with our line contractors. Davis H. Elliot, Pike Electric, B&B Electric and William E. Groves are the

four main contractors which have been awarded the T&D Overhead Construction and Maintenance contracts.

Transmission Lines Material Cost Breakdown	
Material	**Cost**
Steel Poles	$721k
Hardware	$46k
Total	$767k

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	**2016**	**2017**	**2018**	**Post 2018**	**Total**
1. Capital Investment Proposed	2,261	-	-	-	2,261
2. Cost of Removal Proposed	635	-	-	-	635
3. Total Capital and Removal Proposed (1+2)	2,896	-	-	-	2,896
4. Capital Investment 2016 BP	-	1,885	-	-	1,885
5. Cost of Removal 2016 BP	-	117	-	-	117
6. Total Capital and Removal 2016 BP (4+5)	-	2,002	-	-	2,002
7. Capital Investment variance to BP (4-1)	(2,261)	1,885	-	-	(376)
8. Cost of Removal variance to BP (5-2)	(635)	117	-	-	(518)
9. Total Capital and Removal variance to BP (6-3)	(2,896)	2,002	-	-	(894)

Financial Detail by Year - O&M ($000s)	**2016**	**2017**	**2018**	**Post 2018**	**Total**
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2016 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.49%
Capital Breakdown:	
Labor:	$86k
Contract Labor:	$1,350
Materials:	$767k
Local Engineering:	$197k
Burdens:	$233k
Contingency:	$263k
Reimbursements:	($0)
Net Capital Expenditure:	$2,896k

Financial Analysis - Project Summary ($000)	2016	2017	2018	2019	2020	Life of Project
Project Net Income	$7	$65	$135	$129	$123	$2,633
Project ROE	0.9%	2.7%	7.2%	10.0%	10.0%	9.3%

- **Assumptions**
  Recommendation - This alternative assumes that the line outage will be available and that all eighty-seven (87) structures, and one (1) switch will be replaced during this timeframe.

  Do Nothing alternative – The cost of this alternative would be approximately 60% higher due to overtime labor charges and the cost to mobilize and demobilize construction crews. These poles would fail and require replacement within the next four years.

  Next Best alternative – The cost of this alternative assumes the cost of the wood poles is 24% the cost of the steel poles, and that the wood poles would be replaced again in 30 years.

- **Environmental**
  There are no known environmental issues regarding air, water, lead, asbestos, etc., associated with this project.

- **Risks**
  Without the proposed replacement of the priority poles on the Bardstown-Elizabethtown 69kV line, the company risks unplanned outages and increased cost of repairs in emergency situations. Inclement weather which affects site access and working conditions could increase the project cost and cause schedule delays. Schedule delays may also occur if the requested outage is not obtained to complete the scheduled work.

Conclusions and Recommendation
It is recommended that the Investment Committee approve the Bardstown-Elizabethtown pole replacement project for $2,896k to maintain system integrity, reliability, and to prevent failures and unplanned outages.

Approval Confirmation for Capital Projects Greater Than or Equal to $1 million:

The Capital project spending included in this Investment Proposal has been approved by the members of the LKE Investment Committee. Pursuant to the LKE Authority Limit Matrix, the signatures below are also required for approval of this Capital project spending request.

Kent W. Blake	Victor A. Staffieri
Chief Financial Officer	Chairman, CEO and President

Investment Proposal for Investment Committee Meeting on: March 30, 2016

Project Name: Trimble County-Centerfield Pole Replacement

Total Expenditures: $2,259k
Total Contingency: $169k (8%)

Project Number(s): 147328

Business Unit/Line of Business: Transmission Lines

Prepared/Presented By: John Doll/Adam Smith

Executive Summary

The proposed project is to replace thirty-five (35) wood structures on the Trimble County-Centerfield 138kV line with steel based on the results of a routine line inspection. As such, this proposal is to proactively replace them over the course of the next year, prior to failure, to ensure the integrity and reliability of this line and to prevent outages resulting from such failures.

The alternative of replacing poles upon failure will result in much higher long term replacement costs due to mobilization of crews back to the site each time one fails and the probable overtime work involved in replacing each during an emergency situation. This alternative would also have a negative impact on network reliability.

This project is included in the 2016 BP for $1,360k. The original project cost estimate was based on a formula which did not include energized pricing. Once detailed engineering analysis was completed, a decision was made to complete the work energized due to the risk of not being able to obtain an extended outage to complete the work. The current total project cost is $2,259k and was approved by the RAC in the 2+10 forecast.

Background
Above ground pole inspections are performed by the company at defined intervals in order to discover problems that may impact the integrity and reliability of the Transmission System. During a routine climbing inspection of the Trimble County-Centerfield 138kV line in 2015, thirty-five (35) structures were identified as priority poles and determined to be in need of replacement in order to ensure the integrity and reliability of this line. There are 117 total structures along this 15.7 mile line.

- **Alternatives Considered (1 –Recommendation, 2 –Do nothing, 3 –Next Best Alt)**
  1. Recommendation: NPVRR: ($000s) $3,068k
     The recommendation is to replace the structures energized due to the difficulty in obtaining an extended outage. If the opportunity to complete the project de-energized would occur, we would pursue this option and it would reduce the NPVRR by $557k.
  2. Do Nothing: NPVRR: ($000s) $4,410k
     The alternative of do nothing would result in replacing poles upon failure, which would result in a much higher long term replacement cost due to contract crew mobilization and overtime costs. This cost was derived by an estimated percentage of failure over the next four years. The failure rate and costs may vary depending on environmental factors. This option would also have a negative impact on reliability.
  3. Next Best Alternative(s): NPVRR: ($000s) $3,477k
     The next best alternative would be to replace the poles with wood structures. The manufacturer's recommended life span of a wood pole is 30-35 years, whereas steel poles have a recommended life span of 90 years. This option assumes replacement of wood structures in 30 years and an escalation factor of 4% which is in line with market cost increases over the last 15 years.

Project Description

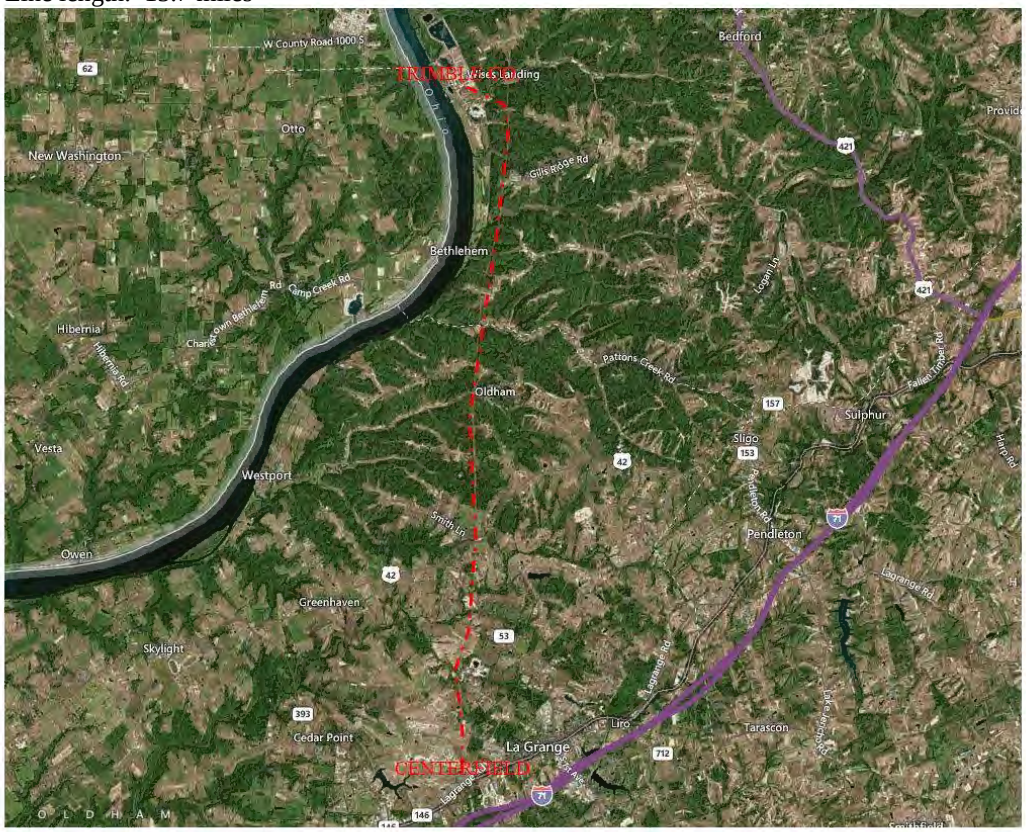
- **Project Scope and Timeline**
  The scope of work will consist of installing twenty-seven (27) standard steel H-frame structures and eight (8) 3-pole structures, and associated hardware and material, and the removal of (27) wood H-frame and (8) 5-pole wood structures, and associated hardware and material. The line construction will be based on continuing contracts from our line contractors. B&B, Elliot, Groves, and Pike are the four contractors awarded the T&D Overhead Construction and Maintenance contract from the October 2011 Investment Committee meeting. The contract extension was re-approved by the IC in July of 2014. Construction is scheduled to begin in May of 2016 and to be completed in July of 2016.

  The construction milestones for this project are provided below:

Construction Milestones	
January 2016	Engineering and Design
April 2016	Steel Poles Ordered
May 2016	Steel Poles Received

Construction Milestones	
May 2016	Line Construction Begins
July 2016	Line Construction Completed

A facility map of the Trimble County-Centerfield 138kV line is shown below:
Line length: 15.7 miles



- **Project Cost**
  This project is included in the 2016 BP for $1,360k. The current total project cost is $2,259k and was approved by the RAC in the 2+10 forecast. Historical and existing contract and purchasing agreements were used to estimate the cost of material and contract labor.

Economic Analysis and Risks

- **Bid Summary**
  Based on preliminary engineering, Transmission Lines has estimated the material packages for construction of this project to be $731k. This project will utilize standard steel structures. Hardware will be purchased through Brownstown Electrical Supply. The line construction

will be based on continuing contracts with our line contractors. Davis H. Elliot, Pike Electric, B&B Electric and William E. Groves are the four main contractors which have been awarded the T&D Overhead Construction and Maintenance contracts.

Transmission Lines Material Cost Breakdown	
Material	**Cost**
Steel Poles	$676k
Hardware	$55k
Total	$731k

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	**2016**	**2017**	**2018**	**Post 2018**	**Total**
1. Capital Investment Proposed	1,826	-	-	-	1,826
2. Cost of Removal Proposed	433	-	-	-	433
3. Total Capital and Removal Proposed (1+2)	2,259	-	-	-	2,259
4. Capital Investment 2016 BP	1,213	-	-	-	1,213
5. Cost of Removal 2016 BP	147	-	-	-	147
6. Total Capital and Removal 2016 BP (4+5)	1,360	-	-	-	1,360
7. Capital Investment variance to BP (4-1)	(613)	-	-	-	(613)
8. Cost of Removal variance to BP (5-2)	(286)	-	-	-	(286)
9. Total Capital and Removal variance to BP (6-3)	(899)	-	-	-	(899)

Financial Detail by Year - O&M ($000s)	**2015**	**2016**	**2017**	**Post 2017**	**Total**
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2016 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.49%
Capital Breakdown:	
Labor:	$46k
Contract Labor:	$1,005k
Materials:	$731k
Local Engineering:	$236k
Burdens:	$72k
Contingency:	$169k
Reimbursements:	($0k)
Net Capital Expenditure:	$2,259k

Financial Analysis - Project Summary ($000)	2016	2017	2018	2019	2020	Life of Project
Project Net Income	$102	$94	$104	$99	$94	$1,751
Project ROE	17.5%	8.3%	9.7%	9.7%	9.7%	9.8%

- **Assumptions**

  Recommendation – The cost of this alternative assumes that the line outage will not be available and the structure replacements will need to be completed with the 138kV line energized.

  Do nothing alternative – The cost of this alternative would be approximately 60% higher due to overtime labor charges and the cost to mobilize and demobilize the construction crews. These poles would fail and require replacement within the next four years.

  Next best alternative - The cost of this alternative assumes the cost of the wood poles is 51% of the cost of the steel poles, and that the wood poles would be replaced again in 30 years.

- **Environmental**
  There are no known environmental issues regarding air, water, lead, asbestos, etc., associated with this project.

- **Risks**
  Without the proposed replacement of the priority poles on the Trimble County-Centerfield 138kV line, the company risks unplanned outages and increased cost of repairs in emergency situations. Inclement weather which affects site access and working conditions could increase the project cost and cause schedule delays. Schedule delays may also occur if the requested outage is not obtained to complete the scheduled work.

Conclusions and Recommendation
It is recommended that the Investment Committee approve the Trimble County-Centerfield Pole Replacement project for $2,259k to maintain system integrity, reliability, and to prevent failures and unplanned outages.

Investment Proposal Project 147334 London-Sweet Hollow Pole Replacement

Investment Proposal for Investment Committee Meeting on: April 27, 2016

Project Name: London-Sweet Hollow Pole Replacement

Total Expenditures: $3,987k
Total Contingency: $345k (9%)

Project Number(s): 147334

Business Unit/Line of Business: Transmission Lines

Prepared/Presented By: Nick Poston/Adam Smith

Executive Summary

The proposed project is to replace sixty-five (65) wood structures on the London-Sweet Hollow 69kV line with steel based on the results of a routine line inspection. As such, this proposal is to proactively replace them over the course of the next year, prior to failure, to ensure the integrity and reliability of this line and to prevent outages resulting from such failures.

The alternative of replacing poles upon failure will result in much higher long term replacement costs due to mobilization of crews back to the site each time one fails and the probable overtime work involved in replacing each during an emergency situation. This alternative would also have a negative impact on network reliability.

This project is included in the 2016 BP for $2,720k. The original scope of work included the replacement of sixty-five (65) structures with wood and steel during a scheduled outage. Through coordination with distribution, we have worked out a solution for the distribution underbuild to attach to the steel poles. As a result, the decision was made to replace all sixty five (65) structures with steel. Also, due to the difficulty of obtaining an extended outage, the cost to complete the project energized was added. The current total project cost is $3,987k and was approved by the RAC in the 3+9 forecast.

Background
Above ground pole inspections are performed by the company at defined intervals in order to discover problems that may impact the integrity and reliability of the Transmission System. During a routine climbing inspection of the London-Sweet Hollow 69kV line in 2012, sixty-five (65) structures were identified as priority poles and determined to be in need of replacement in order to ensure the integrity and reliability of this line. There are 106 total structures along this 11.21 mile line.

- **Alternatives Considered (1 –Recommendation, 2 –Do nothing, 3 –Next Best Alt)**
  1. Recommendation: NPVRR: ($000s) $5,499k
     The recommendation is to replace the structures energized due to the difficulty in obtaining an extended outage. If the opportunity to complete the project de-energized would occur, we would pursue this option and it would reduce the NPVRR by $1,116k.
  2. Do Nothing: NPVRR: ($000s) $7,885k
     The alternative of do nothing would result in replacing poles upon failure, which would result in a much higher long term replacement cost due to contract crew mobilization and overtime costs. This cost was derived by an estimated percentage of failure over the next four years. The failure rate and costs may vary depending on environmental factors. This option would also have a negative impact on reliability.
  3. Next Best Alternative(s): NPVRR: ($000s) $4,377k
     The next best alternative would be to replace all 65 poles with wood structures. The manufacturer's recommended life span of a wood pole is 30-35 years, whereas steel poles have a recommended life span of 90 years. This option assumes replacement of wood structures in 30 years and an escalation factor of 4% which is in line with market cost increases over the last 15 years.

Project Description

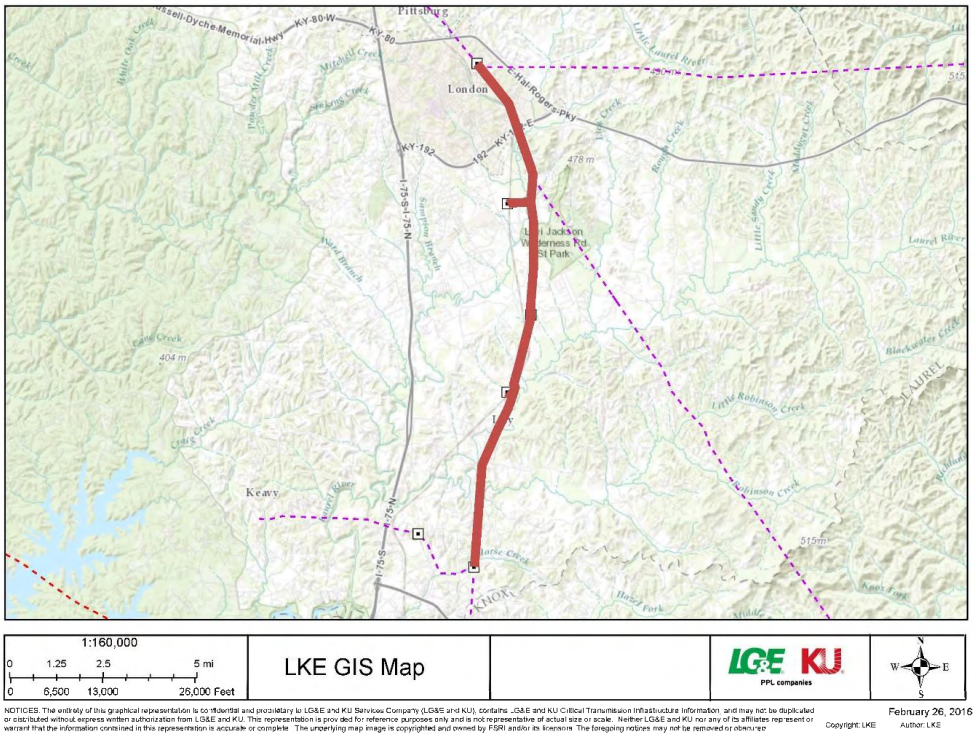
- **Project Scope and Timeline**
  The scope of work will consist of installing fifty-eight (58) standard steel H-frame structures, one (1) custom steel H-frame structure, one (1) steel custom switch and platform structure, four (4) custom steel running corners, one (1) standard steel z-frame structure, and associated hardware and material, and the removal of (65) wood structures, and associated hardware and material. The line construction will be based on continuing contracts from our line contractors. B&B, Elliot, Groves and Pike are the four contractors awarded the T&D Overhead Construction and Maintenance contract from the October 2011 Investment Committee meeting. The contract extension was re-approved by the IC in July of 2014. Construction is scheduled to begin in June of 2016 and to be completed in July of 2016.

  The construction milestones for this project are provided below:

Construction Milestones	
April 2016	Engineering and Design
April 2016	Steel Poles Ordered
June 2016	Steel Poles Received
June 2016	Line Construction Begins

July 2016	Line Construction Completed

A facility map of the London-Sweet Hollow 69kV line is shown below:
Line length: 11.21 miles



- **Project Cost**
  This project is included in the 2016 BP for $2,720k. The current total project cost is $3,987k and was approved by the RAC in the 3+9 forecast. Historical and existing contract labor and purchasing agreements were used to estimate the cost of the material and contract labor. This project includes 9% contingency to cover unexpected increases in cost due to weather, rocky soil, outage delays, reclamation, etc. 10% contingency is a standard assumption used across all of our projects and is calculated as a percentage of total burdened costs. The 9% contingency on this project resulted from late estimate changes.

Economic Analysis and Risks

- **Bid Summary**
  Based on preliminary engineering, Transmission Lines has estimated the material packages for construction of this project to be $1,131k. This project will utilize standard and custom steel structures. Hardware will be purchased through Brownstown Electrical Supply. The line construction will be based on continuing contracts with our line contractors. Davis H.

Elliot, Pike Electric, B&B Electric and William E. Groves are the four main contractors which have been awarded the T&D Overhead Construction and Maintenance contracts.

Transmission Lines Material Cost Breakdown	
Material	**Cost**
Steel Poles	$1,096k
Hardware	$35k
Total	$1,131k

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	**2016**	**2017**	**2018**	**Post 2018**	**Total**
1. Capital Investment Proposed	3,794	-	-	-	3,794
2. Cost of Removal Proposed	193	-	-	-	193
3. Total Capital and Removal Proposed (1+2)	3,987	-	-	-	3,987
4. Capital Investment 2016 BP	2,289	-	-	-	2,289
5. Cost of Removal 2016 BP	431	-	-	-	431
6. Total Capital and Removal 2016 BP (4+5)	2,720	-	-	-	2,720
7. Capital Investment variance to BP (4-1)	(1,505)	-	-	-	(1,505)
8. Cost of Removal variance to BP (5-2)	238	-	-	-	238
9. Total Capital and Removal variance to BP (6-3)	(1,267)	-	-	-	(1,267)

Financial Detail by Year - O&M ($000s)	**2016**	**2017**	**2018**	**Post 2018**	**Total**
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2016 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.49%
Capital Breakdown:	
Labor:	$123k
Contract Labor:	$1,811k
Materials:	$1,131k
Local Engineering:	$265k
Burdens:	$312k
Contingency:	$345k
Reimbursements:	($0)
Net Capital Expenditure:	$3,987k

Financial Analysis - Project Summary ($000)	2016	2017	2018	2019	2020	Life of Project
Project Net Income	$152	$149	$186	$177	$168	$2,654
Project ROE	14.8%	7.4%	9.7%	9.0%	9.7%	9.6%

- **Assumptions**

  Recommendation – The cost of this alternative assumes that the line outage will not be available and the structures will need to be replaced with the 69kV line energized. This alternative also assumes that all required permitting will be received timely.

  Do nothing alternative – The cost of this alternative would be approximately 60% higher due to overtime labor charges and the cost to mobilize and demobilize the construction crews. These poles would fail and require replacement within the next four years.

  Next best alternative - The cost of this alternative assumes the cost of the wood poles is 24% of the cost of the steel poles, and that the wood poles would be replaced again in 30 years.

- **Environmental**
  There are no known environmental issues regarding air, water, lead, asbestos, etc., associated with this project.

- **Risks**
  Without the proposed replacement of the priority poles on the London-Sweet Hollow 69kV line, the company risks unplanned outages and increased cost of repairs in emergency situations. Inclement weather which affects site access and working conditions could increase the project cost and cause schedule delays. Schedule delays may also occur if the required permitting is not received, or the requested outage is not obtained to complete the scheduled work.

Conclusions and Recommendation
It is recommended that the Investment Committee approve the London-Sweet Hollow pole replacement project for $3,987k to maintain system integrity, reliability, and to prevent failures and unplanned outages.

Investment Proposal Project 147335 Green River Plant-Morganfield Pole Replacement

Investment Proposal for Investment Committee Meeting on: June 29, 2016

Project Name: Green River Plant-Morganfield Pole Replacement

Total Expenditures: $2,517k
Total Contingency: $229k (10%)

Project Number(s): 147335

Business Unit/Line of Business: Transmission Lines

Prepared/Presented By: Nate Mullins/Adam Smith

Executive Summary

The proposed project is to replace forty-two (42) existing wood structures with forty (40) steel and two (2) wood structures on the Green River Plant-Morganfield 161kV line based on the results of a routine line inspection. The forty structures being replaced with steel will be completed during a scheduled outage. The two structures being replaced with wood will be completed energized due to their location in a double circuit section wherein operational restrictions require that one of the circuits remain energized during construction. Wood is being utilized for these two structures as a safety precaution.

This proposal is to proactively replace the structures over the course of the next year, prior to failure, to ensure the integrity and reliability of this line and to prevent outages resulting from such failures. The alternative of replacing poles upon failure will result in much higher long term replacement costs due to mobilization of crews back to the site each time one fails and the probable overtime work involved in replacing each during an emergency situation. This alternative would also have a negative impact on network reliability.

This project is included in the 2016 BP for $1,511k. The original estimate was based on an average per structure replacement cost. Once the engineering analysis was completed, the project estimate was revised to be in line with the scope of work required. the proposed estimate includes $42k to replace two of the structures energized. The current total project cost is $2,517k and was approved by the RAC in the 5+7 forecast.

Background
Above ground pole inspections are performed by the company at defined intervals in order to discover problems that may impact the integrity and reliability of the Transmission System. During a routine climbing inspection of the Green River Plant-Morganfield 161kV line in 2014, forty-two (42) structures were identified as priority poles and determined to be in need of replacement in order to ensure the integrity and reliability of this line. There are 442 total structures along this 52.52 mile line. In addition to the 42 structures to be replaced on this project, there will be 25 replaced concurrently on the Green River Plant-Morganfield NRP project (147478). These structures are located at various points along the entire length of the line. The proposed estimate accounts for the unique delta configuration within a 7.75 mile 161kV/69kV double circuit section of the line.

- **Alternatives Considered (1 –Recommendation, 2 –Do nothing, 3 –Next Best Alt)**
    1. Recommendation: NPVRR: ($000s) $3,425k
    The recommendation is to replace forty (40) wood structures with steel during a scheduled outage and two (2) wood structures with wood. The wood structures will be replaced while one of the circuits within a double circuit section is energized. The additional cost of completing the energized work is $42k. These two structures must be completed energized. There is no option to complete de-energized due to the delta configuration.
    2. Do Nothing: NPVRR: ($000s) $4,930k
    The alternative of do nothing would result in replacing poles upon failure, which would result in a much higher long term replacement cost due to contract crew mobilization and overtime costs. This cost was derived by an estimated percentage of failure over the next four years. The failure rate and costs may vary depending on environmental factors. This option would also have a negative impact on network reliability.
    3. Next Best Alternative(s): NPVRR: ($000s) $3,709k
    The next best alternative would be to replace 40 of the 42 structures identified for steel replacement with wood. The manufacturer's recommended lifespan of a wood pole is 30-35 years, whereas steel poles have a recommended lifespan of 90 years. This option assumes replacement of the wood structures in 30 years and an escalation factor of 4%, which is in line with market cost increases over the last 15 years.

Project Description

- **Project Scope and Timeline**
    The scope of work will consist of installing forty-two (40) steel H-frame structures, two (2) wood structures, and associated hardware and material, and the removal of 42 wood structures, associated hardware and material. The project will utilize standard steel and wood structures and associated hardware. The line construction will be based on continuing contracts from our line contractors. B&B, Elliot, Groves and Pike are the four contractors awarded the T&D Overhead Construction and Maintenance contract from the October 2011 Investment

Committee meeting. The contract extension was re-approved by the IC in July of 2014. Construction is scheduled to begin in August of 2016 and be completed in October of 2016.

The construction milestones for this project are provided below:

Construction Milestones	
July 2016	Engineering and Design
August 2016	Line Construction Begins
October 2016	Line Construction Completed

A facility map of the Green River Plant-Morganfield 161kV line is shown below:
Total line length: 52.52 miles

- **Project Cost**
  This project is included in the 2016 BP for $1,511k. The current total project cost is $2,517k and was approved by the RAC in the 5+7 forecast. Historical and existing contract and purchasing agreements were used to estimate the cost of material and contract labor. This project includes 10% contingency which is reasonable based on the level of detailed engineering, confidence in cost of materials and contractors, and potential unknown risks such as weather delays, and potential outage restrictions.

Economic Analysis and Risks

- **Bid Summary**
  Based on preliminary engineering, Transmission Lines has estimated the material packages for construction for this project to be $723k. This project will utilize standard steel and wood structures and associated hardware. The line construction will be based on continuing contracts with our line contractors. Davis H. Elliot, Pike Electric, B&B Electric and William E. Groves are the four main contractors which have been awarded the T&D Overhead Construction and Maintenance contracts.

Transmission Lines Material Cost Breakdown	
Material	Cost
Steel Poles	$678k
Wood Poles	$16k
Hardware	$29k
Total	$723k

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	**2016**	**2017**	**2018**	**Post 2018**	**Total**
1. Capital Investment Proposed	2,175	-	-	-	2,175
2. Cost of Removal Proposed	343	-	-	-	343
3. Total Capital and Removal Proposed (1+2)	2,517	-	-	-	2,517
4. Capital Investment 2016 BP	1,406	-	-	-	1,406
5. Cost of Removal 2016 BP	105	-	-	-	105
6. Total Capital and Removal 2016 BP (4+5)	1,511	-	-	-	1,511
7. Capital Investment variance to BP (4-1)	(769)	-	-	-	(769)
8. Cost of Removal variance to BP (5-2)	(238)	-	-	-	(238)
9. Total Capital and Removal variance to BP (6-3)	(1,006)	-	-	-	(1,006)

Financial Detail by Year - O&M ($000s)	**2016**	**2017**	**2018**	**Post 2018**	**Total**
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2016 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.49%
Capital Breakdown:	
Labor:	$61k
Contract Labor:	$1,132
Materials:	$723k

Local Engineering:	$167k
Burdens:	$205k
Contingency:	$229k
Reimbursements:	($0)
Net Capital Expenditure:	$2,517k

Financial Analysis - Project Summary ($000)	2016	2017	2018	2019	2020	Life of Project
Project Net Income	$11	$57	$118	$112	$107	$2,289
Project ROE	1.8%	4.5%	9.8%	9.8%	9.8%	9.3%

- **Assumptions**
  Recommendation – The cost of this alternative assumes that forty (40) structures will be completed during a scheduled outage, and two (2) structures will be completed with one circuit within a double circuit section energized.

  Do nothing alternative – The cost of this alternative would be approximately 60% higher due to overtime labor charges and the cost to mobilize and demobilize the construction crews. These poles would fail and require replacement within the next four years.

  Next best alternative – The cost of this alternative assumes that the cost of the wood poles to replace the 40 structres identified for steel replacement is 36% the cost of the steel poles. The manufacturer's recommended lifespan of a wood pole is 30-35 years, whereas steel poles have a recommended lifespan of 90 years. This option assumes replacement of the wood structures in 30 years and an escalation factor of 4%, which is in line with market cost increases over the last 15 years.

- **Environmental**
  There are no known environmental issues regarding air, water, lead, asbestos, etc., associated with this project.

- **Risks**
  Without the proposed replacement of the priority poles on the Green River Plant-Morganfield 161kV line, the company risks unplanned outages and increased cost of repairs in emergency situations. Inclement weather which affects site access and working conditions could increase the project cost and cause schedule delays. Schedule delays may also occur if the requested outage is not obtained to complete the scheduled work.

Conclusions and Recommendation

It is recommended that the Investment Committee approve the Green River Plant-Morganfield Pole Replacement project for $2,517k to maintain system integrity, reliability, and to prevent failures and unplanned outages.

Approval Confirmation for Capital Projects Greater Than or Equal to $1 million:

The Capital project spending included in this Investment Proposal has been approved by the members of the LKE Investment Committee. Pursuant to the LKE Authority Limit Matrix, the signatures below are also required for approval of this Capital project spending request.

Kent W. Blake.	Victor A. Staffieri
Chief Financial Officer	Chairman, CEO and President

Investment Proposal Project 147999 Earlington North-Nebo Static Replacement

Investment Proposal

Project Name: Earlington North-Nebo Static Replacement

Total Expenditures: $1,601k
Total Contingency: $146k (10%)

Project Number(s): 147999

Business Unit/Line of Business: Transmission Lines

Prepared/Presented By: Gary King/Adam Smith

Executive Summary

The 13.18 mile section of 69kV line between Earlington North and Nebo contains 9.01 miles of the original 3/8" high strength (HS) static wire, and 4.17 miles of 7#8 alumoweld. The 9.01 miles of 3/8" HS wire dates back to 1927 and has had multiple failures in recent years. The 4.17 miles of 7#8 alumoweld will also be removed to accommodate the replacement of all 13.18 miles in this section with Optical Ground Wire (OPGW).

Telecom has requested to replace this static wire with OPGW in lieu of a standard shield wire. While there is no immediate benefit, the long-term strategic benefits of this project make it worthwhile for Telecom to request OPGW be included with this project. These benefits include utilizing OPGW from Earlington North-Nebo-Morganfield which will eventually offset expensive leased line costs for the Call Center when the route is complete. In addition, network communications could potentially be provided for Distribution Automation, and other use cases for 5 additional substations. This project will cover the installation of 13.18 miles of OPGW (starting at Earlington North), with the remainder of OPGW to be installed from Nebo-Morganfield in a subsequent year (Project 148854 currently budgeted in 2021).

This project was included in the 2017 BP for $846k based on preliminary estimates for replacing 9.01 miles of 3/8" HS static wire with standard shield wire on the existing lattice towers. Telecom's request to replace the existing static wire with OPGW increased the amount of wire needing to be replaced to 13.18 miles. Detailed engineering along with complete scope development increased the planned work for this project. This project now includes a complete below grade inspection of all tower legs, replacement of five (5) lattice towers with steel poles, and the installation of OPGW. These changes increased the cost by $755k. The entire project cost of $1,601k was approved by the RAC in the 3+9 forecast.

Background
Aerial patrol inspections of this line revealed that the existing 3/8" HS static wire is in poor mechanical condition and has reached the end of its useful life. Due to the conditions of this line, there is a risk of additional failures that will expose the transmission network to further unscheduled outages. The goal is to replace the remainder of the static wire between Nebo and Morganfield (same vintage) in subsequent years.

- **Alternatives Considered**
  1. Recommendation: NPVRR: ($000s) $2,039k
     The recommendation is to replace 13.18 miles of static wire with new OPGW. The additional expense is a prudent strategic investment in this one time opportunity to be able to gain a company-owned fiber path along this route.
  2. Alternative #1-Splice Failed Sections As Needed: NPVRR: ($000s) $1,676k
     Without the proposed replacement of the existing static wire in the Earlington North-Nebo 69kV line, the company risks increased exposure to line outages. If the existing static wire is not replaced, the company risks having to make repairs with an unplanned outage which would add increased costs due to overtime labor. Repairs would involve splicing the failed static wire back together. Although this alternative has a lower cost, it would not allow the company-owned fiber path along this route to be extended.
  3. Alternative #2:-Replace With Standard 7#8 alumoweld NPVRR: ($000s) $1,229k
     The next best alternative would be to replace the existing 9.01 miles of existing 3/8" HS static wire with conventional 7#8 alumoweld, instead of the requested OPGW. The line outages related to static wire failures will be reduced, however the communications link will not be provided to Telecom. (Please see the background section for details regarding the communications aspect of this project).

Project Description

- **Project Scope and Timeline**
  The scope of work will consist of installing 13.18 miles of OPGW and related hardware. Five (5) new steel poles, twelve (12) steel lattice tower cage extensions, and forty-three (43) steel static peaks (tower steel) will also be required. A thorough ground-line, tower steel corrosion inspection will also be performed on these aging towers.

  The steel poles will be purchased through our steel pole alliance partner, Trinity-Meyer. The tower steel will be purchased through our steel tower alliance partner, SAE Tower. The OPGW will be bid between past proven providers, Prysmian and AFL. The line construction will be based on continuing contracts from our line contractors. B&B Electric, Davis H. Elliot, William E. Groves and Pike Electric are the four contractors awarded the T&D Overhead Construction and Maintenance contract from the October 2011 Investment Committee (IC) meeting. The contract extension was re-approved by the IC in July of 2014. Construction is scheduled to begin in June of 2017 and to be completed in December of 2017.

Construction Milestones	
May 2017	Project Approved
May 2017	Lattice Tower Steel, OPGW & Hardware Ordered
June 2017	Lattice Tower Steel, OPGW & Hardware Delivered
June 2017	Line Construction Begins
December 2017	Line Construction Completed

Below is a map of the 13.18 mile section of the Earlington North-Nebo line:

- **Project Cost**
  This project was included in the 2017 BP for $846k with preliminary estimates for replacing 9.01 miles of 3/8" HS static wire with standard shield wire on the existing lattice towers. Telecom's request to replace the existing static wire with OPGW increased the amount of wire needing to be replaced to 13.18 miles. Detailed engineering along with complete scope development increased the planned work for this project. , a complete below grade inspections of all tower legs, replacement of five (5) lattice towers with steel poles, and the

installation of OPGW. These changes increased the cost by $755k. The entire project cost of $1,601k was approved by the RAC in the 3+9 forecast.

Economic Analysis and Risks

- **Bid Summary**
  Based on detailed engineering, Transmission Lines has estimated the material package for this project to be $259k. The project will utilize OPGW, standard steel structures, and material. The OPGW will be bid between Prysmian and AFL. The line construction will be based on continuing contracts with our line contractors. B&B Electric, Davis H. Elliot, William E. Groves and Pike Electric are the four contractors which have been awarded the T&D Overhead Construction Maintenance contracts.

Transmission Lines Material Cost Breakdown	
Material	Cost
Steel Poles	$65k
Tower Steel	$26k
OPGW	$100k
Hardware	$68k
Total	$259k

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	**2017**	**2018**	**2019**	**Post 2019**	**Total**
1. Capital Investment Proposed	1,487	-	-	-	1,487
2. Cost of Removal Proposed	115	-	-	-	115
3. Total Capital and Removal Proposed (1+2)	1,601	-	-	-	1,601
4. Capital Investment 2017 BP	846	-	-	-	846
5. Cost of Removal 2017 BP	-	-	-	-	-
6. Total Capital and Removal 2017 BP (4+5)	846	-	-	-	846
7. Capital Investment variance to BP (4-1)	(641)	-	-	-	(641)
8. Cost of Removal variance to BP (5-2)	(115)	-	-	-	(115)
9. Total Capital and Removal variance to BP (6-3)	(755)	-	-	-	(755)

Financial Detail by Year - O&M ($000s)	**2017**	**2018**	**2019**	**Post 2019**	**Total**
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2017 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.49%
Capital Breakdown:	
Labor:	$47k
Contract Labor:	$981k
Materials:	$259k
Local Engineering:	$99k
Burdens:	$69k
Contingency:	$146k
Net Capital Expenditure:	$1,601k

- **Assumptions**

  Recommendation - This assumes that the 13.18 miles of existing static wire will be replaced with OPGW. An outage must be obtained to replace the existing static wire and is scheduled for summer of 2017. This also assumes that all highway and railroad crossing permits will be granted by the Kentucky Transportation Cabinet (KYTC), and associated railroads.

  Alternative #1 - This assumes that the existing static wire would be replaced in 2026 and the company will have to make any necessary repairs in the meantime during unplanned outages.

  Alternative #2 - This assumes that the existing 9.01 miles of existing 3/8" HS static wire will be replaced with 7#8 alumoweld rather than the requested OPGW. If 7#8 is used, the communications link will not be provided to Telecom. This also assumes that all highway and railroad crossing permits will be granted by the KYTC, and associated railroads.

- **Environmental**
  There are no known environmental issues regarding air, water, lead, asbestos, etc., associated with this project.

- **Risks**
  Without the proposed replacement of the existing static wire in the Earlington North-Nebo 69kV line, the company risks increased exposure to line outages. The wire along the 9.01 miles has deteriorated and corroded over time. It has become brittle and does not have its original design strength. Unplanned outages are often time-consuming and costly when it comes to repairs. If the line outage cannot be obtained, the proposed static replacement project cannot be performed safely within the budget constraints. Construction delays may be encountered due to possible severe weather events. If the appropriate crossing permits are not granted, it could result in the project being delayed.

Conclusions and Recommendation
It is recommended that Management approve the Earlington North-Nebo static replacement project for $1,601k to improve the reliability of the electric transmission system.

Capital Investment Proposal

Investment Proposal for Investment Committee Meeting on: N/A

Project Name: REL-Hoover 604 Breaker Add

Total Expenditures: $967k (Including $88k of Contingency)

Project Number(s): 148370

Business Unit/Line of Business: Transmission Reliability Performance & Standards

Prepared/Presented By: Keith Yocum – Manager Reliability Performance & Standards

Executive Summary

The Transmission Reliability Performance and Standards group identified the need for a breaker at the Hoover substation to reduce the System Average Interruption Duration Index (SAIDI) and the MegaWatt-Mile (MW-Mile is calculated by multiplying total miles of line exposure times the MWs served from the line) exposure on the Adams to Haefling 69 kV line. This line has significant MW-Mile exposure and has been a significant SAIDI contributor for Transmission.

The Adams to Haefling 69 kV line is 12.07 miles long and has 7 distribution transformers in 5 distribution stations tapped off of it which serve around 10,689 customers and 82.95 MW of load. A fault anywhere along this line will result in an outage on all 5 distribution stations. The placement of a breaker at Hoover will reduce MW-Mile exposure from 1001 to 305, a 69.5% reduction, resulting in only 30% as many customers losing power during a given fault. Diagram 1 include in Appendix A depicts the configuration for the Adams to Haefling 69 kV line.

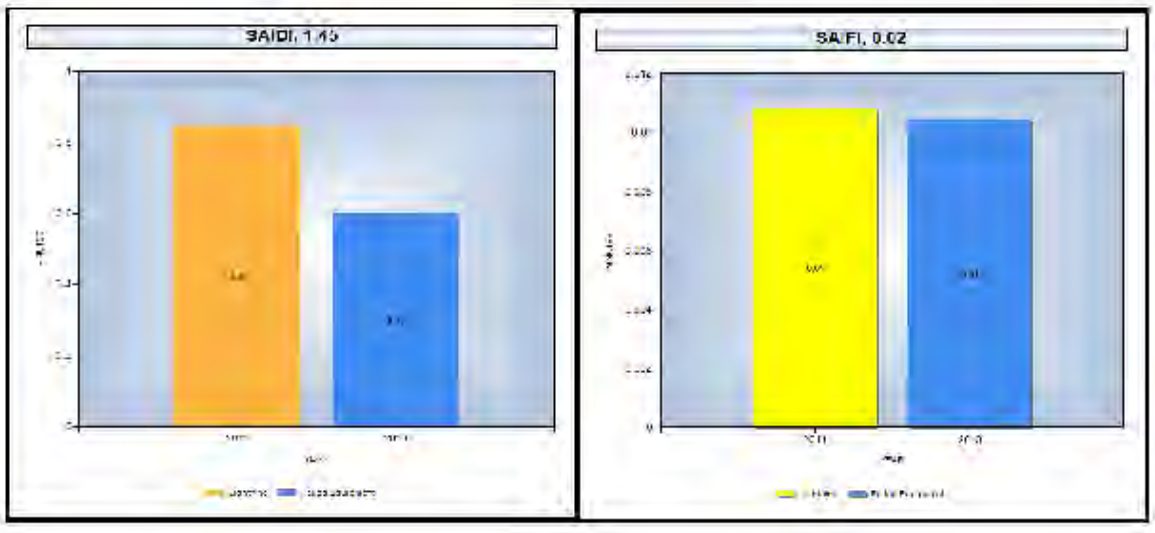
This project was initially opened for $100k to conduct preliminary engineering in an effort to better estimate the total funding needed to complete the project with the understanding that the cost of the full project would be presented for approval once those estimates were completed. The total cost of this project will be $967k with $134k in 2016 and $834k in 2017. The 2017 BP included $850k for this project with $100k in 2016 and $750k in 2017. The budgeted amount was estimated based on similar projects that have been previously completed and has been updated based on the preliminary engineering performed. The funding needed above the budgeted amount in 2016 was addressed by the RAC during 2016. The funding needed above the budget in 2017 ($84k) will be funded by a reduction in project #152141 (PBR-Lynch 69kV Brkr Rpl). The estimated total project figure includes a 10% contingency. This contingency is expected to cover uncertainty with the contract labor costs based upon variances that have been noticed on past similar projects.

Background
The Adams to Haefling 69 kV line has been a consistent high contributor to Transmission's SAIDI metric. This breaker will reduce the mileage exposure by half for all of the customers served by this line as Hoover is located in the approximate middle of the line. Therefore, for a given fault, only half as many customers will go out in the case with the breaker, as compared to the case without the breaker. This will also speed up restoration in that the line requiring patrol will also be cut in half.

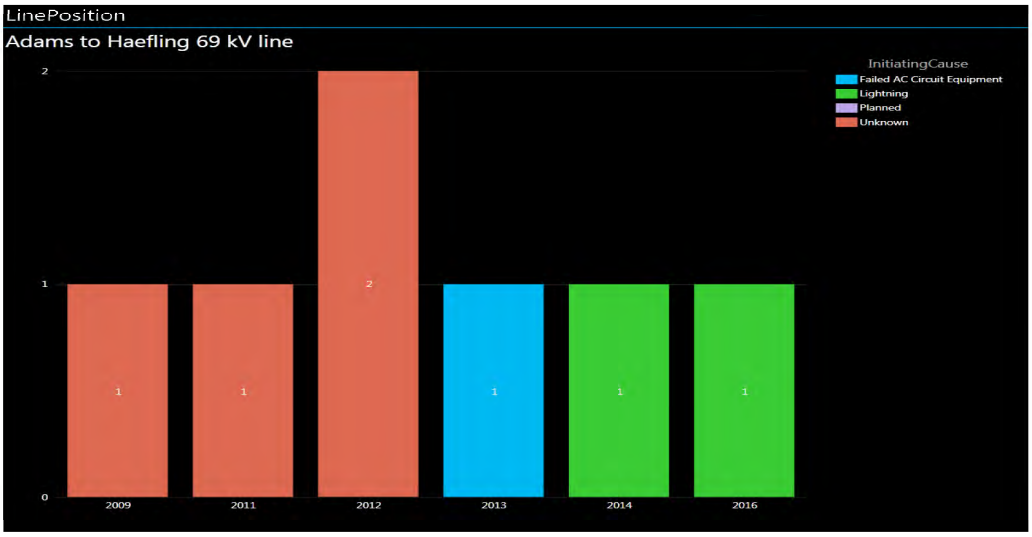
The chart below shows the historical SAIDI/SAIFI (including MED) for this line:

Adams to Haefling 69 kV line

Voltage(s): 23, 34, 69, 138, 161, 345, 500 Year(s): 2010, 2011, 2012, 2013, 2014, 2015, 2016 Month(s): 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1



The following graph shows the number of relay events since 2010 and their associated cause codes.



- **Alternatives Considered**
  1. Recommendation: NPVRR: ($000s) $1,057k
     It is recommended that a breaker be installed on the Adams to Haefling 69 kV line to limit the exposure of customers on a line that has historically had SAIDI issues. This recommendation assists Transmission in achieving the SAIDI targets established as part of the Transmission Reliability Plan (TRP), as well as reduces the number of customers that would otherwise experience a power outage during an event. In addition, this recommendation provides additional relay data to aid in restoring service quickly that includes information to help determine the cause and location of the event.

  2. Alternative #1: NPVRR: ($000s) $615k
     The next best alternative is to add an automated motor operated switch instead of a breaker at the Hoover tap. The automated switch at the Hoover tap would sectionalize the line and improve the restoration process, however, all customers on this line will continue to experience a power outage during an event. This option is not advisable as this circuit has ranked in the top ten of MW-Mile (customer outage) exposure. These switches also will not provide the additional relaying event data that the breaker option will provide which helps in determining the cause and location of an outage. This option, although not the lowest cost alternative, is not recommended because it does not achieve all of the objectives of the project.

3. Do Nothing: NPVRR: N/A
   This option is not advisable as this circuit has ranked in the top ten of MW-Mile (customer outage) exposure and the current state of the line puts Transmission at risk of not being able to accomplish SAIDI targets established as part of the Transmission Reliability Plan which assumed the completion of this project.

Project Description

- **Project Scope and Timeline**

Description	Date
Project Initially Approved for preliminary engineering	September, 2016
Materials Ordered	November, 2016
Materials Received	January, 2017
Project Approved for Full Funding	January, 2017
Below Grade Work Begins	February, 2017
Below Grade Work Completed	February, 2017
Above Grade Work Begins	March, 2017
Above Grade Work Completed	March, 2017
Project Complete	April, 2017

- **Project Cost**
  This project was initially opened for $100k to conduct preliminary engineering in an effort to better estimate the total funding needed to complete the project with the understanding that the cost of the full project would be presented for approval once those estimates were completed. The total cost of this project is $967k with $134k in 2016 and $834k in 2017. The 2017 BP included $850k for this project with $100k in 2016 and $750k in 2017. The budgeted amount was estimated based on similar projects that have been previously completed and has been updated based on the preliminary engineering performed. The funding needed above the budgeted amount in 2016 was addressed by the RAC during 2016. The funding needed above the budget in 2017 ($84k) will be funded by a reduction in project #152141 (PBR-Lynch 69kV Brkr Rpl). The estimated total project figure includes a 10% contingency. This contingency is expected to cover uncertainty with the contract labor costs based upon variances that have been noticed on past similar projects.

Economic Analysis and Risks

- **Bid Summary**
  Previously established blanket contract agreements will be utilized for related materials. Bids for any other necessary materials, as well as the below and above grade construction, will be sent out soon after project approval.

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	2016	2017	2018	Post 2018	Total
1. Capital Investment Proposed	134	834	-	-	967
2. Cost of Removal Proposed			-	-	-
3. Total Capital and Removal Proposed (1+2)	134	834	-	-	967
4. Capital Investment 2017 BP	100	750	-	-	850
5. Cost of Removal 2017 BP	-	-	-	-	-
6. Total Capital and Removal 2017 BP (4+5)	100	750	-	-	850
7. Capital Investment variance to BP (4-1)	(34)	(84)	-	-	(117)
8. Cost of Removal variance to BP (5-2)	-	-	-	-	-
9. Total Capital and Removal variance to BP (6-3)	(34)	(84)	-	-	(117)

Financial Detail by Year - O&M ($000s)	2016	2017	2018	Post 2018	Total
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2017 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.5%
Capital Breakdown:	
Labor:	$57k
Contract Labor:	$445k
Materials:	$261k
Other:	$0k
Local Engineering:	$59k
Burdens:	$57k
Contingency:	$88k
Net Capital Expenditure:	$967k

Spend (000's)	Construction	P&C	Telecom	Total
Company Labor	$ 32	$ 20	$ 5	**$ 57**
Contract Labor	$ 320	$ 121	$ 4	**$ 445**
Materials	$ 131	$ 125	$ 5	**$ 261**
Burdens	$ 72	$ 39	$ 5	**$ 116**
Contingency	$ 56	$ 31	$ 2	**$ 88**
Total	**$ 611**	**$ 336**	**$ 21**	**$ 967**

- **Assumptions**
  - Suppliers and contractors will meet reasonable and customary delivery dates for materials and services.
  - The testing and validation for the operation of the new breaker is completed in the time frame scheduled for the project and not delayed due to the availability of resources. Delays could require additional mobilization costs for construction removal and cut-over to the new system.

- Telecommunications will install a new radio communications at the site to provide communication for the new breaker.
- Construction costs are estimated and not based on bid pricing.

- **Environmental**
  This project does not require permitting and there are no known issues regarding air, water, waste, lead, or asbestos.

- **Risks**
  - Completing the project involves risk related to construction work within an operating substation. This project involves installing new underground conduits and reconfiguring the existing system.
  - If the breaker is not added, Transmission will continue to see negative SAIDI impacts associated with this line.

Conclusions and Recommendation

It is recommended that Management approve the Hoover Breaker Addition project for $967k to enhance the reliability of the Transmission system.

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Appendix A

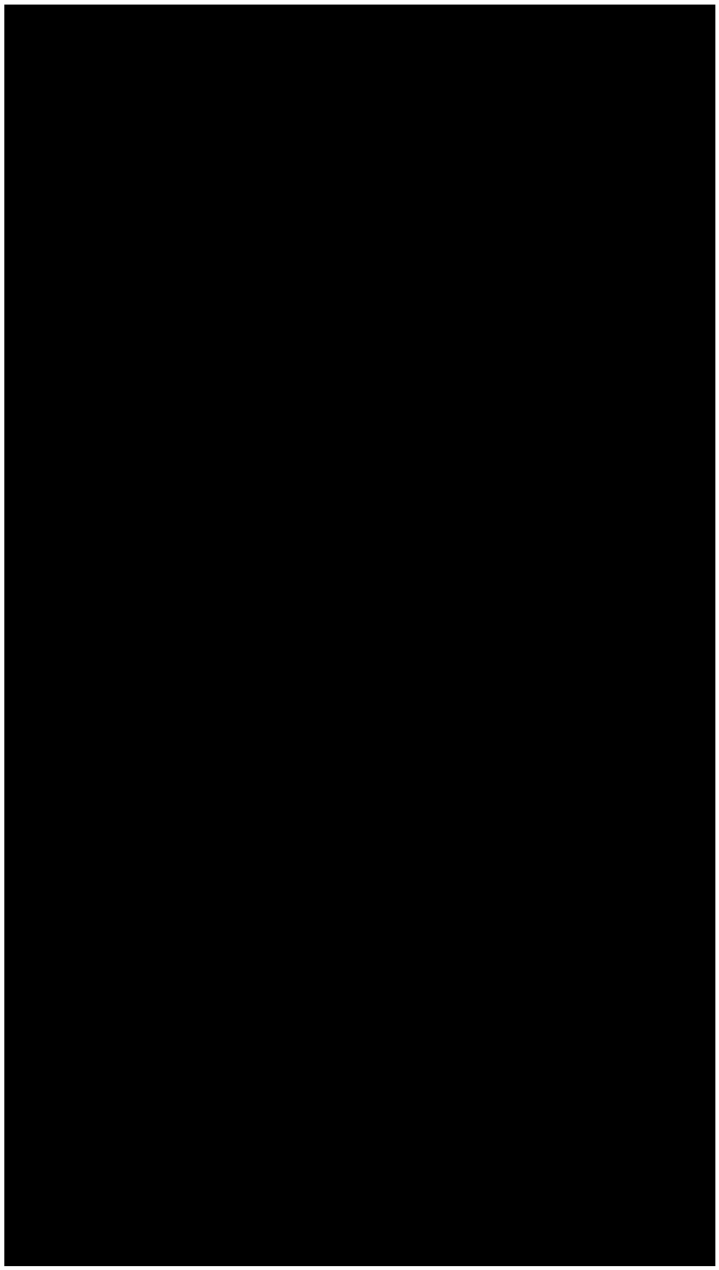


DIAGRAM 1

Capital Investment Proposal

Investment Proposal N/A

Project Name: REL-Earlington 604 Breaker Add

Total Expenditures: $1,245k (Including $113k of Contingency)

Project Number(s): 148371

Business Unit/Line of Business: Transmission Reliability Performance & Standards

Prepared/Presented By: Keith Yocum – Manager Reliability Performance & Standards

Executive Summary

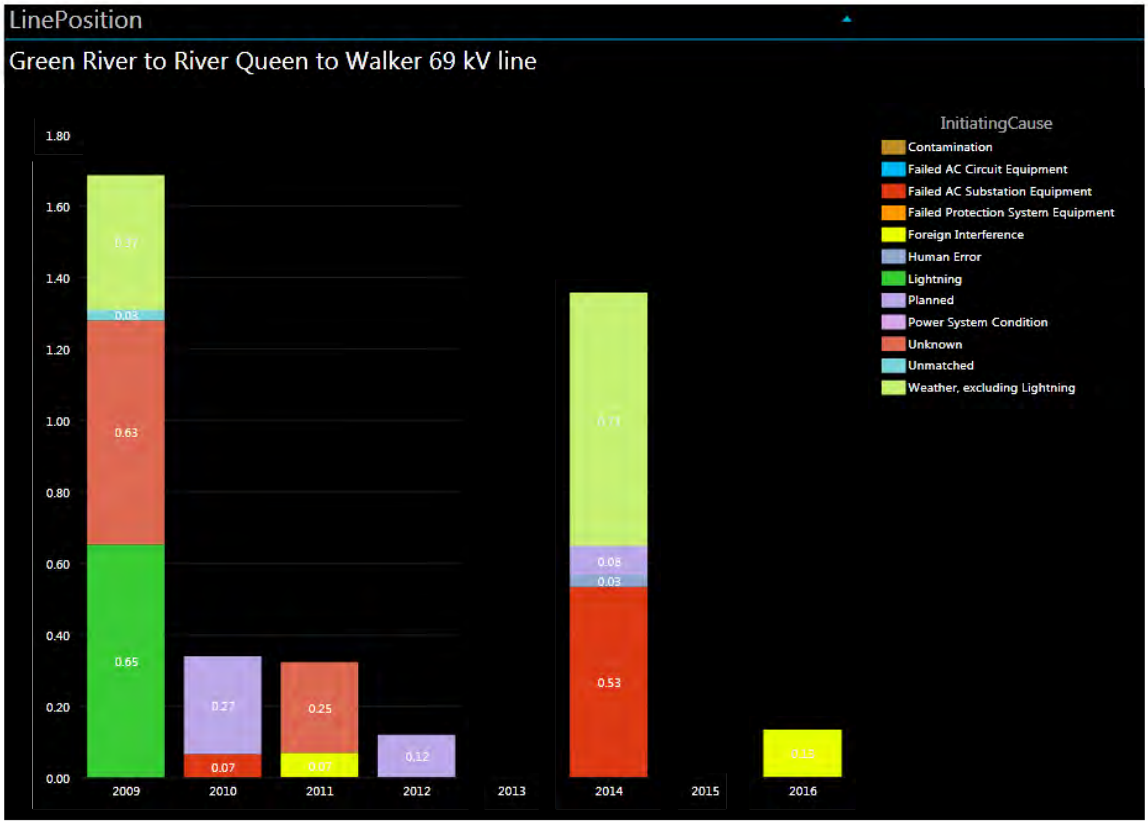
The Transmission Reliability Performance and Standards group identified the need for a breaker at the Earlington Substation to reduce the System Average Interruption Duration Index (SAIDI) and the MegaWatt-Mile (MW-Mile is calculated by multiplying total miles of line exposure times the MWs served from the line) exposure on the Green River to River Queen to Walker 69 kV line. This line has significant MW-Mile exposure and has been a significant SAIDI contributor for Transmission.

The Green River to River Queen to Walker 69 kV line is 32.51 miles long and has 11 distribution transfomers tapped off of it which serve around 3,955 customers and 29.50 MW of load. A fault anywhere along this line will result in an outage on all 11 distribution stations. The placement of a breaker at Earlington will reduce MW-Mile exposure from 959 to 580, a 39.5% reduction, resulting in only 60% as many customers losing power during a given fault. Diagram 1 included in Appendix A depicts the configuration for the Green River to River Queen to Walker 69 kV line.

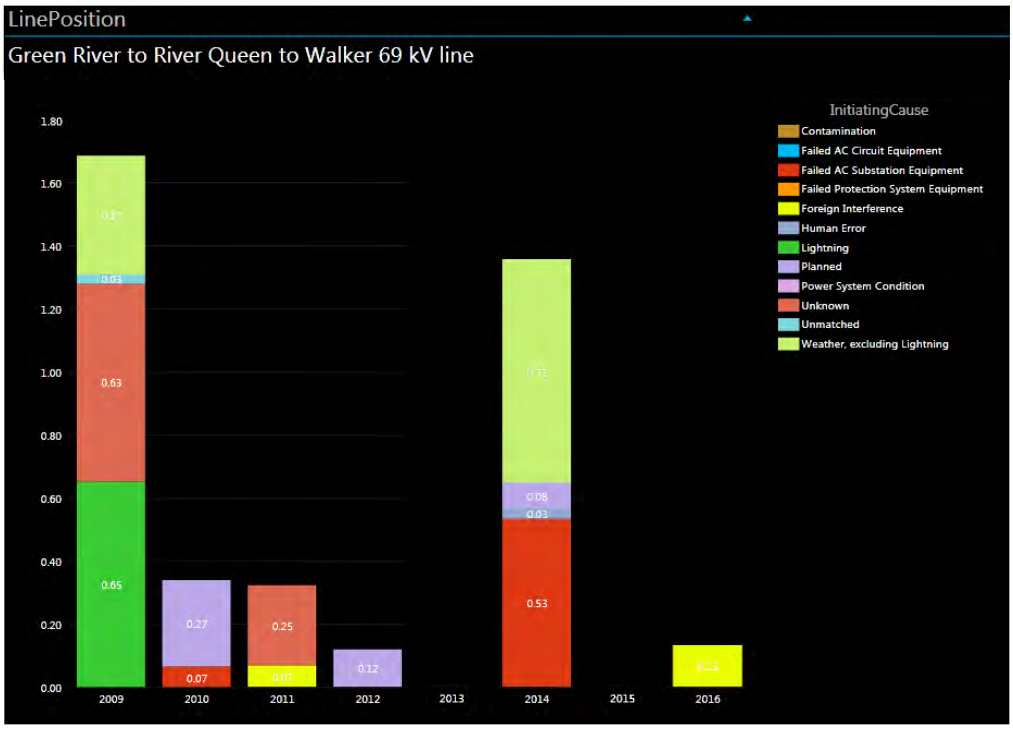
This project was initially opened for $100k to conduct preliminary engineering in an effort to better estimate the total funding needed to complete the project with the understanding that the cost of the full project would be presented for approval once those estimates were completed. The total cost of this project will be $1,245k with $43k in 2016 and $1,202k in 2017. The 2017 BP included $850k for this project with $100k in 2016 and $750k in 2017. The budgeted amount was estimated based on similar projects that have been previously completed and has been updated based on the preliminary engineering performed. The funding needed above the budgeted amount in 2016 was addressed by the RAC during 2016. The funding needed above the budget in 2017 ($451k) was partially funded by the RAC in the 3+9 forecast ($85k) and partially funded by a reduction in project KRTU-17 ($366k). The estimated total project figure includes a 10% contingency. This contingency is expected to cover uncertainty with the contract labor costs based upon variances that have been noticed on past similar projects.

Background
The Green River to River Queen to Walker 69 kV line has been a consistent high contributor to Transmission's SAIDI metric. This breaker will reduce the mileage exposure for all of the customers served by this line as Earlington is located in the approximate middle of the line. Therefore, for a given fault, only 40-60% (depending on which side of the breaker the fault is on) as many customers will go out in the case with the breaker, as compared to the case without the breaker. This will also speed up restoration in that the line requiring patrol will also be reduced.

The chart below shows the historical SAIDI/SAIFI (including MED) for this line:



The following graph shows the number of relay events since 2010 and their associated cause codes.



- **Alternatives Considered**
  1. Recommendation: NPVRR: ($000s) $1,367k
     It is recommended that a breaker be installed on the Green River to River Queen to Walker 69 kV line to limit the exposure of customers on a line that has historically had chronic SAIDI issues. This recommendation assists Transmission in achieving the SAIDI targets established as part of the Transmission Reliability Plan (TRP), as well as reduces the number of customers that would otherwise experience a power outage during an event. In addition, this recommendation provides additional relay data to aid in restoring service quickly that includes information to help determine the cause and location of the event.

2. Alternative #1: NPVRR: ($000s) $615k
   The next best alternative is to add an automated motor operated switch in the steel at Earlington. This switch would sectionalize the line and improve the restoration process, however, all customers on this line will continue to experience a power outage during an event. This option is not advisable as this circuit has ranked in the top ten of MW-Mile (customer outage) exposure. These switches also will not provide the additional relaying event data that the breaker option will provide which helps in determining the cause and location of an outage. This option, although not the lowest cost alternative, is not recommended because it does not achieve all of the objectives of the project.

3. Do Nothing: NPVRR: N/A
   This option is not advisable as this circuit has ranked in the top ten of MW-Mile (customer outage) exposure and the current state of the line puts Transmission at risk of not being able to accomplish SAIDI targets established as part of the Transmission Reliability Plan which assumed the completion of this project.

Project Description

- **Project Scope and Timeline**

Description	Date
Project Initially Approved for preliminary engineering	September, 2016
Materials Ordered	November, 2016
Materials Received	March and July, 2017
Project Approved for Full Funding	April, 2017
Below Grade Work Begins	June, 2017
Below Grade Work Completed	July, 2017
Above Grade Work Begins	August, 2017
Above Grade Work Completed	October, 2017
Project Complete	November, 2017

- **Project Cost**
  This project was initially opened for $100k to conduct preliminary engineering in an effort to better estimate the total funding needed to complete the project with the understanding that the cost of the full project would be presented for approval once those estimates were completed. . The total cost of this project will be $1,245k with $43k in 2016 and $1,202k in 2017. The 2017 BP included $850k for this project with $100k in 2016 and $750k in 2017. The budgeted amount was estimated based on similar projects that have been previously completed and has been updated based on the preliminary engineering performed. The funding needed above the budgeted amount in 2016 was addressed by the RAC during 2016. The funding needed above the budget in 2017 ($451k) was partially funded by the RAC in the 3+9 forecast ($85k) and partially funded by a reduction in project KRTU-17 ($366k). The estimated total project figure includes a 10% contingency. This contingency is expected to cover uncertainty with the contract labor costs based upon variances that have been noticed on past similar projects.

Economic Analysis and Risks

- **Bid Summary**
  Previously established blanket contract agreements will be utilized for related materials. Bids for any other necessary materials, as well as the below and above grade construction, will be sent out soon after project approval.

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	2016	2017	2018	Post 2018	Total
1. Capital Investment Proposed	43	1,190	-	-	1,233
2. Cost of Removal Proposed	-	12	-	-	12
3. Total Capital and Removal Proposed (1+2)	43	1,202	-	-	1,245
4. Capital Investment 2017 BP	100	750	-	-	850
5. Cost of Removal 2017 BP	-	-	-	-	-
6. Total Capital and Removal 2017 BP (4+5)	100	750	-	-	850
7. Capital Investment variance to BP (4-1)	57	(440)	-	-	(383)
8. Cost of Removal variance to BP (5-2)	-	(12)	-	-	(12)
9. Total Capital and Removal variance to BP (6-3)	57	(452)	-	-	(395)

Financial Detail by Year - O&M ($000s)	2016	2017	2018	Post 2018	Total
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2017 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.5%
Capital Breakdown:	
Labor:	$94k
Contract Labor:	$580k
Materials:	$271k
Other:	$0k
Local Engineering:	$67k
Burdens:	$120k
Contingency:	$113k
Net Capital Expenditure:	$1,245k

- **Assumptions**
  - Suppliers and contractors will meet reasonable and customary delivery dates for materials and services.
  - The testing and validation for the operation of the new breaker is completed in the time frame scheduled for the project and not delayed due to the availability of resources. Delays could require additional mobilization costs for construction removal and cut-over to the new system.

- Telecommunications will install fiber communications at the site to provide communication for the new breaker which includes four splice locations.
- Construction costs are estimated and not based on bid pricing.

- **Environmental**
  This project likely does not require permitting and there are no known issues regarding air, water, waste, lead, or asbestos. Mudboat access across wet vegetated area is required and all environmental protection measures will be utitlized as necessary.

- **Risks**
  - Completing the project involves risk related to construction work within an operating substation. This project involves installing new underground conduits and reconfiguring the existing system.
  - If the breaker is not added, Transmission will continue to see negative SAIDI impacts associated with this line.

Conclusions and Recommendation

It is recommended that Management approve the Earlington Breaker Addition project for $1,245k to enhance the reliability of the Transmission system.

CONFIDENTIAL INFORMATION REDACTED

Appendix A

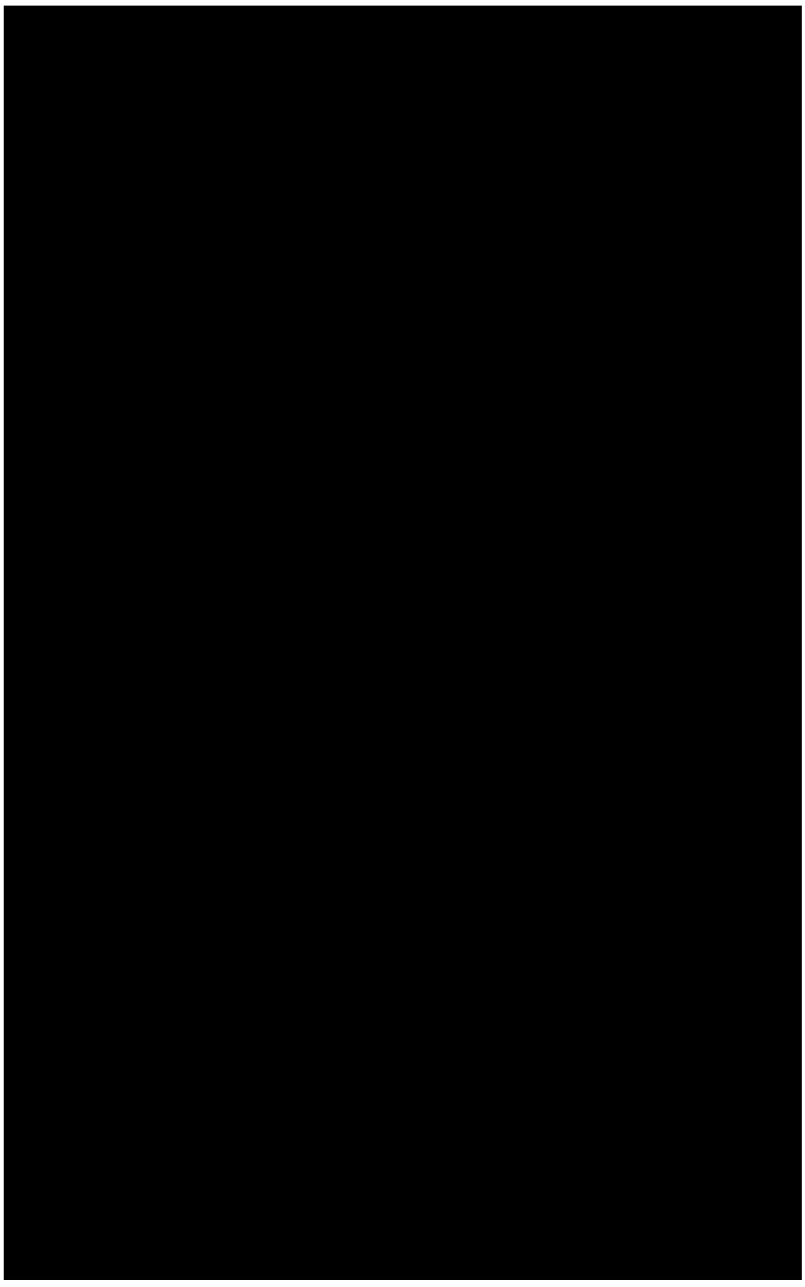


DIAGRAM 1

Investment Proposal Project 148821 Floyd-Seminole Static Replacement

Investment Proposal

Project Name: SR Floyd-Seminole

Total Expenditures: $1,829k
Total Contingency: $167k (10%)

Project Number(s): Transmission Lines - 148821
Distribution Operations - 157696

Business Unit/Line of Business: Transmission Lines/Distribution Operations

Prepared/Presented By: John Doll/Adam Smith

Executive Summary

The proposed project is to replace 1.75 miles of overhead transmission static that is over 49 years old and beyond its expected useful life. Performance of this line has diminished, with the most recent wire failure occurring in 2011 from a failed static. This project will improve reliability, maintain system integrity, and reduce the risk of failures and unplanned transmission interruptions to the University of Louisville, Wilder Park, Bradley, and Louisville Fairground areas.

A Transmission System Improvement Plan was submitted as support in the 2016 Rate Case, outlining programs and projects aimed at reducing the risk of failure, avoiding extended sustained outages, and limiting costly emergency repairs. The programs submitted with the plan were selected to ensure long-term system integrity and modernize the transmission system to avoid degradation of performance over time due to aging infrastructure. Replacement of overhead wires beyond or approaching their expected useful life was included as part of the Transmission System Improvement Plan to replace aging infrastructure.

Transmission Lines plans to replace the 1.75 miles of 69kV static between the Floyd-Seminole substations with optical ground wire (OPGW). In addition, thirty-one (31) wood structures will be replaced with new steel structures. Distribution Operations will transfer distribution equipment along this route from the existing to new transmission structures.

The total project cost is $1,829k ($1,665k Transmission Lines, $164k Distribution Operations). This project was included in the 2018 Business Plan (BP) for $1,500k, with estimated spend of $200k in 2018, and $1,300k in 2019. As the scope, timing, and certainty of work has evolved, the estimates have been further refined. The current total project cost is $1,829k, with estimated spend of $247k in 2018, and $1,582k in 2019. The 2018 spend was approved by the RAC in the 7+5 forecast. The 2019 spend is consistent with the proposed 2019 BP.

Background
The existing 1.75 mile section of 69kV line between Floyd and Seminole contains aging 5/16" copperweld which dates back to 1969 and has experienced diminishing performance in recent years. Furthermore, static failures have occurred in recent years, causing significant damage to the already brittle and aged wire, with the most recent event occurring in 2011.

Due to the condition of this line, there is risk for additional failures that will expose the transmission network to further unscheduled outages. The following picture is representative of the static on sections of this line.

The aging static will be replaced with OPGW. In addition, new steel structures will be installed in place of existing wood structures.

In March of 2018, the transmission project was opened to support preliminary engineering and project scope development. Preliminary engineering included design development, structure design and selection, and the development of the construction plan. The transmission line design was provided to all departments involved for review.

One additional anchor easement will be required along the route at the Seminole substation. This easement will eliminate an intermediate structure, which will allow entry into the face of steel at a more direct angle. The Real Estate and Right of Way department indicates the easement acquisition is feasible and likely. The existing structures are horizontal post construction with porcelain insulators. This configuration will be replaced with steel poles on horizontal post construction with polymer insulators which allows for increased capacity of the structure.

This project also includes a supporting project from Distribution Operations. Distribution Operations plans to transfer distribution equipment from the existing to new transmission structures.

- **Alternatives Considered**
    1. Recommendation: NPVRR: ($000s) $2,152
    The recommendation is to replace 1.75 miles of overhead static with new OPGW. In addition, thirty-one (31) wood structures will be replaced with new steel structures.

2. Alternative #1: Do Nothing NPVRR: ($000s) N/A
   This option is not advisable as this line is nearing the end of its useful life and puts Transmission at risk of not being able to accomplish the objectives established as part of the Transmission System Improvement Plan that was filed as support in the 2016 Rate Case and assumed the completion of this project. These objectives include reducing the risk of failure, avoiding an extended sustained outage, and costly emergency repairs.
3. Alternative #2: Construct Alternate Route NPVRR: ($000s) $3,705
   The Next Best Alternative would be to construct a new 1.2 mile transmission line along Crittenden Drive. Constructing a new route would require the purchase of 1.2 miles of new right of way that customers may not be willing to sell. Selecting a new route for this alternative would likely cause project delays and result in community concerns and opposition over the new route.

Project Description
Floyd-Seminole Static Replacement Facility Map

- **Project Scope and Timeline**
  Transmission Lines Project Description – Project 148821

The Transmission Lines project involves the upgrade of 1.75 miles of existing static wire with OPGW between Floyd and Seminole 69kV line. This project also involves the replacement of thirty-one (31) existing wood structures with new steel structures.

Transmission Lines Project Scope and Timeline

Design Start	March 2018
Design Complete	June 2018
Space reserved for steel pole production with manufacturer	July 2018
Materials Delivered	January 2019
Construction Start	February 2019
Facility In-Service	July 2019
Project Completion	August 2019

Distribution Operations Project Description – Project 157696
Distribution Operations plans to transfer distribution equipment to the new transmission structures. In addition, Distribution Operations plans to replace existing cross-arms, LB switches, transformers and capacitor banks.

Distribution Operations Project Scope and Timeline

Design Start	February 2018
Design Complete	4th Quarter 2018
Materials Ordered	January 2019
Materials Delivered	February 2019
Construction Start	March 2019
Construction Finish	December 2019

- **Project Cost**

	Transmission Lines	Distribution Operations	Total
Total 2018	$247k	$0k	$247k
Total 2019	$1,418k	$164k	$1,582k
Project Total	$1,665k	$164k	$1,829k
Contingency	10%	10%	

Economic Analysis and Risks

- **Bid Summary**

Transmission Lines
Based on detailed engineering, Transmission Lines has estimated the material package for this project to be $215k. The project will utilize OPGW, custom steel structures, standard steel structures, and material. The OPGW will be purchased through AFL. The line construction will be based on continuing contracts with our line contractors. B&B Electric,

Davis H. Elliot, William E. Groves and Pike Electric are the four contractors which have been awarded the T&D Overhead Construction Maintenance contracts.

Distribution Operations:
Distribution Operations line relocation will be performed by company labor (no bids required).

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	2018	2019	2020	Post 2020	Total
1. Capital Investment Proposed	247	1,418	-	-	1,665
2. Cost of Removal Proposed	-	165	-	-	165
3. Total Capital and Removal Proposed (1+2)	247	1,582	-	-	1,829
4. Capital Investment 2018 BP	200	1,300	-	-	1,500
5. Cost of Removal 2018 BP	-	-	-	-	-
6. Total Capital and Removal 2018 BP (4+5)	200	1,300	-	-	1,500
7. Capital Investment variance to BP (4-1)	(47)	(118)	-	-	(164)
8. Cost of Removal variance to BP (5-2)	-	(165)	-	-	(165)
9. Total Capital and Removal variance to BP (6-3)	(47)	(282)	-	-	(329)

Financial Detail by Year - O&M ($000s)	2018	2019	2020	Post 2020	Total
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2018 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Discount Rate: 6.59%
Capital Breakdown:

	148857 Trans Lines	157697 Dist Ops	Total
Labor	$60k	$0k	$60k
Contract Labor	$926k	$109k	$1,035k
Materials	$215k	$25k	$240k
Local Engineering	$234k	$11k	$245k
Burdens	$79k	$4k	$83k
Contingency	$151k	$15k	$166k
Reimbursements	$0	$0	$0
Net Capital Expenditure	$1,665k	$164k	$1,829k

- **Assumptions**
  Recommendation - This assumes that the 1.75 miles of existing static will be replaced with OPGW. An outage must be obtained to complete the project and is scheduled for 2019. This also assumes that all permits will be granted by Louisville Metro Public Works. It is anticipated that no customers will be out of service for the duration of this work.

  Alternative #1 – Do Nothing - This option is not advisable as this line is nearing the end of its useful life and puts Transmission at risk of not being able to accomplish the objectives established as part of the Transmission System Improvement Plan, that was filed as support in the 2016 Rate Case, which assumed the completion of this project. These objectives include reducing the risk of failure, avoiding and extended sustained outage, and costly emergency repairs.

  Alternative #2 – Next Best Alternative – This alternative assumes that a new 1.2 mile transmission line would be constructed. This option would require additional funding due to the need to purchase 1.2 miles of new right of way, in which the property owners may not be willing to sell. The impacts associated with this option would be more disruptive and have a larger negative impact on the community during construction.

- **Environmental**
  There are no known environmental issues regarding air, water, lead, asbestos, etc., associated with this project.

- **Customer Experience**
  A communication plan is being developed in coordination with the project proponents, corporate communications, and external affairs. This plan will be executed to limit the impacts to the community and businesses along the route.

- **Risks**
  - Without the proposed replacement of the existing wire in the Floyd-Seminole 69kV line, the company risks increased exposure to line outages. The wire along the 1.75 miles has deteriorated over time, and is beyond its expected useful life. Unplanned outages are often time-consuming and costly when it comes to repairs.
  - The Louisville Metro Department of Public Works requires permits for lane closures and flagging. The permit application will be submitted prior to construction. Lane closure permits are typically obtained in a timely manner from this agency to support our projects.
  - This project requires an easement acquisition from a private property owner. This easement has been informally agreed upon and is currently being processed for formal execution.
  - The local community may react negatively to the work and potential inconvenience of the project. A communication plan is being developed in coordination with the project proponents, corporate communications, and external affairs. This plan will be executed to limit the impacts to the community and businesses.

Conclusions and Recommendation
It is recommended that Management approve the Floyd-Seminole Static Replacement project for $1,829k to improve reliability of the electric transmission system.

Investment Proposal Project 148823 CR Earlington North-Green River Steel

Investment Proposal for Investment Committee Meeting on: July 31, 2018

Project Name: Earlington North-Green River Steel Conductor Replacement

Total Expenditures: $25,925k
Total Contingency: $2,351k (10%)

Project Number(s): Transmission Lines - 148823
Distribution Operations – 157839

Business Unit/Line of Business: Transmission Lines/Distribution Operations

Prepared/Presented By: Joe Dionisio/Adam Smith

Executive Summary

The proposed project is to replace 35.73 miles of overhead transmission line containing conductor that is over 75 years old and beyond its expected useful life. Performance of this line has diminished, with the most recent failure occurring in 2018 from a failed conductor. Over 1,870 customers with a peak load over 18 MVA are served by the facilities being replaced. Substations directly served by this line include Green River Steel, Rumsey, East Diamond, Earlington, and Earlington North. This project will improve reliability, maintain system integrity, and reduce the risk of failures and unplanned transmission interruptions in the Owensboro, Earlington, and Calhoun areas.

A Transmission System Improvement Plan was submitted as support in the 2016 Rate Case, outlining programs and projects aimed at reducing the risk of failure, avoiding extended sustained outages, and limiting costly emergency repairs. The programs submitted with the plan were selected to ensure long-term system integrity and modernize the transmission system to avoid degradation of performance over time due to aging infrastructure. Replacement of overhead wires beyond or approaching their expected useful life was included as part of the Transmission System Improvement Plan to replace aging infrastructure.

Transmission Lines plans to replace 35.73 miles of 69kV line between the Earlington North and Green River Steel substations. The proposed project utilizes a new design which optimizes the structure placement, removing one hundred seventy-two (172) structures, minimizing our footprint on local farmlands. In addition, reliability of the circuit will be improved by replacing existing wood structures with new steel structures. Finally, the addition of steel towers at critical points will add system resiliency by preventing a future cascading line failure. Distribution Operations will provide the layout work and transfer of underbuilt distribution conductors where needed.

The total project cost is $25,925k ($25,847k Transmission Lines, $78k Distribution Operations). This project was included in the 2018 Business Plan (BP) for $32,000k, including estimated spend of $300k in 2018, $2,260k in 2019, $9,176k in 2020, and $20,264k in years 2021-2023. As the scope, timing and certainty of work has evolved, the estimates have been further refined. The current total project cost is $25,925k, with estimated spend of $2,981k in 2018, $8,502k in 2019, and $14,442k in 2020. 2018 spend was approved by the RAC in the 6+6 forecast. The 2019 and 2020 spend is consistent with the proposed 2019 BP for the Transmission project. The 2019 and 2020 spend for the Distribution project will be identified through the 2019 Forecasting and RAC process.

Background

The existing 35.73 mile sections of 69kV line between Earlington North and Green River Steel contains aging 1F copper conductor, which dates back to 1942 and has experienced diminishing performance in recent years. This aging conductor is obsolete, no longer commonly used in the industry, and is difficult to obtain for needed repairs. Inspections revealed that the existing 1F copper conductor and 3/8" steel static wire showed signs of corrosion and are in fair to poor condition. Similar copper conductors with 75+ years of service life often have sections with broken conductor strands and significant corrosion at the clamps where the conductor attaches to the structure. This line has experienced six (6) conductor failures over the last five years, with the most recent failure occurring in 2018. Along with the conductor failure events, this line has experienced numerous equipment failures over the past five years. The primary cause for these forced outages has been cross arms failures. This circuit ranks 7th for highest number of events and ranks in the top 30 in terms of worst SAIDI performers over the past five years on the LGE-KU transmission system. Due to the conditions of this line, there is a risk of additional failures that will expose the transmission network to further unscheduled outages. The following pictures are representative of the condition of this line.

The picture on the left highlites a broken conductor strand and corrosion, which is representative of the wire condition. The picture on the right shows one of many broken grounding wires, corrosion to the static wire and ridge iron, and general degradation of the wood pole that has occurred over the asset's service life. Left unrepaired these conditions leave the system vulnerable to future unplanned outages.

This aging conductor will be replaced with aluminum conductor steel-reinforced (ACSR) conductor and the deteriorating 3/8" steel static wire will be replaced with optical ground wire (OPGW) and new steel structures will be installed in place of existing wood structures. In

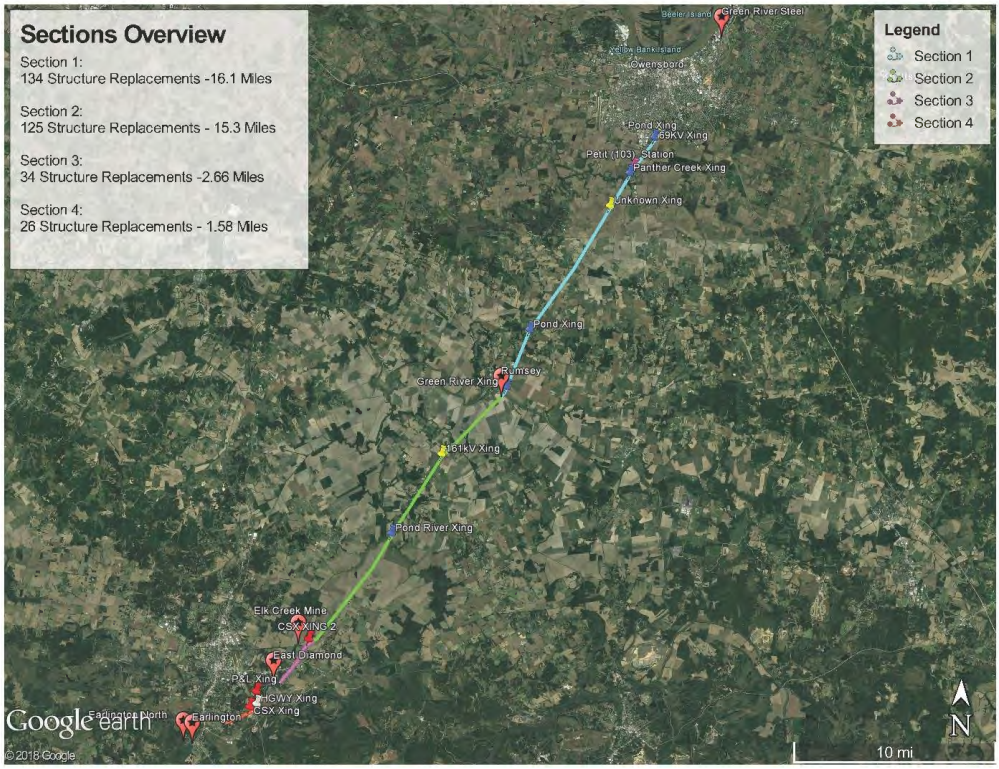
addition to the performance history of this line, a routine inspection of the wood structures on the line was completed in 2017. From this inspection, eighty six (86) structures were found to be in need of replacement, of which seventy-three (73) structures will be addressed as a part of this project. The remaining 13 structures are in different sections of this line that do not have copper conductor targeted for replacement and will be replaced under a separate project.

In May 2018, the transmission project was opened to support preliminary engineering and project scope development. Preliminary engineering included design development, structure design and selection, and development of the construction sequence. This project will upgrade the identified 35.73 miles of 69kV transmission line in three (3) phases. Phase I will upgrade 16.11 miles of 69kV line between Green River Steel and Rumsey substations, replacing two hundred twenty-six (226) existing wood structures with one hundred thirty-one (131) new steel structures, and three (3) new lattice steel towers. Phase II will upgrade 17.94 miles of 69kV line between Rumsey and East Diamond substations, replacing two hundred thirty-six (236) existing wood structures with one hundred fifty-six (156) new steel structures, and three (3) new lattice steel towers. Phase III will upgrade 1.68 miles of 69kV line between East Diamond and Earlington Substations, and will replace twenty-four (24) existing wood structures with twenty-seven (27) new steel structures.

This project also includes a supporting project from Distribution Operations. The Distribution Operations project will provide the layout work and transfer of underbuilt distribution conductors where needed.

- **Alternatives Considered**
  1. Recommendation: NPVRR: ($000s) $29,748
     The recommendation is to replace 35.73 miles containing 1F copper conductor with new ACSR, and the existing 3/8" static wire with new OPGW. In addition, 486 wood structures will be replaced with 314 new steel structures, which includes the installation of six (6) new lattice steel towers.
  2. Alternative #1: Do Nothing NPVRR: ($000s) N/A
     This option is not advisable as this line is nearing the end of its useful life and puts Transmission at risk of not being able to accomplish the objectives established as part of the Transmission System Improvement Plan that was filed as support in the 2016 Rate Case and assumed the completion of this project. These objectives include reducing the risk of failure, avoiding an extended sustained outage, and costly emergency repairs.
  3. Alternative #2 – 1 for 1 Structure Replacement: NPVRR: ($000s) $39,446
     The Next Best Alternative would be to perform a 1 for 1 structure replacement on the entire 35.73 miles. Still replacing the 1F copper conductor with ACSR and the 3/8" static wire with new OPGW. This option would require the replacement of 172 additional structures and would increase the overall project cost.

Project Description
Earlington North-Green River Steel Conductor Replacement Facility Map



- **Project Scope and Timeline**
  Transmission Lines Project Description – Project 148851
  The Transmission Lines project involves the upgrade of 35.73 miles of existing conductor with ACSR and existing static wire with OPGW between the Earlington North, Rumsey, and Green River Steel substations on the Earlington North-Green River Steel 69kV line. This project also involves the replacement of 486 existing wood structures with 314 new steel structures, and the installation of six (6) new steel lattice towers.

  Transmission Lines Project Scope and Timeline

Design Start	October 2017
Design Complete	July 2018
Space reserved for steel pole production with manufacturer	November 2018
Materials Delivered	December 2018
Construction Start	January 2019
Construction Finish	September 2020

Distribution Operations Project Description – Project 157839
The Distribution Operations project will layout and transfer underbuilt distribution conductor, along with the removal and installation distribution framing materials.

Distribution Operations Project Scope and Timeline

Design Start	April 2018
Design Complete	June 2018
Materials Ordered (Section #2)	February 2019
Materials Delivered (Section #2)	July 2019
Materials Ordered (Section #4)	January 2020
Materials Delivered (Section #4)	April 2020
Construction Start	September 2018
Construction Finish	September 2020

- **Project Cost**

	Transmission Lines 148823	Distribution Operations 157839	Total
Total 2018	$2,981k	$0k	$2,981k
Total 2019	$8,472k	$30k	$8,502k
Total 2020	$14,394k	$48k	$14,442k
Total Project	$25,847k	$78k	$25,925k
Contingency	10%	10%	

Economic Analysis and Risks

- **Bid Summary**
  Transmission Lines
  Based on detailed engineering, Transmission Lines has estimated the material package for this project to be $7,446k. The project will utilize OPGW, standard and custom steel structures, and material. The OPGW will be purchased through an existing contract with AFL. The conductor will be competitively bid through normal Supply chain processes. The line construction will be based on continuing contracts with our line contractors. B&B Electric, Davis H. Elliot, William E. Groves and Pike Electric are the four contractors which have been awarded the Transmission Overhead Construction Maintenance contracts.

  Distribution Operations:
  Distribution Operations is working on detailed engineering and has provided a basis for the Distribution lines estimate and design. Bids for materials will be sent out once the detailed engineering has been finalized.

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	2018	2019	2020	Post 2020	Total
1. Capital Investment Proposed	2,981	7,840	10,838	-	21,659
2. Cost of Removal Proposed	-	662	3,604	-	4,266
3. Total Capital and Removal Proposed (1+2)	2,981	8,502	14,442	-	25,925
4. Capital Investment 2018 BP	300	2,260	9,176	20,264	32,000
5. Cost of Removal 2018 BP	-	-	-	-	-
6. Total Capital and Removal 2018 BP (4+5)	300	2,260	9,176	20,264	32,000
7. Capital Investment variance to BP (4-1)	(2,681)	(5,580)	(1,662)	20,264	10,341
8. Cost of Removal variance to BP (5-2)	-	(662)	(3,604)	-	(4,266)
9. Total Capital and Removal variance to BP (6-3)	(2,681)	(6,242)	(5,266)	20,264	6,075

Financial Detail by Year - O&M ($000s)	2018	2019	2020	Post 2020	Total
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2018 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Discount Rate: 6.59%

Capital Breakdown:

	148857 Trans Lines	157389 Dist Ops	Total
Labor	$582k	$0k	$582k
Contract Labor	$12,002k	$54k	$12,056k
Materials	$7,446k	$13k	$7,459k
Other	$5k	$0k	$5k
Local Engineering	$1,658k	$8k	$1,666k
Burdens	$1,803k	$3k	$1,806k
Contingency	$2,351k	$0k	$2,351k
Reimbursements	$0k	$0k	$0k
Net Capital Expenditure	$25,847k	$78k	$25,925k

- **Assumptions**
  Recommendation - This assumes that the 35.73 miles of existing conductor will be replaced with ACSR and the existing static wire will be replaced with OPGW.

  Alternative #1 – Do Nothing - This option is not advisable as this line is nearing the end of its useful life and puts Transmission at risk of not being able to accomplish the objectives established as part of the Transmission System Improvement Plan, that was filed as support

in the 2016 Rate Case, which assumed the completion of this project. These objectives include reducing the risk of failure, avoiding an extended sustained outage, and costly emergency repairs.

Alternative #2 – This alternative assumes that all four hundred eighty-six structures would be replaced on all 35.73 miles of line, the 1F copper conductor would be replaced with ACSR, and the 3/8" static wire with new OPGW. This option would require the replacement of 172 additional structures which would increase the cost of the overall project.

- **Environmental**
  There are no known environmental issues regarding air, water, lead, asbestos, etc., associated with this project. All permitting, including the Army Corps of Engineers, the Kentucky Division of Water, and CSX Railroad are in process.

- **Customer Experience**
  A communication plan is being developed in coordination with the project proponents, corporate communications, and external affairs. This plan will be executed to limit the impacts to the community, businesses, and farmers along the project route.

- **Risks**
  - Without the proposed replacement of existing wire in the Earlington North to Green River Steel 69kV line, the company risks increased exposure to line outages. The wire along the 35.73 mile route has deteriorated and corroded over time, and is beyond its expected useful life. There have been notable failures in the conductor's 75+ year service life. Unplanned outages are often time-consuming and costly when it comes to repairs.
  - A single overhead transmission failure would impact over 1,870 customers, reducing their reliability until the repairs are complete.
  - An Army Corps of Engineers environmental permit is required for the Green River crossing. Through coordination with environmental affairs, this permit application is being processed.
  - A Storm Water Pollution Prevention Plan (SWPPP) is being developed for the Kentucky Division of Water. All required permitting will be obtained prior to construction.
  - The local community and farmers may react negatively to the work and potential inconvenience of the project. A communication plan is being developed in coordination with the project proponents, corporate communications, and external affairs. This plan will be executed to limit the impacts to the community, businesses, and agricultural operations.

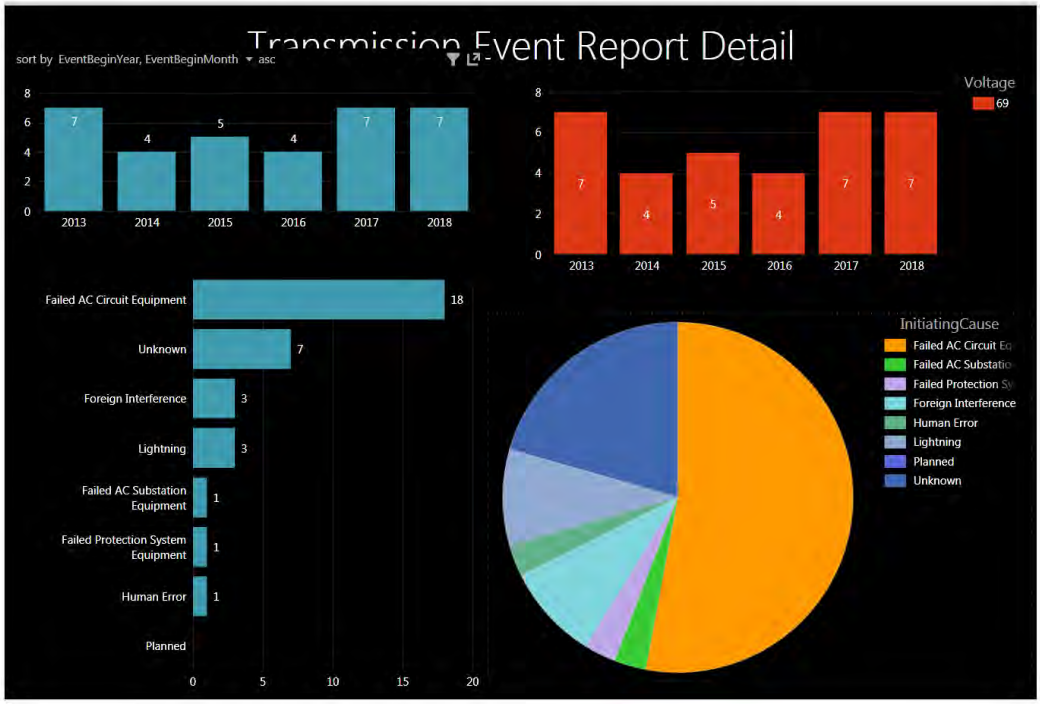
Conclusions and Recommendation
It is recommended that the Investment Committee approve the Earlington North-Green River Steel Conductor replacement project for $25,925k to improve the reliability of the electric transmission system.

Approval Confirmation for Capital Projects Greater Than $2 million:

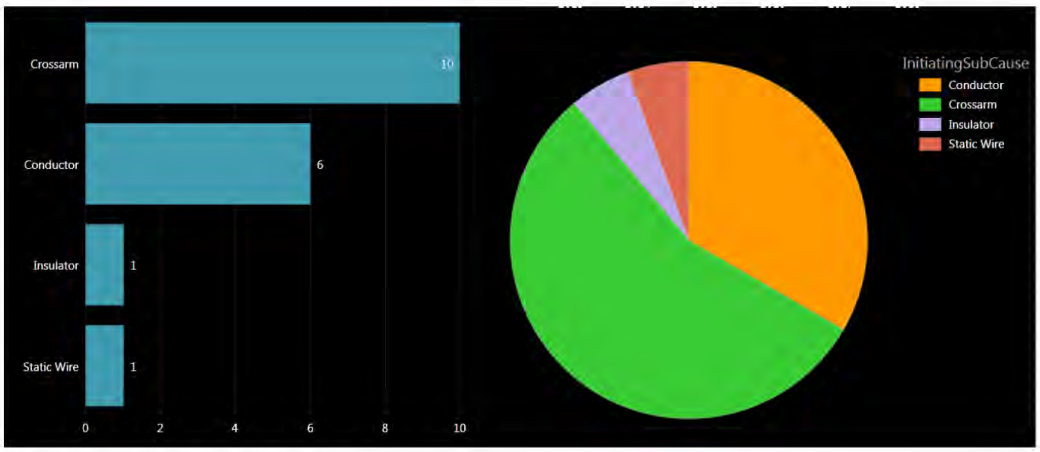
The Capital project spending included in this Investment Proposal has been approved by the members of the LKE Investment Committee. Pursuant to the LKE Authority Limit Matrix, the signatures below are also required for approval of this Capital project spending request.

Kent W. Blake Date	Paul W. Thompson Date
Chief Financial Officer	Chairman, CEO and President

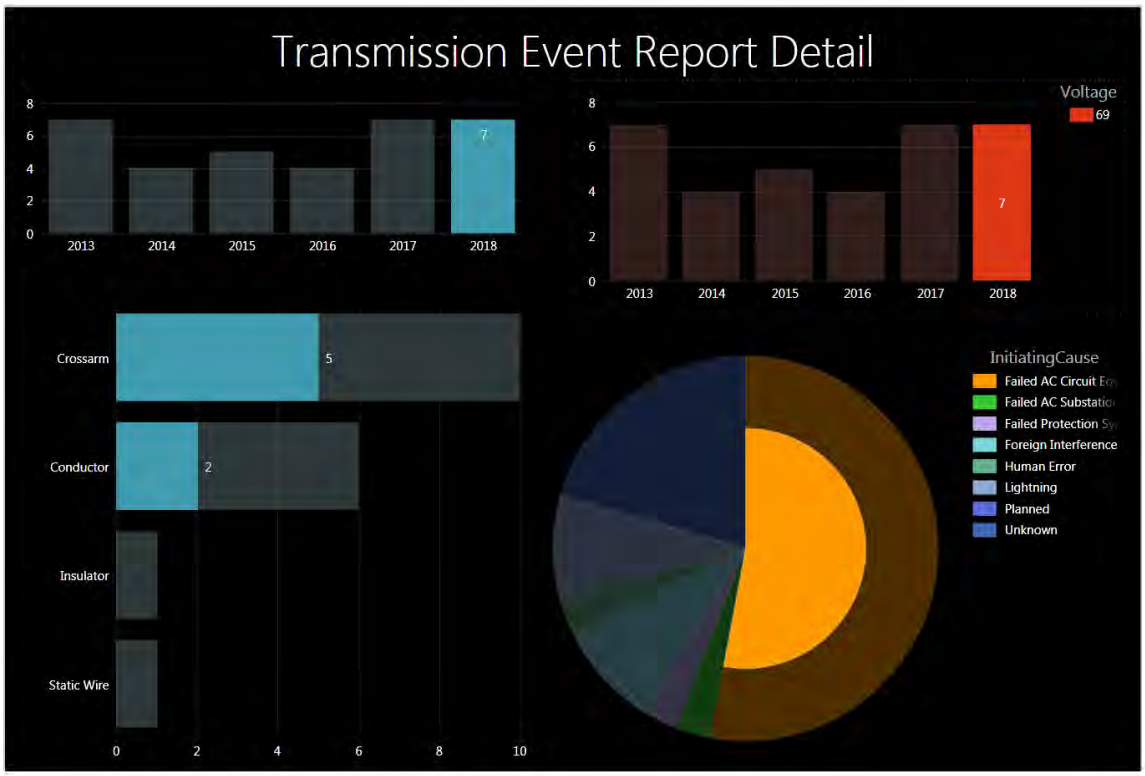
Transmission Reliability Outage Data System (TRODS) 5 Year DATA



TRODS 5 Year DATA of failed AC Circuit Equipment for Earlington North-Green River Steel



TRODS 2018 DATA for Earlington North-Green River Steel



Investment Proposal Project 148851 CR Morganfield-Overland North

Investment Proposal for Investment Committee Meeting on: June 27, 2018

Project Name: Morganfield-Overland North Conductor Replacement

Total Expenditures: $5,337k
Total Contingency: $477k (10%)

Project Number(s): Transmission Lines - 148851
Transmission Substation – 157437

Business Unit/Line of Business: Transmission Lines/Transmission Substation

Prepared/Presented By: Ronnie Bradford/Adam Smith

Executive Summary

The proposed project is to replace 9.1 miles of overhead transmission line containing conductor that is over 90 years old and beyond its expected useful life. Performance of this line has diminished, with the most recent failure occurring in 2016 from a failed conductor. Over 750 customers with a peak load over 30 MVA are served by the facilities being replaced. These customers include Alliance Coal, the City of Uniontown, the Uniontown sewer facility, and the Morganfield water department. This project will improve reliability, maintain system integrity, and reduce the risk of failures and unplanned transmission interruptions to the Morganfield area.

A Transmission System Improvement Plan was submitted as support in the 2016 Rate Case, outlining programs and projects aimed at reducing the risk of failure, avoiding extended sustained outages, and limiting costly emergency repairs. The programs submitted with the plan were selected to ensure long-term system integrity and modernize the transmission system to avoid degradation of performance over time due to aging infrastructure. Replacement of overhead wires beyond or approaching their expected useful life was included as part of the Transmission System Improvement Plan to replace aging infrastructure.

Transmission Lines plans to replace the 9.1 mile section of 69kV line between the Morganfield and Uniontown substations. Transmission Substation plans to remove a breaker from service at the Morganfield substation and modify the relays to ensure protection for the Riverview Coal, Uniontown, and Overland North substations during construction. Telecom also plans to install OPGW (optical ground wire) along the transmission route providing connectivity to the Uniontown substation.

The total project cost is $5,337k ($5,172k Transmission Lines, $165k Transmission Substation). This project was included in the 2018 Business Plan (BP) for $8,500k, including estimated spend of $4,250k in 2018, and $4,250k in 2019. The original scope also included replacement of the 2 mile section of conductor between Uniontown-Overland North. As the

scope, timing and certainty of work has evolved, the estimates have been further refined to only include the 9.1 mile section between Morganfield and Uniontown substations. Distribution Planning is evaluating options to provide distribution service at Overland North in lieu of rebuilding the additional 2 mile section of transmission line between the Uniontown and Overland North substations. This analysis will be utilized to determine the recommended alternative for a future project.

The current total project cost is $5,337k, with actuals of $26k in 2017, estimated spend of $3,514k in 2018, $1,124k in 2019, and $673k in 2020. 2018 spend was approved by the RAC in the 4+8 forecast.

Background
The existing 9.1 mile section of 69kV line between Morganfield and Uniontown contains aging 3/0 conductor which dates back to 1927 and has experienced diminishing performance in recent years. Non-destructive inspections were performed to measure the remaining cross sectional area of steel and to detect the presence of pits and flaws due to corrosion in the steel core wires of ferrous conductors and static wires. These inspections revealed that the existing 3/0 conductor and 3/8" HS static wire showed signs of corrosion and are in fair to poor condition. In addition, there have been recent failures in 2014 and 2016 of the 90+ year old conductor. This line has also experienced lightning arrestor failures and a number of momentary events due to lightning. Over the past five years, this circuit ranks in the top 50 in terms of worst SAIDI performers and is in the top 20 for highest number of events. Due to the conditions of this line, there is a risk of additional failures that will expose the transmission network to further unscheduled outages. The following pictures are representative of the 3/0 conductor condition on sections of this line.

The picture on the left shows broken strands on the existing conductor and signs of corrosion on the steel core. The picture on the right highlights evidence of damage to the existing conductor, and hardware age.

This aging conductor will be replaced with aluminum conductor steel-reinforced (ACSR) conductor (with multiple outer layers of aluminum strands) and the deteriorating 3/8" HS static wire will be replaced with OPGW. There is currently 2.1 miles of the existing line without a static wire which is needed for lightning protection, this project will install OPGW along the entire 9.1 mile route. In addition, new steel structures will be installed in place of existing wood structures and a complete below grade inspection and coating for twenty-five (25) existing steel lattice towers will be completed. A PSC inspection was completed on this line in 2017. From

this inspection, twenty-five (25) structures were found to be in need of replacement. The twenty-five (25) structures found during inspection will be addressed as a part of this project.

In October 2017, the transmission line engineering phase of this project was approved and initiated. The engineering phase consisted of development of a project plan, determination of the preferred line route modifications, structure design and selection, and development of the construction sequence. This project will upgrade the identified 9.1 miles of 69kV transmission line in two phases. Phase I will upgrade 8.0 miles of 69kV line between the Morganfield and Riverview Coal substations in 2018. Forty-nine (49) existing wood structures will be replaced with new steel structures, and a complete below grade inspection and coating on twenty-five (25) lattice steel towers will be performed. Phase II will upgrade 1.1 miles of 69kV line between the Riverview Coal and Uniontown substations in 2019. This phase will replace sixteen (16) existing wood structures with new steel structures.

Alliance Coal has provided KU with a new easement for the section of line deviating from the existing route. This newly acquired easement will provide better access to facilitate future construction and maintenance to this line. In addition, the easement should accommodate the future development plans of Alliance Coal and eliminate the need for additional relocations. All environmental permits associated with this new route have been acquired.

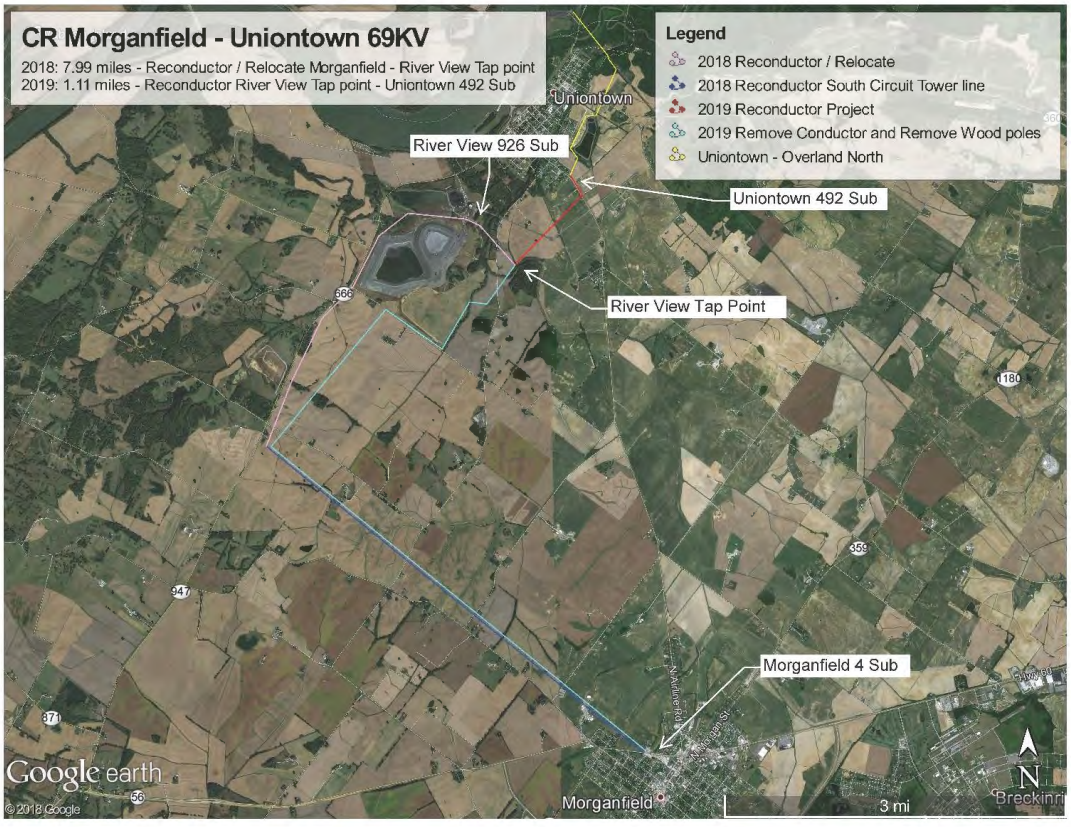
This project also includes a supporting project from Transmission Substation. The Transmission Substation project will involve modifications of Morganfield Substation steel structures to accommodate transmission line reconfiguration and installation of protection and control devices at the relay panels that will provide improved telemetry to Transmission Control Center. Also, Protection & Control will review the current relay settings and adjust them, if necessary, during construction phases.

- **Alternatives Considered**
  1. Recommendation: NPVRR: ($000s) $6,206
     The recommendation is to replace 9.1 miles containing 3/0 conductor with new ACSR, and existing 3/8" static wire with new OPGW. In addition, sixty five (65) wood structures will be replaced with new steel structures, and a thorough ground-line, tower steel corrosion inspection will also be performed on twenty-five (25) lattice steel towers.
  2. Alternative #1: Do Nothing NPVRR: ($000s) N/A
     This option is not advisable as this line is nearing the end of its useful life and puts Transmission at risk of not being able to accomplish the objectives established as part of the Transmission System Improvement Plan that was filed as support in the 2016 Rate Case and assumed the completion of this project. These objectives include reducing the risk of failure, avoiding an extended sustained outage, and costly emergency repairs.
  3. Alternative #2 – Construct Alternate Route: NPVRR: (000s) $8,246
     The Next Best Alternative would be to construct a new 5.3 mile transmission line which would provide an alternate route beginning at the Morganfield 4 Substation,

and would parallel the Morganfield - Green River Plant 161kV line. Constructing a new route would require the purchase of 4.7 miles of new right of way that customers may not be willing to sell. This could cause potential project delays that may result in additional expenses and customer challenges. In addition, an alternate route would not provide Alliance Coal the option to expand future operations. This alternative would also require an additional 1.5 miles of existing 69kV line to the Riverview Tap to be re-built in order to complete the alternate route. The 1.5 miles to the Riverview Tap is located on existing right of way.

Project Description

Recommendation - Morganfield-Overland North Conductor Replacement Facility Map



- **Project Scope and Timeline**

Transmission Lines Project Description – Project 148851
The Transmission Lines project involves the upgrade of 9.1 miles of existing conductor with ACSR and existing static wire with OPGW between the Morganfield-Uniontown section on the Morganfield-Overland North 69kV line. This project also involves the replacement of

sixty-five (65) existing wood structures with new steel structures, and a ground-line tower steel corrosion inspection on twenty-five lattice steel towers.

Transmission Lines Project Scope and Timeline

Design Start	November 2017
Design Complete	January 2018
Space reserved for steel pole production with manufacturer	February 2018
Materials Delivered	August 2018
Construction Start	September 2018
Construction Finish	July 2019
Clean up and Permit Close Out	January 2020

Transmission Substation Project Description – Project 157437
The Transmission Substation project will involve modifications of Morganfield Substation steel structures to accommodate transmission line reconfiguration and installation of protection and control devices at the relay panels that will provide improved telemetry to Transmission Control Center. Also, Protection & Control will review the current relay settings and adjust them, if necessary, during construction phases.

Transmission Substation Project Scope and Timeline

Design Start	July 2018
Design Complete	July 2018
Materials Ordered	July 2018
Materials Delivered	August 2018
Construction Start	September 2018
Construction Finish	April 2019

- **Project Cost**

	Transmission Lines	Transmission Substation	Total
Total 2017	$26k	$0k	$26k
Total 2018	$3,354k	$160k	$3,514k
Total 2019	$1,119k	$5k	$1,124k
Total 2020	$673k	$0k	$673k
Contingency	10%	6%	

Economic Analysis and Risks

- **Bid Summary**
  Transmission Lines

Based on detailed engineering, Transmission Lines has estimated the material package for this project to be $930k. The project will utilize OPGW, standard steel structures, and material. The OPGW will be purchased through an existing contract with AFL. The line construction will be based on continuing contracts with our line contractors. B&B Electric, Davis H. Elliot, William E. Groves and Pike Electric are the four contractors which have been awarded the T&D Overhead Construction Maintenance contracts.

Transmission Substation:
Based on detailed engineering, Transmission Substation has provided a solid basis for the substation estimate and design. Bids for materials, as well as the below grade and above grade construction, will be sent out once the detailed engineering has been finalized.

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	**2017**	**2018**	**2019**	**Post 2019**	**Total**
1. Capital Investment Proposed	26	3,440	997	673	5,136
2. Cost of Removal Proposed	-	74	127	-	201
3. Total Capital and Removal Proposed (1+2)	26	3,514	1,124	673	5,337
4. Capital Investment 2018 BP		4,016	3,899		7,916
5. Cost of Removal 2018 BP		234	351		584
6. Total Capital and Removal 2018 BP (4+5)	-	4,250	4,250	-	8,500
7. Capital Investment variance to BP (4-1)	(26)	576	2,902	(673)	2,779
8. Cost of Removal variance to BP (5-2)	-	160	223	-	383
9. Total Capital and Removal variance to BP (6-3)	(26)	736	3,126	(673)	3,163

Financial Detail by Year - O&M ($000s)	**2018**	**2019**	**2020**	**Post 2020**	**Total**
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2018 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

	148851 Trans Lines	**157437 Trans Substation**	**Total**
Discount Rate:	6.59%	6.59%	6.59%
Capital Breakdown:			
Labor	$167k	$14k	$181k
Contract Labor	$2,861k	$82k	$2,943k
Materials	$930k	$33k	$963k

Other	$79k	$0k	$79k
Local Engineering	$360k	$11k	$371k
Burdens	$307k	$16k	$323k
Contingency	$468k	$9k	$477k
Reimbursements	$0	$0	$0
Net Capital Expenditure	$5,172k	$165k	$5,337k

- **Assumptions**
  Recommendation - This assumes that the 9.1 miles of existing conductor will be replaced with ACSR and the existing static wire will be replaced with OPGW. Temporary transmission line work and a portable substation will be needed to limit service interruptions at the Uniontown substation. Short planned outages to the Riverview Coal substation will be needed to support this project. These outages will be coordinated with the customer to limit impacts.

  Alternative #1 – Do Nothing - This option is not advisable as this line is nearing the end of its useful life and puts Transmission at risk of not being able to accomplish the objectives established as part of the Transmission System Improvement Plan, that was filed as support in the 2016 Rate Case, which assumed the completion of this project. These objectives include reducing the risk of failure, avoiding an extended sustained outage, and costly emergency repairs.

  Alternative #2 – Next Best Alternative – This alternative assumes that a new 5.3 mile transmission line would be constructed, and an additional 1.5 miles would need to be re-built. This option would also require additional funding due to the need to purchase 4.7 miles of new right of way, in which the property owners may not be willing to sell. The impacts associated with this option would be more disruptive and have a larger negative impact on the community during construction. The remaining 2.1 miles is located on existing right of way.

- **Environmental**
  There are no known environmental issues regarding air, water, lead, asbestos, etc., associated with this project. All environmental permitting, including the Army Corps of Engineers, and Department of Environmental Protection have been acquired.

- **Customer Experience**
  A communication plan is being developed in coordination with the project proponents, corporate communications, external affairs, customer experience and major accounts, and the local business office. This plan will be executed to limit the impacts to the community, businesses, and farmers.

- **Risks**
    - Without the proposed replacement of existing wire in the Morganfield-Overland North 69kV line, the company risks increased exposure to line outages. The wire along the 9.1 miles has deteriorated and corroded over time, and is beyond its expected useful life. There have been notable failures in the conductor's 90+ year service life. Unplanned outages are often time-consuming and costly when it comes to repairs.
    - A single overhead transmission failure would impact over 750 customers, with limited options to restore their service until the repairs are complete. This would be especially concerning for many key customers, including Alliance Coal, the City of Uniontown, and the Morganfield water department.
    - The construction sequence for this project has been communicated and coordinated with Alliance Coal to minimize impacts to their operations.
    - Easements have been acquired for Alliance Coal and one private property owner. An additional easement is required from a second private property owner which has been formally agreed upon and is currently being processed for formal execution.
    - An Army Corps of Engineers environmental permit is required for a line segment being constructed near a wetland on Alliance Coal's property. Through coordination with environmental affairs, this permit has been obtained for the proposed plan.
    - The local community and farmers may react negatively to the work and potential inconvenience of the project. A communication plan is being developed in coordination with the project proponents, corporate communications, external affairs, customer experience, major accounts, and the local business office. This plan will be executed to limit the impacts to the community and businesses.
    - To limit customer impacts and maintain service continuity at Uniontown, a temporary transmission line and portable substation will be installed near the existing Uniontown substation. The temporary service will utilize an existing Alliance Coal 69kV line and the metering adjusted to ensure billing integrity is maintained.

Conclusions and Recommendation
It is recommended that the Investment Committee approve the Morganfield-Overland North Conductor replacement project for $5,337k to improve the reliability of the electric transmission system.

Approval Confirmation for Capital Projects Greater Than $2 million:

The Capital project spending included in this Investment Proposal has been approved by the members of the LKE Investment Committee. Pursuant to the LKE Authority Limit Matrix, the signatures below are also required for approval of this Capital project spending request.

Kent W. Blake Date	Paul W. Thompson Date
Chief Financial Officer	Chairman, CEO and President

Investment Proposal Project 148857 Oxmoor Underground Replacement

Investment Proposal for Investment Committee Meeting on: October 26, 2016

Project Name: Oxmoor Underground Replacement

Total Expenditures: $1,681k (2016-$50k) (2017-$1,631k)
Total Contingency: $140k (9%)

Project Number(s): 148857

Business Unit/Line of Business: Transmission Lines

Prepared/Presented By: Chris Wheeldon/Adam Smith

Executive Summary

The proposed project is to replace the underground segment (600 feet) of two (2) 69kV transmission feeds into the Oxmoor substation, Oxmoor-Aiken (circuit 6650), and Oxmoor-Breckenridge (circuit 6653). This project will include a new duct bank underneath Shelbyville Road (US 60), 3,600 feet of underground cable, and two (2) new steel risers to replace the existing wood riser poles.

The total project cost is $1,681k and was included in the 2016 Business Plan for $1,890k in 2019. The original estimate was created with the assumptions that anchor bolt foundation structures would be required to replace the existing wood pole risers. Subsequent to the 2016 Business Plan, a more detailed engineering analysis was completed which resulted in eliminating the need for large foundation structures. This project was accelerated in the 2017 Business Plan for construction in 2016-2017 due to reliability issues with the condition of the existing cable. This project was approved by the RAC in the 9+3 forecast.

Background
The termination for the underground feed on the Oxmoor-Aiken (circuit 6650) 69kV line at the Oxmoor Substation failed in 2015 and damaged a portion of the cable. The original cable was installed in 1975 and has been in service for 41 years. The Oxmoor Substation currently serves 6,304 customers. As part of the commissioning of the cable, High Voltage Maintenance (HVM) was contracted to do acceptance testing for the repair. The cable testing identified concerns with phase C because the resistance results fell outside of the National Electrical Testing Association (NETA) specifications due to corrosion of the shield wire. The termination was installed at a lower height due to the need to remove the damaged portion of cable requiring installation of a temporary barrier to ensure compliance with the National Electric Safety Code (NESC) clearances for personnel safety. In addition, the riser pole for circuit 6650 was identified to be replaced from a recent inspection. The Oxmoor-Breckenridge (circuit 6653) underground segment will be replaced concurrently with the Oxmoor to Aiken underground segment due to the age of existing cable, and its inclusion in the existing duct bank that will be replaced as part of the proposed project.

- **Alternatives Considered**
  1. Recommendation: NPVRR: ($000s) $2,149k
     The recommendation is to replace 600 feet of two (2) underground transmission feeds into the Oxmoor substation during a scheduled outage.
  2. Alternative #1-Do Nothing: NPVRR: ($000s) $2,928k
     This NPVRR for this alternative is based on an estimated termination failure in 2018 and cable failure in 2020. The do nothing alternative is not recommended as the underground conductor is deteriorated, there has been a recent failure, and proactive replacement will avoid in service failures affecting 6,304 customers served from the Oxmoor Substation.
  3. Alternative #2-Next Best Alternative: NPVRR: ($000s) $2,308k
     The next best alternative would be to construct 600 feet of new overhead transmission line, which would require acquisition of easement rights to build overhead. This option would also require full unbalanced terminal structures on the line side of Shelbyville Road, and A-Frames in the substation. The original underground construction was driven at least in part by aesthetics and community acceptance of the substation which is adjacent to the Oxmoor shopping mall. Converting to overhead construction and acquisition of required easements would be opposed by the community and local businesses.

Project Description

- **Project Scope and Timeline**
  The scope of work will consist of the replacement of 1 existing duct bank, six (6) existing cables (three on each circuit), and the replacement of two (2) existing wood riser poles with new steel poles. The construction will be based on continuing contracts from our line contractors. B&B, Elliot, Groves and Pike are the four contractors awarded the T&D Overhead Construction and Maintenance contract from the October 2011 Investment Committee meeting. The contract extension was re-approved by the IC in July of 2014. Preliminary

engineering is scheduled to begin in December of 2016. Construction is scheduled to begin in March of 2017 and be completed in June of 2017.

Construction Milestones	
October 2016	Preliminary Engineering
November 2016	Material Ordered
March 2017	Material Received
March 2017	Construction Begins
June 2017	Construction Completed

A facility map of the Oxmoor-Aiken (circuit 6650) and Oxmoor-Breckenridge (circuit 6653) 69kV lines is shown below:
Line length: Circuit 6650=5.14 miles/Circuit 6653=6.61 miles

- **Project Cost**
  The total project cost is $1,681k, with estimates of $50k in 2016 and $1,631k in 2017. This project is included in the 2016 Business Plan for $1,890k in 2019. Subsequent to the 2016 Business Plan, a more detailed engineering analysis was completed which resulted in eliminating the need for large foundation structures. This project was approved by the RAC in the 9+3 forecast. Historical and existing contract and purchasing agreements were used to

estimate the cost of material and contract labor. This project includes a 9% contingency which is reasonable based on the level of detailed engineering, confidence in the cost of materials and contractors, and potential unknown risks such as weather delays, outage delays, reclamation, and site access.

Economic Analysis and Risks

- **Bid Summary**
  Based on preliminary engineering, Transmission Lines has estimated the material package for construction to be $364k. This project will utilize standard steel structures, and associated hardware and material. The terminators will be purchased through Raychem. The current estimate for the 69kV underground cable is based on historical pricing. Bids for the 69kV underground cable will be sent out shortly after project approval. The underground line construction will be competitively bid. The overhead line construction will be based on continuing contracts with our line contractors. Davis H. Elliot, Pike Electric, B&B Electric and William E. Groves are the four main contractors which have been awarded the T&D Overhead Construction and Maintenance contracts.

Transmission Lines Material Cost Breakdown	
Material	**Cost**
Duct Bank	$15k
Terminators	$15k
Underground Cable	$280k
Steel Poles	$46k
Hardware	$8k
Total	$364k

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	**2016**	**2017**	**2018**	**Post 2018**	**Total**
1. Capital Investment Proposed	50	1,472	-	-	1,522
2. Cost of Removal Proposed	-	159	-	-	159
3. Total Capital and Removal Proposed (1+2)	50	1,631	-	-	1,681
4. Capital Investment 2016 BP	-	-	-	1,743	1,743
5. Cost of Removal 2016 BP	-	-	-	147	147
6. Total Capital and Removal 2016 BP (4+5)	-	-	-	1,890	1,890
7. Capital Investment variance to BP (4-1)	(50)	(1,472)	-	1,743	221
8. Cost of Removal variance to BP (5-2)	-	(159)	-	147	(12)
9. Total Capital and Removal variance to BP (6-3)	(50)	(1,631)	-	1,890	209

Financial Detail by Year - O&M ($000s)	**2016**	**2017**	**2018**	**Post 2018**	**Total**
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2016 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Proposed spending is consistent with the 2017 BP

Financial Summary ($000s):

Discount Rate:	6.49%
Capital Breakdown:	
Labor:	$54k
Contract Labor:	$917k
Materials:	$364k
Local Engineering:	$131k
Burdens:	$75k
Contingency:	$140k
Reimbursements:	($0)
Net Capital Expenditure:	$1,681k

Financial Analysis - Project Summary ($000)	2016	2017	2018	2019	2020	Life of Project
Project Net Income	$0	$55	$82	$78	$74	$1,294
Project ROE	0.0%	6.2%	8.1%	10.0%	10.0%	9.7%

- **Assumptions**
  Recommendation – This alternative assumes that the line outage will be available and that the work will be completed during this timeframe. This alternative also assumes that the Kentucky Transportation Cabinet (KYTC) will approve a traffic control plan which will allow for lane closure during construction.

  Alternative #1-Do Nothing – This alternative assumes a termination failure would occur in year three, and a cable failure would occur in year five. Estimated failure years are based on the initial testing date of 2015.

  Alternative #2 – Next Best Alternative – The cost if this alternative assumes that all required easement rights would be purchased at a reasonable cost without condemnation in order to complete construction of the overhead line.

- **Environmental**
  There are no known environmental issues regarding air, water, lead, asbestos, etc., associated with this project.

- **Risks**
  Without completion of the proposed project, the company risks unplanned outages and increased cost of repairs in emergency situations. Schedule delays may occur if the requested outage is not obtained to complete the scheduled work. Schedule delays may also occur if the KYTC does not approve the recommended traffic control plan.

  The local community and businesses may react negatively to the work and potential inconvenience of the traffic plan. The Customer Experience process will be used to mitigate this risk proactively.

Conclusions and Recommendation
It is recommended that the Investment Committee approve the Oxmoor Underground Replacement project for $1,681k to maintain system integrity, reliability, and to prevent failures and unplanned outages.

Approval Confirmation for Capital Projects Greater Than or Equal to $1 million:

The Capital project spending included in this Investment Proposal has been approved by the members of the LKE Investment Committee. Pursuant to the LKE Authority Limit Matrix, the signatures below are also required for approval of this Capital project spending request.

Kent W. Blake Chief Financial Officer	Victor A. Staffieri Chairman, CEO and President

Investment Proposal

Investment Proposal for Investment Committee Meeting on: N/A

Project Name: Middlesboro (5) 69kV Breaker Replacements

Total Expenditures: $782k (Including $35k of Contingency)

Project Number(s): 150636

Business Unit/Line of Business: Transmission Substation Construction & Maintenance

Prepared/Presented By: Corbin Williams – Electrical Engineer

Executive Summary

The proposed project consists of replacing (5) 69kV oil breakers with new SF6 gas breakers at the Middlesboro substation. The breakers that will be replaced are 602, 614, 624, 634, and 644. Breakers 602 and 644 are the primary breakers of concern and are a concern to mitigating an oil release into navigable water. These breakers are in close proximity to a stream and any failure would cause a release. 614, 624 and 634 are older breakers that lack the spare parts available to continue maintaining this equipment. It is expected that the new breakers will have fewer maintenance issues and increase system reliability due to the fact that they will have a lower likelihood of operating incorrectly.

The total cost of this project will be $782k and was approved by the 2016 1+11 RAC. $0k was included in the 2016 BP for this project. These breakers were flagged with a spill prevention compliance issues after inspections done by a third party engineering firm last year. Transmission had 54 non-compliant sites and Middlesboro was not reviewed until the end of the year, after the BP was prepared. Containing these breakers only created maintenance issues and still left sizable risk of oil releasing into navigable water. Transmission Substation Construction felt a better solution was to replace 602 & 644 with SF6 breakers. It made sense to add the remaining breakers to this project due to their age and operating performance while on site to replace 602 and 604. The estimated total project figure includes a 5% contingency.

Background
Replacement of the 602 and 644 breakers with new SF6 breakers is recommended. The breakers currently in-service are late 1970's vintage McGraw-Edison, type CGR (20kA) and could be used to replace older 1950's vintage breakers in other parts of the system. The remaining three breakers (614, 624, and 634) are vintage 1950's General Electric models that need to be replaced to alleviate issues with ageing parts and to reduce breaker operations and maintenance costs.

- **Alternatives Considered (1 –Recommendation, 2 –Do nothing, 3 –Next Best Alt)**
  Recommendation – It is recommended that (5) 69kV breakers at Middlesboro substation be replaced. This will enhance the reliability of the Transmission system in the area.
  NPVRR: ($000s) $981k

  Do Nothing – Do nothing and accept risk of breaker failures. Emergency replacement can become costly and is inevitable with older breakers such as these. Cost savings can be achieved and greater reliability of the Transmission System can be gained by replacing all five under one project. The CEM assumes a failure every other year beginning in 2016.
  NPVRR: ($000s) $1,377k

  Next Best Alternative – Build secondary containment to mitigate an oil release from the 602 and 644 breakers and refurbish the 614, 624, and 634 breakers by replacing bushings, performing interrupter maintenance, fixing oils leaks and fabricating and replacing mechanized parts to increase the life of this asset by an estimated 10-15 years. This option is not advisable as installing secondary containment would be costly due to existing substation layout and it does not alleviate operational issues these breakers have previously experienced. Any means to contain these breakers would be invasive and impact future response times to maintain or repair these breakers. Additionally, a complete overhaul of the breakers currently in-service is not possible due to obsolete parts for key breaker assemblies.
  NPVRR: ($000s) $1,194k

Project Description

- **Project Scope and Timeline**

Description	Date
Project Approved	March, 2016
Materials Ordered	April, 2016
Materials Received	July, 2016
Below Grade Work Begins	August, 2016
Below Grade Work Completed	September, 2016
Above Grade Work Begins	September, 2016
Above Grade Work Completed	October, 2016
Project Complete	December, 2016

- **Project Cost**

The total cost of this project will be $782k and was approved by the 2016 1+11 RAC. $0k was included in the 2016 BP for this project. The estimated total project figure includes a 5% contingency.

Economic Analysis and Risks

- **Bid Summary**
  The 69kV breakers will be purchased under the existing breaker purchasing agreement. Bids for any other necessary materials as well as the civil, below, and above grade work will be sent out early in March, 2016.

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	2016	2017	2018	Post 2018	Total
1. Capital Investment Proposed	693	-	-	-	693
2. Cost of Removal Proposed	88	-	-	-	88
3. Total Capital and Removal Proposed (1+2)	782	-	-	-	782
4. Capital Investment 2016 BP	-	-	-	-	-
5. Cost of Removal 2016 BP	-	-	-	-	-
6. Total Capital and Removal 2016 BP (4+5)	-	-	-	-	-
7. Capital Investment variance to BP (4-1)	(693)	-	-	-	(693)
8. Cost of Removal variance to BP (5-2)	(88)	-	-	-	(88)
9. Total Capital and Removal variance to BP (6-3)	(782)	-	-	-	(782)

Financial Detail by Year - O&M ($000s)	2016	2017	2018	Post 2018	Total
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2016 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.5%
Capital Breakdown:	
Labor:	$107k
Contract Labor:	$248k
Materials:	$243k
Other:	$0k
Local Engineering:	$60
Burdens:	$89
Contingency:	$35
Reimbursements:	($0k)
Net Capital Expenditure:	$782

Financial Analysis - Project Summary ($000)	2016	2017	2018	2019	2020	Life of Project
Project Net Income	$ 16	$ 24	$ 37	$ 35	$ 33	$ 831
Project ROE	8.0%	6.2%	9.8%	9.8%	9.8%	9.6%

- **Assumptions**
  - Assumes internal project management.
  - Assumes contract labor for construction.
  - Assumes use of LG&E/KU relay techs for commissioning and breaker testing.
  - Assumes no site or geo-technical work required for this project.
  - Below grade is suitable to accommodate standard 69kV breaker foundation.
  - Same contractor will be used for above and below grade work
  - New breakers will be purchased that will match the existing breaker's requirements for CT ratios and accuracies. No changes to relays or relay settings will be required.
  - Special equipment, outages or outage coordination were not needed to remove the existing breaker and install the replacement.
  - Normal work schedule can be used with no expedited construction schedule or overtime required.
  - RTU points available to accommodate new spring discharge points. Otherwise alarms will be parallel.
  - Onsite disposal of excess soil obtained during foundation installation.
  - Rock will not be encountered during installation of the foundations.
  - Doble test connectors will not be installed on the breaker.
  - Breaker testing will be completed by contractor.
  - New AC and DC power feeders for the spring charge motor is required and there is adequate AC and DC power infrastructure to support these changes. It was also assumed that the existing cable trench and conduits leaving the control house has adequate space for the new conductors. It was assume all other existing control cable could be reused up to the new junction box.

- **Environmental**
  This project does not require permitting and there are no known issues regarding air, water, waste, lead, or asbestos.

- **Risks**
  If action is not taken, there will continue to be challenges associated with keeping these breakers in good working order. There is also an increased probability of failure, reduction of system reliability through the occurrence of system outages and possible collateral damage in the event of a catastrophic failure.

Conclusions and Recommendation

It is recommended that the Middlesboro (5) 69kV Breaker Replacements project for $782k be approved to enhance the reliability of the transmission system by removing equipment that can no longer be maintained.

Investment Proposal Project 150646 Livingston-South Paducah Pole Replacement

Investment Proposal for Investment Committee Meeting on: N/A

Project Name: Livingston-South Paducah Pole Replacement

Total Expenditures: $1,091k
Total Contingency: $92k (9%)

Project Number(s): 150646

Business Unit/Line of Business: Transmission Lines

Prepared/Presented By: Nate Mullins/Adam Smith

Executive Summary

The proposed project is to replace twenty-seven (27) wood structures on the Livingston-South Paducah 161kV line based on the results of a routine line inspection. As such, this proposal is to proactively replace them over the course of the next year, prior to failure, to ensure the integrity and reliability of this line and to prevent outages resulting from such failures.

The alternative of replacing poles upon failure will result in much higher long term replacement costs due to mobilization of crews back to the site each time one fails and the probable overtime work involved in replacing each during an emergency situation. This alternative would also have a negative impact on network reliability.

This project is being accelerated to align with the Livingston-South Paducah NRP project (147465). Completing both projects together will allow for resource efficiencies and limit the impacts to property owners. The total project cost is $1,091k and was not included in the 2016 Business Plan, however was approved by the RAC in the 3+9 forecast.

Background
Above ground pole inspections are performed by the company at defined intervals in order to discover problems that may impact the integrity and reliability of the Transmission System. During a routine climbing inspection of the Livingston-South Paducah 161kV line in 2013, twenty-seven (27) structures were identified as priority poles and determined to be in need of replacement in order to ensure the integrity and reliability of this line. There are 160 total structures along this 21.52 mile line. In addition to the 27 structures to be replaced on this project, there will be 20 replaced concurrently on the Livingston-South Paducah NRP project (147465). These structures are located at various points along the entire length of the line.

The transmission industry has been consistent in utilizing standard wood pole equivalent steel structures for many single pole applications. The industry has yet to align on wood pole equivalent steel structures for multi pole structures and typically approaches these as custom/unique design. Based on the quantity of wood H-frames on the transmission system and the anticipated replacement of these structure types, the company developed a library of standard steel H-frames with our alliance partner Trinity-Meyer in 2014. These structures have proved advantageous and to be a good addition to our replacement strategy. Wood was selected for these projects as the design parameters of these structures allows for wood replacements. Specifically, many of these structures identified for replacement were original vintage and there was limited wood pecker issues observed in this area. This project will be able to utilize wood poles from current inventory to avoid lead time issues in materials delivery.

- **Alternatives Considered (1 –Recommendation, 2 –Do nothing, 3 –Next Best Alt)**
    1. Recommendation: NPVRR: ($000s) $1,485k
    The recommendation is to replace 27 wood structures with new wood H-frames during a scheduled outage. Given the average lifespan of wood, these structures would likely need replacement again in 30 years. The NPVRR of replacing now and in 30 years would be $2,132k, however the second replacement in 30 years is not being requested at this time.
    2. Do Nothing: NPVRR: ($000s) $2,138k
    The alternative of do nothing would result in replacing poles upon failure, which would result in a much higher long term replacement cost due to contract crew mobilization and overtime costs. This cost was derived by an estimated percentage of failure over the next four years. The failure rate and costs may vary depending on environmental factors. This option would also have a negative impact on network reliability.
    3. Next Best Alternative(s): NPVRR: ($000s) $1,837k
    The next best alternative would be to replace the poles with steel structures. Although the lifespan of steel is generally three times longer than wood and would eliminate the need for additional wood replacements in 30 years (as noted above, replacing with wood now and in 30 years would have an NPVRR of $2,132k), based on the design of these structures being good candidates for wood replacements, the immediate inventory availability of wood, the synergies to be gained by completing this project concurrently with the Livingston-South Paducah NRP project, and the

opportunity to help manage wood structure inventory levels with this project as we transition more fully to steel, we are recommending wood replacements in this case.

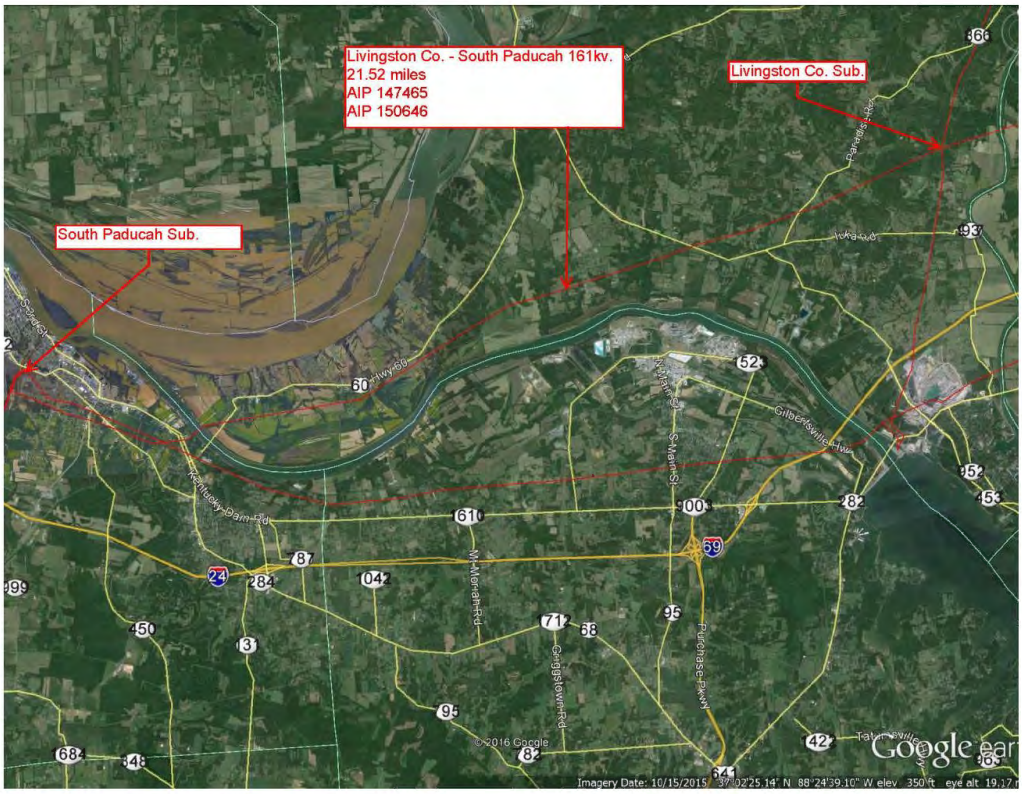
Project Description

- **Project Scope and Timeline**
  The scope of work will consist of installing twenty-seven (27) wood H-frame structures and associated hardware and material, and the removal of 27 wood H-frame structures, and associated hardware and material. The project will utilize standard wood structures and associated hardware. The line construction will be based on continuing contracts from our line contractors. B&B, Elliot, Groves and Pike are the four contractors awarded the T&D Overhead Construction and Maintenance contract from the October 2011 Investment Committee meeting. The contract extension was re-approved by the IC in July of 2014. Construction is scheduled to begin in May of 2016 and be completed in June of 2016.

The construction milestones for this project are provided below:

Construction Milestones	
April 2016	Engineering and Design
May 2016	Line Construction Begins
June 2016	Line Construction Completed

A facility map of the Livingston-South Paducah 161kV line is shown below:
Total line length: 21.52 miles



- **Project Cost**
  The total project cost is $1,091k and is not included in the 2016 Business Plan. Historical and existing contract and purchasing agreements were used to estimate the cost of material and contract labor. This project includes 9% contingency to cover unexpected increases in cost due to weather, rocky soil, outage delays, reclamation, etc. 10% contingency is a standard assumption used across all of our projects and is calculated as a percentage of total burdened costs. The 9% contingency on this project resulted from late estimate changes.

Economic Analysis and Risks

- **Bid Summary**
  Based on preliminary engineering, Transmission Lines has estimated the material packages for construction for this project to be $161k. This project will utilize standard wood structures and associated hardware. The line construction will be based on continuing contracts with our line contractors. Davis H. Elliot, Pike Electric, B&B Electric and William E. Groves are the four main contractors which have been awarded the T&D Overhead Construction and Maintenance contracts.

Transmission Lines Material Cost Breakdown

Material	Cost
Wood Poles	$96k
Hardware	$65k
Total	$161k

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	2016	2017	2018	Post 2018	Total
1. Capital Investment Proposed	863	-	-	-	863
2. Cost of Removal Proposed	228	-	-	-	228
3. Total Capital and Removal Proposed (1+2)	1,091	-	-	-	1,091
4. Capital Investment 2016 BP	-	-	-	-	-
5. Cost of Removal 2016 BP	-	-	-	-	-
6. Total Capital and Removal 2016 BP (4+5)	-	-	-	-	-
7. Capital Investment variance to BP (4-1)	(863)	-	-	-	(863)
8. Cost of Removal variance to BP (5-2)	(228)	-	-	-	(228)
9. Total Capital and Removal variance to BP (6-3)	(1,091)	-	-	-	(1,091)

Financial Detail by Year - O&M ($000s)	2016	2017	2018	Post 2018	Total
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2016 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.49%
Capital Breakdown:	
Labor:	$42k
Contract Labor:	$650k
Materials:	$161k
Local Engineering:	$73k
Burdens:	$73k
Contingency:	$92k
Reimbursements:	($0)
Net Capital Expenditure:	$1,091k

Financial Analysis - Project Summary ($000)	2016	2017	2018	2019	2020	Life of Project
Project Net Income	$63	$54	$51	$49	$46	$1,079
Project ROE	22.3%	9.7%	9.8%	9.8%	9.8%	10.1%

- **Assumptions**

Recommendation – The cost of this alternative assumes that the line outage will be available and the structure replacements will be completed during this timeframe.

Do nothing alternative – The cost of this alternative would be approximately 60% higher due to overtime labor charges and the cost to mobilize and demobilize the construction crews. These poles would fail and require replacement within the next four years.

- Next best alternative – Utilizing steel poles would not allow for this project to be worked concurrently with the Livingston-South Paducah NRP project due to the limited availability and lead time required to obtain the steel structures.

- **Environmental**
  There are no known environmental issues regarding air, water, lead, asbestos, etc., associated with this project.

- **Risks**
  Without the proposed replacement of the priority poles on the Livingston-South Paducah 161kV line, the company risks unplanned outages and increased cost of repairs in emergency situations. Inclement weather which affects site access and working conditions could increase the project cost and cause schedule delays. Schedule delays may also occur if the requested outage is not obtained to complete the scheduled work.

Conclusions and Recommendation
It is recommended that the Livingston-South Paducah pole replacement project be approved in the amount of $1,091k to maintain system integrity, reliability, and to prevent failures and unplanned outages.

Investment Proposal for Investment Committee Meeting on: April 27, 2016

Project Name: Blackwell-Kenton Pole Replacement

Total Expenditures: $3,495k
Total Contingency: $318k (10%)

Project Number(s): 150652

Business Unit/Line of Business: Transmission Lines

Prepared/Presented By: Terry Snow/Adam Smith

Executive Summary

The proposed project is to replace forty-two (42) wood structures on the Blackwell-Kenton 138kV line with steel based on the results of a routine line inspection. As such, this proposal is to proactively replace them over the course of the next year, prior to failure, to ensure the integrity and reliability of this line and to prevent outages resulting from such failures.

The alternative of replacing poles upon failure will result in much higher long term replacement costs due to mobilization of crews back to the site each time one fails and the probable overtime work involved in replacing each during an emergency situation. This alternative would also have a negative impact on network reliability.

This project is being accelerated to align with the Blackwell-Kenton NRP project (146984). Completing both projects together will allow for resource efficiencies and limit the impacts to property owners. The total project cost is $3,495k and was not included in the 2016 BP, however was approved by the RAC in the 3+9 forecast.

Background
Above ground pole inspections are performed by the company at defined intervals in order to discover problems that may impact the integrity and reliability of the Transmission System. During a routine climbing inspection of the Blackwell-Kenton 138kV line in 2014, forty-two (42) structures were identified as priority poles and determined to be in need of replacement in order to ensure the integrity and reliability of this line. There are 290 total structures along this 46.47 mile line. In addition to the (42) structures to be replaced on this project, there will be seven (7) replaced concurrently on the Blackwell-Kenton NRP project (146984). These structures are located at various points along the entire length of the line.

- **Alternatives Considered (1 –Recommendation, 2 –Do nothing, 3 –Next Best Alt)**
  1. Recommendation: NPVRR: ($000s) $4,756k
     The recommendation is to replace the structures energized due to the difficulty in obtaining an extended outage. If the opportunity to complete the project de-energized would occur, we would pursue this option and it would reduce the NPVRR by $1,088k.
  2. Do Nothing: NPVRR: ($000s) $6,847k
     The alternative of do nothing would result in replacing poles upon failure, which would result in a much higher long term replacement cost due to contract crew mobilization and overtime costs. This cost was derived by an estimated percentage of failure over the next four years. The failure rate and costs may vary depending on environmental factors. This option would also have a negative impact on reliability.
  3. Next Best Alternative(s): NPVRR: ($000s) $6,033k
     The next best alternative would be to replace the poles with wood structures. The manufacturer's recommended life span of a wood pole is 30-35 years, whereas steel poles have a recommended life span of 90 years. This option assumes replacement of wood structures in 30 years and an escalation factor of 4% which is in line with market cost increases over the last 15 years.

Project Description

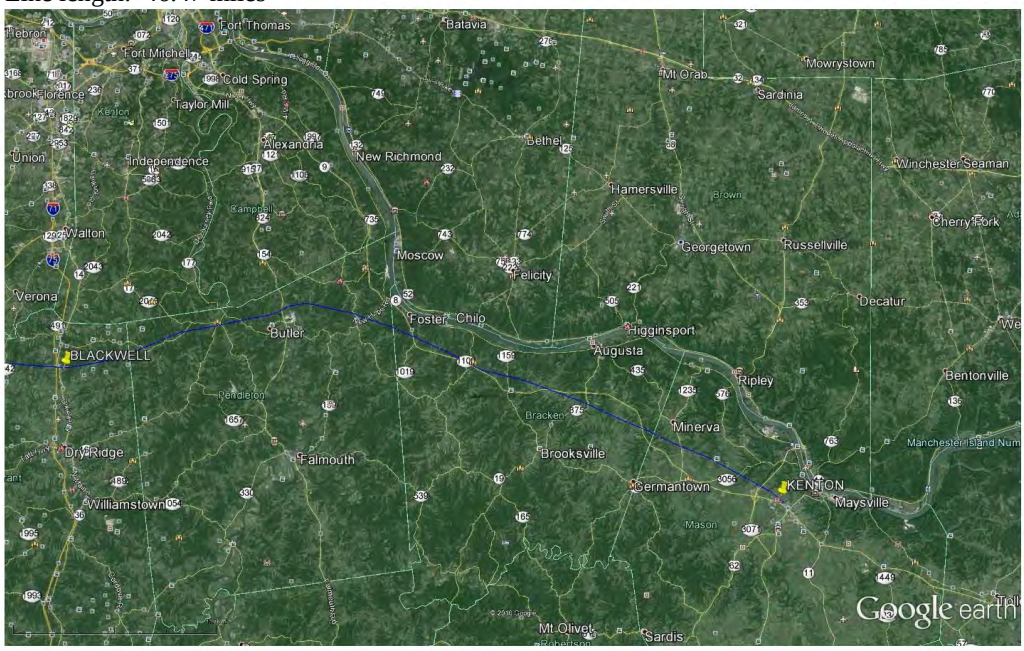
- **Project Scope and Timeline**
  The scope of work will consist of installing thirty-eight (38) standard steel H-frame structures, two (2) 3-pole running corners, one (1) running corner, and one (1) 3-pole dead end with tap and associated hardware and material, and the removal of (42) wood structures and associated hardware and material. The line construction will be based on continuing contracts from our line contractors. B&B, Elliot, Groves and Pike are the four contractors awarded the T&D Overhead Construction and Maintenance contract from the October 2011 Investment Committee meeting. The contract extension was re-approved by the IC in July of 2014. Construction is scheduled to begin in August of 2016 and be completed in November of 2016.

  The construction milestones for this project are provided below:

Construction Milestones	
March 2016	Engineering and Design

April 2016	Steel Poles Ordered
July 2016	Steel Poles Received
August 2016	Line Construction Begins
November 2016	Line Construction Completed

A facility map of the Blackwell-Kenton 138kV line is shown below:
Line length: 46.47 miles



- **Project Cost**
  This project is not included in the 2016 BP, however was approved by the RAC in the 3+9 forecast. Historical and existing contract and purchasing agreements were used to estimate the cost of material and contract labor. This project includes 10% contingency to cover unexpected increases in cost due to weather, rocky soil, outage delays, reclamation, etc. 10% contingency is a standard assumption used across all of our projects and is calculated as a percentage of total burdened costs.

Economic Analysis and Risks

- **Bid Summary**
  Based on preliminary engineering, Transmission Lines has estimated the material packages for construction of this project to be $1,022k. This project will utilize standard and custom steel structures. Hardware will be purchased through Brownstown Electrical Supply. The line construction will be based on continuing contracts with our line contractors. Davis H.

Elliot, Pike Electric, B&B Electric and William E. Groves are the four main contractors which have been awarded the T&D Overhead Construction and Maintenance contracts.

Transmission Lines Material Cost Breakdown	
Material	**Cost**
Steel Poles	$858k
Hardware	$164k
Total	$1,022k

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	**2016**	**2017**	**2018**	**Post 2018**	**Total**
1. Capital Investment Proposed	3,025	-	-	-	3,025
2. Cost of Removal Proposed	470	-	-	-	470
3. Total Capital and Removal Proposed (1+2)	3,495	-	-	-	3,495
4. Capital Investment 2016 BP	-	-	-	-	-
5. Cost of Removal 2016 BP	-	-	-	-	-
6. Total Capital and Removal 2016 BP (4+5)	-	-	-	-	-
7. Capital Investment variance to BP (4-1)	(3,025)	-	-	-	(3,025)
8. Cost of Removal variance to BP (5-2)	(470)	-	-	-	(470)
9. Total Capital and Removal variance to BP (6-3)	(3,495)	-	-	-	(3,495)

Financial Detail by Year - O&M ($000s)	**2016**	**2017**	**2018**	**Post 2018**	**Total**
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2016 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.49%
Capital Breakdown:	
Labor:	$141k
Contract Labor:	$1,601k
Materials:	$1,022k
Local Engineering:	$236k
Burdens:	$177k
Contingency:	$318k
Reimbursements:	($0)
Net Capital Expenditure:	$3,495k

Financial Analysis - Project Summary ($000)	2016	2017	2018	2019	2020	Life of Project
Project Net Income	$16	$79	$163	$155	$148	$3,179
Project ROE	1.8%	4.5%	9.8%	9.8%	9.8%	9.3%

- **Assumptions**

  Recommendation – The cost of this alternative assumes that the line outage will not be available and the structure replacements will need to be completed with the 138kV line energized.

  Do nothing alternative – The cost of this alternative would be approximately 60% higher due to overtime labor charges and the cost to mobilize and demobilize the construction crews. These poles would fail and require replacement within the next four years.

  Next best alternative - The cost of this alternative assumes the cost of the wood poles is 49% of the cost of the steel poles, and that the wood poles would be replaced again in 30 years.

- **Environmental**
  There are no known environmental issues regarding air, water, lead, asbestos, etc., associated with this project.

- **Risks**
  Without the proposed replacement of the priority poles on the Blackwell-Kenton 138kV line, the company risks unplanned outages and increased cost of repairs in emergency situations. Inclement weather which affects site access and working conditions could increase the project cost and cause schedule delays. Schedule delays may also occur if the requested outage is not obtained to complete the scheduled work.

Conclusions and Recommendation
It is recommended that the Investment Committee approve the Blackwell-Kenton Pole Replacement project for $3,495k to maintain system integrity, reliability, and to prevent failures and unplanned outages.

Investment Proposal for Investment Committee Meeting on: March 30, 2016

Project Name: Pocket-Pennington Gap Pole Replacement

Total Expenditures: $1,572k
Total Contingency: $ 143k (10%)

Project Number(s): 150687

Business Unit/Line of Business: Transmission Lines

Prepared/Presented By: Nick Poston/Adam Smith

Executive Summary
The proposed project is to replace seven (7) wood structures on the Pocket-Pennington Gap 69kV line with steel based on the results of a routine line inspection. As such, this proposal is to proactively replace them over the course of the next year, prior to failure, to ensure the integrity and reliability of this line and to prevent outages resulting from such failures.

The alternative of replacing poles upon failure will result in much higher long term replacement costs due to mobilization of crews back to the site each time one fails and the probable overtime work involved in replacing each during an emergency situation. This alternative would also have a negative impact on network reliability.

The initial estimate to complete this work was less than $500k, so a portion of the work was charged to a task under the Priority Pole Replacement blanket (project K9-2013) in accordance with the Capital Policy. As inspections began, limited accessability to the structures and extremely rough terrain required additional project planning. Because of this limited access, a helicopter will now be used to facilitate the installation of the conductor. Replacement of these poles will require a section of this tap to be constructed parallel to the existing line, while the existing line remains energized. Once the new line is constructed, the load will be transferred from the existing line to the new line and the existing original line will be removed. There are no alternate means for distribution to maintain power to the affected customers. An extended transmission outage is not feasible to complete this work. Approximately 2,200 customers are serviced from this line. Due to this scope change, the total cost of the project will exceed $500k. The proposed project is being submitted in order to move the existing costs from the Priority Pole Replacement blanket (project K9-2013) and to facilitate completion of the project.

The total project cost is $1,572k of which $559k was spent previously under the K9-2013 Pole Replacement blanket before terrain issues were discovered and will be moved to this project once approved. This project was not included in the 2016 Business Plan, however was approved by the RAC in the 2+10 forecast.

Background
Above ground pole inspections are performed by the company at defined intervals in order to discover problems that may impact the integrity and reliability of the Transmission System. During a routine climbing inspection of the Pocket-Pennington Gap 69kV line, six (6) structures were identified as priority poles and determined to be in need of replacement in order to ensure the integrity and reliability of this line. There are 23 total structures along this 1.71 mile line.

Work began during December 2013 with company labor and tree clearing. Tree clearing continued into 2014, steel structures and other material was purchased, and contract labor to survey, move material and equipment, to inspect site conditions and to construct access roads began. During 2015, additional survey work was performed and construction of access work was completed. During January 2016, additional materials were purchased and contract labor to move material and equipment continued. To date, approximately $559k has been spent, which includes $151k for material, $45k for preliminary survey, $30k for tree clearing, $200k to move material and equipment, $2k for employee vehicle and meal expense, and $131k to construct access roads. The additional cost to complete the the project includes the remaining cost of construction, which includes energized pricing as well as facilitaton by helicopter to install the conductor. Once this project is approved, that spending will be transferred to this project.

- **Alternatives Considered (1 –Recommendation, 2 –Do nothing, 3 –Next Best Alt)**
  1. Recommendation: NPVRR: ($000s) $2,139k
     The recommendation is to replace the six wood H-frames and one wood running corner with steel structures parallel to the existing line and to remove the existing line.
  2. Do Nothing: NPVRR: ($000s) $3,079k
     The alternative of do nothing would result in replacing poles upon failure, which would result in a much higher long term replacement cost due to contract crew mobilization and overtime costs. This cost was derived by an estimated percentage of failure over the next four years. The failure rate and costs may vary depending on environmental factors. This option would also have a negative impact on network reliability.
  3. Next Best Alternative(s): NPVRR: ($000s) $5,239k
     The next best alternative would be to construct a permanent new line from Pocket to Pennington Gap.

Project Description

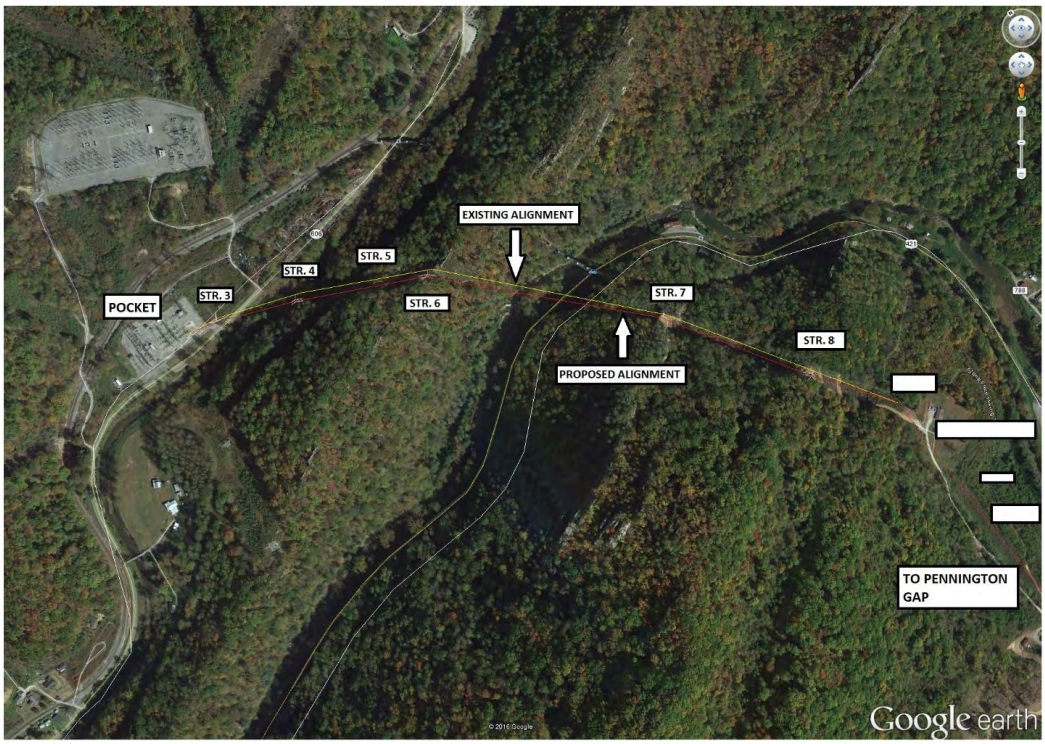
- **Project Scope and Timeline**
  The scope of the work will consist of installing six (6) standard steel H-frames and one (1) single steel structure, and associated hardware and material, as well as the removal of 7 wood structures and associated hardware and material. The line construction will be based on continuing contracts from our line contractors. B&B, Elliot, Groves, and Pike are the four contractors awarded the T&D Overhead Construction and Maintenance contract from the October 2011 Investment Committee meeting. The contract extension was re-approved by the

IC in July of 2014. Construction is scheduled to begin in April of 2016 and to be completed in May of 2016.

The construction milestones for this project are provided below:

Construction Milestones	
January 2016	Engineering and Design
April 2016	Line Construction Begins
May 2016	Line Construction Completed

A facility map of the Pocket-Pennington Gap 69kV line is shown below:
Line length: 1.71 miles



- **Project Cost**
  The total project cost of $1,572k was not included in the 2016 Business Plan but has been approved by the RAC in the 2+10 Forecast. Historical and existing contract and purchasing agreements were used to estimate the cost of the material and contract labor.

Economic Analysis and Risks

- **Bid Summary**
  Based on preliminary engineering, Transmission Lines has estimated the material package for construction of this project to be $160k. Approximately $125K was spent on K9-2013 for the replacement structures and hardware. An additional $35k will be spent on material for the new line. This project will utilize standard steel structures and associated hardware and material. The line construction will be based on continuing contracts with our line contractors. Davis H. Elliot, Pike Electric, B&B Electric, and William E. Groves are the four main contractors which have been awarded the T&D Overhead Construction and Maintenance contracts.

Transmission Lines Material Cost Breakdown	
Material	**Cost**
Steel Poles	$118k
Hardware	$42k
Total	$160k

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	**2016**	**2017**	**2018**	**Post 2018**	**Total**
1. Capital Investment Proposed	1,251	-	-	-	1,251
2. Cost of Removal Proposed	321	-	-	-	321
3. Total Capital and Removal Proposed (1+2)	1,572	-	-	-	1,572
4. Capital Investment 2016 BP	-	-	-	-	-
5. Cost of Removal 2016 BP	-	-	-	-	-
6. Total Capital and Removal 2016 BP (4+5)	-	-	-	-	-
7. Capital Investment variance to BP (4-1)	(1,251)	-	-	-	(1,251)
8. Cost of Removal variance to BP (5-2)	(321)	-	-	-	(321)
9. Total Capital and Removal variance to BP (6-3)	(1,572)	-	-	-	(1,572)

Financial Detail by Year - O&M ($000s)	**2016**	**2017**	**2018**	**Post 2018**	**Total**
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2016 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.49%
Capital Breakdown:	
Labor:	$16k
Contract Labor:	$1,085k
Materials:	$160k
Local Engineering:	$124k
Burdens:	$44k
Contingency:	$143k
Reimbursements:	($0)
Net Capital Expenditure:	$1,572k

Financial Analysis - Project Summary ($000)	2016	2017	2018	2019	2020	Life of Project
Project Net Income	$90	$77	$73	$70	$67	$1,555
Project ROE	22.3%	9.7%	9.8%	9.8%	9.8%	10.1%

- **Assumptions**

  Recommendation – This alternative assumes that all required permits will be received in order to complete construction.

  Do Nothing Alternative – The cost of this alternative would be approximately 60% higher due to overtime labor charges and the cost to mobilize and demobilize the construction crews. These poles would fail and require replacement within the next four years.

  Next Best Alternative – The cost of this alternative assumes that construction of a new line parallel to the existing Pocket-Pennington Gap 69kV line will be completed. This alternative also assumes that all required permits will be received in order to complete construction.

- **Environmental**
  There are no known environmental issues regarding air, water, lead, asbestos, etc., associated with this project.

- **Risks**
  Without the proposed replacement of the priority poles on the Pocket-Pennington Gap 69kV line, the company risks unplanned outages and increased cost of repairs in emergency situations. In the event repairs would have to be made in an emergency situation, limited accessibility to the site combined with the rough terrain would result in extended unplanned outages. Inclement weather which affects site access and working conditions could increase project costs and cause schedule delays. Schedule delays may also occur if the requested outage and permits are not obtained to complete the scheduled work.

Conclusions and Recommendation
It is recommended that the Investment Committee approve the Pocket-Pennington Gap pole replacement project for $1,572k to maintain system integrity, reliability, and to prevent failures and unplanned outages.

Investment Proposal

Investment Proposal for Investment Committee Meeting on: June 29, 2016

Project Name: Pineville Transmission 932 & 952 Breaker Replacements

Total Expenditures: $1,260k ($52k of Contingency)

Project Number(s): 150772

Business Unit/Line of Business: Transmission Substation Construction

Prepared/Presented By: Chris Talley – Manager Transmission Substation Construction

Executive Summary

The scope of this project includes the replacement of the Pineville 192-932 and 192-952 345kV circuit breakers. These breakers present challenges with ongoing maintenance due to a lack of available spare parts and field expertise to make the repairs. In addition, they have a history of leaking excessive amounts of Sulfur Hexaflouide (SF6) gas.

The total cost of this project will be $1,260k and was approved in the 2016 5+7 RAC Approved forecast. Funding for this project was included in the 2016 BP under the project KBR-18. Concerns with maintaining the reliable operation of the 345kV system prompted the need to replace these breakers in 2016. The estimated total project figure includes a 5% contingency. This contingency is expected to cover uncertainty with the contract labor costs based upon variances that have been noticed on past similar projects.

Background

LG&E/KU has seven vintage 1973-1982 dead tank, two pressure ITE type GA breakers in service. They employ complicated operating systems with two pressures blast valve systems for arc extinguishing, multi-breaker contacts, pre-insertion resistors and grading capacitors across the contacts which predisposes these types of breakers to many failure modes. These types of breakers hold up to 1,800 lbs. of gas compared to new style puffer breakers with around 340 lbs. and have infinitely more places to leak. These breakers have the highest gas leakage rates in our system. Since 2010 the combined leak total of these seven breakers averages 1,088.6 pounds per year; the combined total of all remaining gas in our 107 newer style puffer breakers is 451.8 pounds per year. There are no current environmental regulatory implications related to these gas leaks, however there are higher maintenance costs associated with refilling the breakers with new gas.

These breakers ceased being manufactured in the late 1980's and are only marginally supported by the manufacturer at this point. There have been a combined 295 corrective maintenance orders since 2005. Parts for these breakers generally have to be made by third party machine shops. These two breakers were targeted for replacement based upon their maintenance history and SF6 leak rates. The remaining five breakers will be targeted for replacement prior to 2020.

Alternatives Considered:

(1 –Recommendation, 2 – Next Best Alternative, 3 – Do Nothing)

Recommendation – It is recommended to replace the 192-932 and 192-952 circuit breakers at Pineville Transmission. Parts from the breakers that are retired will be used to support other similar breakers that are still in service on the system.
NPVRR: ($000s) $1,581k

Next Best Alternative(s) – Replace one Pineville Transmission breaker at this time and replacing the other breaker in 2017. This would result in continued SF6 leakage from the delayed breaker. It is a more cost effective contracting strategy to coordinate the replacement of both breakers under the same scope of work. NPVRR: ($000s) $1,603k

Do Nothing – This option is not advisable as the breakers currently in-service at Pineville Transmission have a history of maintenance issues and the parts necessary to alleviate these issues are no longer available. These breakers are also leaking SF6 gas, which requires additional maintenance activities as well. The reduction in the number of similar breakers that are still in service makes it challenging to procure the expertise (internal or external) to maintain these assets.. These breakers historically have had high leak rates. SF6 released to the atsmosphere is currently being monitored by the EPA, but there are no compliance risks as of today.

It is assumed one breaker will fail within five years and both will fail within a ten year period. A failure could result from a defective a component within the breaker that cannot be replaced due to spare part availability. The current ongoing maintenance costs of the breakers in-service is approximately $3,500 a year. The new breakers will have an estimated $500 a year in maintenance costs. If one of these breakers fails at certain time of year, more serious consequences could occur within the system, including the loss of customers.
NPVRR: ($000s) $1,188k plus risk of potential loss of customers for undetermined period

Project Description

- **Project Scope and Timeline**

Description	Date
Project Approved	June, 2016
Materials Ordered	June, 2016
Materials Received	September, 2016
Below Grade Work Begins	August, 2016
Below Grade Work Completed	September, 2016
Above Grade Work Begins	October, 2016
Above Grade Work Completed	November, 2016
Project Complete	December, 2016

- **Project Cost**
  The total cost of this project will be $1,260k and was approved in the 2016 5+7 RAC Approved forecast. Project KBR-18 was included in the 2016 BP as a placeholder for breaker replacements and budgeted at $1,700k. The original estimate to complete this project was $950k and would have been funded by moving dollars out of the blanket project (KBR-18). The estimated total project figure includes a 5% contingency. This contingency is expected to cover uncertainty with the contract labor costs based upon variances that have been noticed on past similar projects.

Economic Analysis and Risks

- **Bid Summary**
  The 345kV breakers will be purchased under the existing breaker purchasing agreement. Bids for any other necessary materials, as well as the below and above grade construction, will be sent out late summer of 2016.

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	2016	2017	2018	Post 2018	Total
1. Capital Investment Proposed	1,247	-	-	-	1,247
2. Cost of Removal Proposed	13	-	-	-	13
3. Total Capital and Removal Proposed (1+2)	1,260	-	-	-	1,260
4. Capital Investment 2016 BP	1,700	-	-	-	1,700
5. Cost of Removal 2016 BP	-	-	-	-	-
6. Total Capital and Removal 2016 BP (4+5)	1,700	-	-	-	1,700
7. Capital Investment variance to BP (4-1)	453	-	-	-	453
8. Cost of Removal variance to BP (5-2)	(13)	-	-	-	(13)
9. Total Capital and Removal variance to BP (6-3)	440	-	-	-	440

Financial Detail by Year - O&M ($000s)	2016	2017	2018	Post 2018	Total
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2016 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.5%
Capital Breakdown:	
Labor:	$87k
Contract Labor:	$404k
Materials:	$550k
Other:	$0k
Local Engineering:	$86k
Burdens:	$81k
Contingency:	$52k
Reimbursements:	($0k)
Net Capital Expenditure:	$1,260k

Financial Analysis - Project Summary ($000)	2016	2017	2018	2019	2020	Life of Project
Project Net Income	$ 20	$ 36	$ 59	$ 56	$ 54	$ 1,331
Project ROE	6.3%	5.7%	9.8%	9.8%	9.8%	9.5%

- **Assumptions**
  - There is no Transmission Lines work associated with this project.
  - There will be no relay upgrades associated with this project.
  - The requested outages for construction will be granted. The labor estimate assumes 4 day/week, 10 hour/day work week, with no special construction considerations to minimize the required outage window.
  - Suppliers and contractors will meet reasonable and expected delivery dates for materials and services

- **Environmental**
  This project does not require permitting and there are no known issues regarding air, water, waste, lead, or asbestos.

- **Risks**
  Completing the project involves risk related to high voltage substation construction work. Not completing the project decreases the reliability of the transmission system. To minimize potential risks to the transmission system, one breaker will be replaced at a time, in sequential outages. The project schedule assumes that the outages on each breaker will take place between during the Fall of 2016.

Conclusions and Recommendation
It is recommended that the Investment Committee approve the Pineville Transmission 932 and 952 Breaker Replacements project for $1,260k to enhance the reliability of the Transmission system.

Approval Confirmation for Capital Projects Greater Than or Equal to $1 million:

The Capital project spending included in this Investment Proposal has been approved by the members of the LKE Investment Committee. Pursuant to the LKE Authority Limit Matrix, the signatures below are also required for approval of this Capital project spending request.

Kent W. Blake	Victor A. Staffieri
Chief Financial Officer	Chairman, CEO and President

Investment Proposal Project 150841 Ghent-Scott County Pole Replacement

Investment Proposal for Investment Committee Meeting on: June 29, 2016

Project Name: Ghent-Scott County Pole Replacement

Total Expenditures: $9,759k (2016-$3,972k) (2017-$5,787k)
Total Contingency: $921k (10%)

Project Number(s): 150841

Business Unit/Line of Business: Transmission Lines

Prepared/Presented By: Joe Mina/Adam Smith

Executive Summary

The proposed project is to replace one hundred fifty-five (155) wood structures on the Ghent-Scott County 138kV line with steel, while energized, based on the results of a routine line inspection. Due to the length of time required to receive custom steel structures, along with the limited availability of time remaining to complete the project, fifty (50) structures will be replaced in 2016 and one hundred five (105) structures will be replaced in 2017.

This proposal it to proactively replace the structures over the course of the next year, prior to failure, to ensure the integrity and reliability of this line and to prevent outages resulting from such failures. The alternative of replacing poles upon failure will result in much higher long term replacement costs due to mobilization of crews back to the site each time one fails and the probable overtime work involved in replacing each during an emergency situation. This alternative would also have a negative impact on network reliability.

The total project cost is $9,759k and was not included in the 2016 Business Plan, however was approved by the RAC in the 5+7 forecast. While not specifically identified in the 2016 Business Plan, this project utilizes funding included for pole replacements in the plan. This project is being accelerated due to the severity and number of priority poles identified. The proposed estimate includes an energized cost of $315k to replace fifty (50) structures in 2016 and $1,152k to replace one hundred five (105) structures in 2017.

Background
Above ground pole inspections are performed by the company at defined intervals in order to discover problems that may impact the integrity and reliability of the Transmission System. A routine climbing inspection of the Ghent-Scott County 138kV line was completed in 2015, and a Comprehensive Visual Inspection (CVI) was completed in 2016. The inspection reports indicate that the majority of the structures were damaged by woodpeckers, and one hundred fifty-five (155) structures were identified as priority poles and determined to be in need of replacement in order to ensure the integrity and reliability of this line. There are 284 total structures along this 40.30 mile line.

- **Alternatives Considered (1 –Recommendation, 2 –Do nothing, 3 –Next Best Alt)**
  1. Recommendation: NPVRR: ($000s) $12,922k
     The recommendation is to replace the structures energized due to the difficulty in obtaining an extended outage. If the opportunity to complete the project de-energized would occur, we would pursue this option which would reduce the cost by $1,467k and NPVRR by $1,939k.
  2. Do Nothing: NPVRR: ($000s) $20,665k
     The alternative of do nothing would result in replacing the poles upon failure, which would result in a much higher long term replacement cost due to contract crew mobilization and overtime costs. This cost was derived by an estimated percentage of failure over the next four years. The failure rate and costs may vary depending on environmental factors. This option would also have a negative impact on reliability.
  3. Next Best Alternative(s): NPVRR: ($000s) $16,135
     The next best alternative would be to replace the poles with wood structures. The manufacturer's recommended life span of a wood pole is 30-35 years, whereas steel poles have a recommended life span of 90 years. This option assumes replacement of wood structures in 30 years and an escalation factor of 4% which is in line with market cost increases over the last 15 years.

Project Description

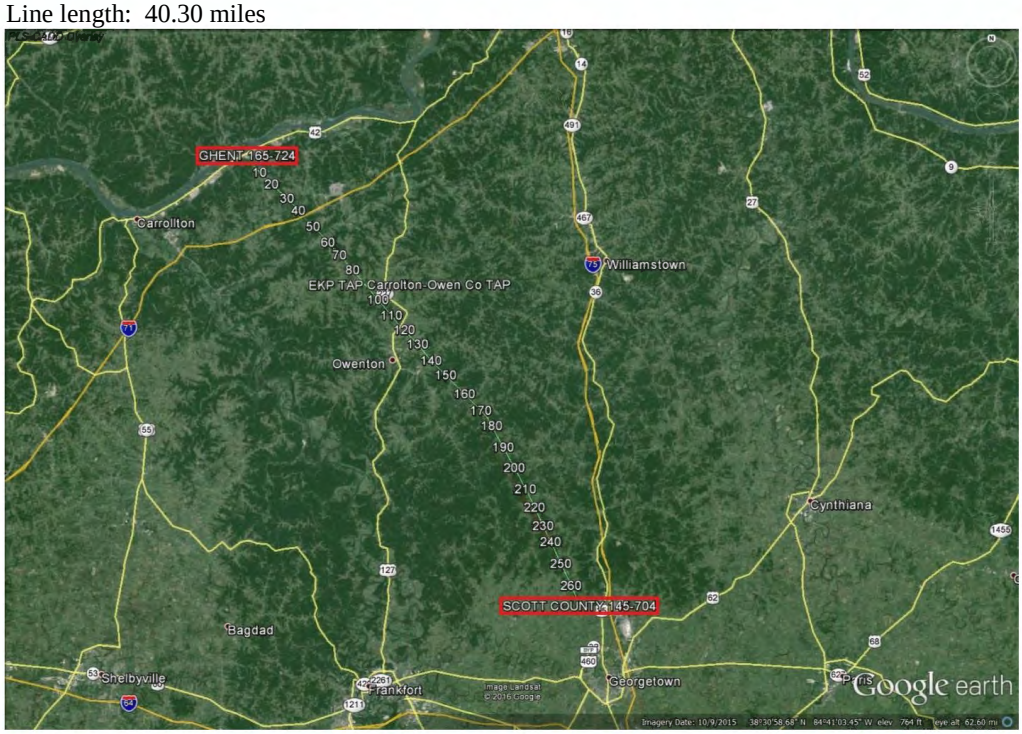
- **Project Scope and Timeline**
  The scope of work will consist of installing one hundred thirty-three (133) standard steel H-frame structures, nineteen (19) custom H-frames, two (2) custom steel 3-pole running corners, one (1) custom steel 3-pole dead end, and associated hardware and material, and the removal of 155 wood structures and associated hardware and material. The line construction will be based on continuing contracts from our line contractors. B&B, Elliot, Groves and Pike are the four contractors awarded the T&D Overhead Construction and Maintenance contract from the October 2011 Investment Committee meeting. The contract extension was re-approved by the IC in July of 2014. Construction is scheduled to begin in October of 2016 and be completed in June of 2017.

  The construction milestones for this project are provided below:

Construction Milestones	
May 2016	Engineering and Design
July 2016	Steel Poles Ordered

September 2016	Standard Steel H-frames Received
October 2016	Line Construction Begins
January 2017	Custom Steel Poles Received
June 2017	Line Construction Completed

A facility map of the Ghent-Scott 138kV line is shown below:
Line length: 40.30 miles



- **Project Cost**
  The total project cost is $9,759k and was not included in the 2016 Business Plan, however was approved by the RAC in the 4+8 forecast. Historical and existing contract and purchasing agreements were used to estimate the cost of material and contract labor. This project contains a 10% contingency which is reasonable based on the level of detailed engineering, confidence in cost of materials and contractors, and potential unknown risks such as weather delays, rock, structure access, and potential outage restrictions.

Economic Analysis and Risks

- **Bid Summary**
  Based on preliminary engineering, Transmission Lines has estimated the material packages for construction of this project to be $2,909k. This project will utilize standard and custom steel structures. The steel structures will be purchased through our steel pole alliance partner,

Trinity Meyer. Hardware will be purchased through Brownstown Electrical Supply. The line construction will be based on continuing contracts with our line contractors. Davis H. Elliot, Pike Electric, B&B Electric and William E. Groves are the four main contractors which have been awarded the T&D Overhead Construction and Maintenance contracts.

Transmission Lines Material Cost Breakdown	
Material	**Cost**
Steel Poles	$2,810k
Hardware	$99k
Total	$2,909k

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	**2016**	**2017**	**2018**	**Post 2018**	**Total**
1. Capital Investment Proposed	3,539	4,173			7,713
2. Cost of Removal Proposed	432	1,614			2,046
3. Total Capital and Removal Proposed (1+2)	3,972	5,787	-	-	9,759
4. Capital Investment 2016 BP	-	-	-	-	-
5. Cost of Removal 2016 BP	-	-	-	-	-
6. Total Capital and Removal 2016 BP (4+5)	-	-	-	-	-
7. Capital Investment variance to BP (4-1)	(3,539)	(4,173)	-	-	(7,713)
8. Cost of Removal variance to BP (5-2)	(432)	(1,614)	-	-	(2,046)
9. Total Capital and Removal variance to BP (6-3)	(3,972)	(5,787)	-	-	(9,759)

Financial Detail by Year - O&M ($000s)	**2016**	**2017**	**2018**	**Post 2018**	**Total**
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2016 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.49%
Capital Breakdown:	
Labor:	$339k
Contract Labor:	$4,455k
Materials:	$2,909k
Local Engineering:	$707k
Burdens:	$428k
Contingency:	$921k
Reimbursements:	($0)
Net Capital Expenditure:	$9,759k

Financial Analysis - Project Summary ($000)	2016	2017	2018	2019	2020	Life of Project
Project Net Income	$0	$303	$479	$456	$434	$9,392
Project ROE	0.0%	8.5%	9.7%	9.8%	9.8%	9.6%

- **Assumptions**

  Recommendation – The cost of this alternative assumes that the line outage will not be available and the structure replacements will need to be completed with the 138kV line energized.

  Do nothing alternative – The cost of this alternative would be approximately 60% higher due to overtime labor charges and the cost to mobilize and demobilize the construction crews. These poles would fail and require replacement within the next four years.

  Next best alternative - The cost of this alternative assumes the cost of the wood poles is 41% of the cost of the steel poles, and that the wood poles would be replaced again in 30 years.

- **Environmental**
  There are no known environmental issues regarding air, water, lead, asbestos, etc., associated with this project.

- **Risks**
  Without the proposed replacement of the priority poles on the Ghent-Scott 138kV line, the company risks unplanned outages and increased cost of repairs in emergency situations. Inclement weather which affects site access and working conditions could increase the project cost and cause schedule delays.

Conclusions and Recommendation
It is recommended that the Investment Committee approve the Ghent-Scott Pole Replacement project for $9,759k to maintain system integrity, reliability, and to prevent failures and unplanned outages.

Approval Confirmation for Capital Projects Greater Than or Equal to $1 million:

The Capital project spending included in this Investment Proposal has been approved by the members of the LKE Investment Committee. Pursuant to the LKE Authority Limit Matrix, the signatures below are also required for approval of this Capital project spending request.

Kent W. Blake.
Chief Financial Officer

Victor A. Staffieri
Chairman, CEO and President

Capital Investment Proposal

Investment Proposal for Investment Committee Meeting on: N/A

Project Name: Mill Creek 4533 Breaker Replacement

Total Expenditures: $784k (Including $59k of contingency)

Project Number(s): 151208

Business Unit/Line of Business: Transmission Substation Construction & Maintenance

Prepared/Presented By: Victor Payne – Electrical Engineer

Executive Summary

The scope of this project includes the replacement of (1) 345kV circuit breaker, free standing current transformers and associated equipment at the Mill Creek substation. This breaker is being replaced due to the lack of manufacturer support, readily available replacement parts and leaking SF6 gas. The breaker position that will be replaced is MC-4533.

The total cost of this project will be $784k and was approved by the 2016 5+7 RAC. Funding for this project was included in the 2016 BP under the project KBR-18, however it is being pulled forward due to the necessity of replacing this breaker and is being charged to a separate project since the detailed engineering estimate exceeds the $500k threshold to charge to the KBR blanket. The estimated total project figure includes a 8% contingency as the breaker to be installed is already owned (a replacement spare will be purchased). This contingency is expected to cover uncertainty with the contract labor costs based upon variances that have been noticed on past similar projects.

Background
The breaker being replaced is a live tank, 345kV, 1976, GE model ATB-362-7 circuit breaker. The live tank design has proven to be highly unreliable and prone to failure. This breaker is over the expected life expectancy and replacement parts are no longer available as the original manufacturer no long supports this breaker. The breaker is also in need of replacement due to leaking SF6 gas, which leads to considerably higher maintenance costs and the leaks can cause low SF6 gas pressure that may cause breaker failure or unplanned opening of the breaker. Live tank breakers leak around the same amount of gas as other similarly manufactured designs. Replacement of this breaker would increase reliability of the Mill Creek 345kV substation.

- **Alternatives Considered**
  1. Recommendation: NPVRR: ($000s) $984k
     It is recommended that MC-4533 be replaced at the Mill Creek substation.

  2. Alternative #1: NPVRR: ($000s) $185k
     The next best alternative is to remove the breaker and lock out-tag-out the breaker disconnects. This option is not recommended as this breaker provides significant additional electric system reliability. The function of this breaker (and every breaker in the LKE system) is to protect the transmission system and generation equipment from potential faults that can occur on the electric grid. This is a commonly accepted industry practice and is considered to be cost effective as well.

     Without the added reliability, transmission and generation power flow could be reduced during outage and fault condition events. This breaker also interrupts power flow to allow other system switching. Additionally, the existence of this breaker adds a supplemental connection between the two 345kV buses and the Mill Creek generation unit itself. This additional path helps reduce the risk of the generator quickly separating from the grid during a bus fault, which could damage the generation unit.

  3. Do Nothing: NPVRR: ($000s) $684k
     This option is not advisable as the breakers currently in-service at Pineville Transmission have a history of maintenance issues and the parts necessary to alleviate these issues are no longer available. These breakers are also leaking SF6 gas, which requires additional maintenance activities as well. Expertise to maintain assets in the field are lacking or are not currently available. These assets historically have had high leak rates. SF6 is currently being monitored by the EPA, but there are no compliance risks as of today. If this breaker were to fail, it could lead to an unplanned Mill Creek unit or line outage or impair a Unit's ability to produce generation for the Louisville Gas & Electric and Kentucky Utility (LKE) system.

Project Description

- **Project Scope and Timeline**

Description	Date
Project Originally Approved	July, 2016

Materials Ordered	July, 2016
Materials Received	October, 2016
Construction Work Begins	November, 2016
Construction Work Completed	November, 2016
Project Complete	December, 2016

- **Project Cost**
  The total cost of this project will be $784k and was approved by the 2016 5+7 RAC. Funding for this project was included in the 2016 BP under the project KBR-18. The estimated total project figure includes a 8% contingency. This contingency is expected to cover uncertainty with the contract labor costs based upon variances that have been noticed on past similar projects.

Economic Analysis and Risks

- **Bid Summary**
  Previously established blanket contract agreements will be utilized for related materials. Bids for any other necessary materials, as well as the below and above grade construction, will be sent out soon after project approval. Materials priced below $50k will not be bid and instead purchased directly from various business partners who LKE has significant previous experience working with.

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	**2016**	**2017**	**2018**	**Post 2018**	**Total**
1. Capital Investment Proposed	700	-	-	-	700
2. Cost of Removal Proposed	84	-	-	-	84
3. Total Capital and Removal Proposed (1+2)	784	-	-	-	784
4. Capital Investment 2016 BP	-	-	-	-	-
5. Cost of Removal 2016 BP	-	-	-	-	-
6. Total Capital and Removal 2016 BP (4+5)	-	-	-	-	-
7. Capital Investment variance to BP (4-1)	(700)	-	-	-	(700)
8. Cost of Removal variance to BP (5-2)	(84)	-	-	-	(84)
9. Total Capital and Removal variance to BP (6-3)	(784)	-	-	-	(784)

Financial Detail by Year - O&M ($000s)	**2016**	**2017**	**2018**	**Post 2018**	**Total**
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2016 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.5%
Capital Breakdown:	
Labor:	$66k
Contract Labor:	$252k
Materials:	$270k
Other:	$0k
Local Engineering:	$82k
Burdens:	$55
Contingency:	$59k
Reimbursements:	($0k)
Net Capital Expenditure:	$784k

Financial Analysis - Project Summary ($000)	2016	2017	2018	2019	2020	Life of Project
Project Net Income	$ 3	$ 18	$ 37	$ 35	$ 33	$ 751
Project ROE	1.6%	4.5%	9.8%	9.8%	9.8%	9.3%

- **Assumptions**
  - There is no Transmission Lines work associated with this project.
  - The ABB spare breaker "BK000612" 380PMI63 will be used.
  - There will be no line relay upgrades associated with this project.
  - The requested outages for construction will be granted. The labor estimate assumes 4 day/week, 10 hour/day work week with no special construction considerations to minimize the required outage window.
  - Costs to expand the ground grid or lightning protection in the entire station to meet current standards or codes are not included in this estimate. The existing ground grid impedance to remote ground along with the touch and step potential is assumed to be adequate. New ground grid is only installed in the affected substation expansion area for touch and step potential upgrade.
  - Suppliers and contractors will meet reasonable and customary delivery dates for materials and services.

- **Environmental**
  This project does not require permitting and there are no known issues regarding air, water, waste, lead, or asbestos. There are no current environmental regulatory implications as related to SF6 gas.

- **Risks**
  If the recommended option is not accepted, there is an increased risk of a breaker failure which could lead to extended out of service time at the Mill Creek Generation facility. The duration of the outage would be dependent upon repairs or other maintenance as related to the failure. Such an outage would impair the generation unit's ability to produce power for the LKE system.

Conclusions and Recommendation
It is recommended that Management approve the Mill Creek 4533 Breaker Replacement project for $784k to enhance the reliability of the Transmission system.

Capital Investment Proposal

Investment Proposal for Investment Committee Meeting on: N/A

Project Name: Cane Run SW CT Add

Total Expenditures: $820k (Including $0k of Contingency)

Project Number(s): 151467

Business Unit/Line of Business: Transmission Substation Construction & Maintenance

Prepared/Presented By: Corbin Williams

Executive Summary

This project was originally opened during June 2016 for $334k to add new, higher capacity current transformers (CTs) at Cane Run Switching in order to reduce the chance of misoperations for faults on adjacent circuits. The project is being revised to include the replacement of (3) 138kV circuit breakers and associated equipment, and the installation of (30) 138kV surge arresters, in addition to the new CTs in order to increase overall reliability of the equipment at this station.

While installing the CTs, it was decided that the continued use of the existing breakers was not prudent. The age, reliability, availability of replacement parts, known operational issues, and higher maintenance costs were drivers for the decision. The replacement of this equipment will lead to fewer unplanned outages and therefore increased reliability within the Transmission grid system.

The total cost of this project will be $820k, of which $541k was spent during 2016 and $279k is forecasted for 2017. $344k of funding was included in the 2017 BP for this project, all of which was in 2016. The 2017 BP did not include any spending for 2017, however was approved by the RAC in the 2017 0+12 forecast. The estimated total project figure includes a no contingency as the project is in its final stages of completion and there is less risk associated with the remaining activities necessary for project completion.

Background
Based on historical data, most circuit breakers reach the end of useful life at 60 years. Appendix A, Diagram 1 outlines the age of the breakers that are currently in service in the LKE system. Failure to fund this project and others that are similar will contribute to the ongoing concern of an aging infrastructure with equipment in-service that has reached the end of its useful life and can no longer be properly maintained. The technology used for the construction of these breakers is antiquated and the high number of moving parts makes it challenging to keep all of the measurements within manufacturers specifications.

Project Description

- **Project Scope and Timeline**

The replaced breakers are CRS-3825-TR2, CRS-3808-24, and CRS-3822-33. The breakers that have an additional set of current transformers installed are CRS-3801-23 and CRS-3866-TR1. All (10) 138kV transmission lines associated with the substation's 138kV breakers have a set of surge arresters installed.

Description	Date
Project Originally Approved	June, 2016
Materials Ordered	July, 2016
Materials Received	October, 2016
Below Grade Work Begins	October, 2016
Below Grade Work Completed	October, 2016
Above Grade Work Begins	October, 2016
Above Grade Work Completed	November, 2016
Project Complete	May, 2017

Economic Analysis and Risks

- **Bid Summary**
  Previously established blanket contract agreements will be utilized for related materials. The below and above grade construction were sole sourced to Davis H. Elliot Construction Company, Inc. (DHE). The work was sole sourced since the priority of the work did not allow sufficient time to conduct a competitive bid by either internal or external sourcing resources. To gauge the prudency of the cost estimate provided by DHE, the estimate was compared to our internally created estimate for the scope of work. As the estimates were comparable, their estimate was determined to be reasonable. A fully executed Sole Source Authorization form was completed.

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	2016	2017	2018	Post 2018	Total
1. Capital Investment Proposed	527	262	-	-	789
2. Cost of Removal Proposed	14	17	-	-	31
3. Total Capital and Removal Proposed (1+2)	541	279	-	-	820
4. Capital Investment 2017 BP	344	-	-	-	344
5. Cost of Removal 2017 BP	-	-	-	-	-
6. Total Capital and Removal 2017 BP (4+5)	344	-	-	-	344
7. Capital Investment variance to BP (4-1)	(183)	(262)	-	-	(445)
8. Cost of Removal variance to BP (5-2)	(14)	(17)	-	-	(31)
9. Total Capital and Removal variance to BP (6-3)	(197)	(279)	-	-	(476)

Financial Detail by Year - O&M ($000s)	2016	2017	2018	Post 2018	Total
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2017 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.5%
Capital Breakdown:	
Labor:	$49k
Contract Labor:	$313k
Materials:	$308k
Other:	$8k
Local Engineering:	$96k
Burdens:	$46k
Contingency:	$0k
Net Capital Expenditure:	$820k

- **Environmental**
  This project does not require permitting and there are no known issues regarding air, water, waste, lead, or asbestos.

- **Risks**
  Completing the project involves risk related to high voltage substation construction work. If action is not taken, there will continue to be challenges associated with keeping these breakers in good working order. There is also an increased probability of failure, reduction of system reliability through the occurrence of system outages and possible collateral damage in the event of a catastrophic failure.

Conclusions and Recommendation
It is recommended that the Cane Run SW CT Add revised project be approved for $820k to enhance the reliability of the Transmission system.

Appendix A

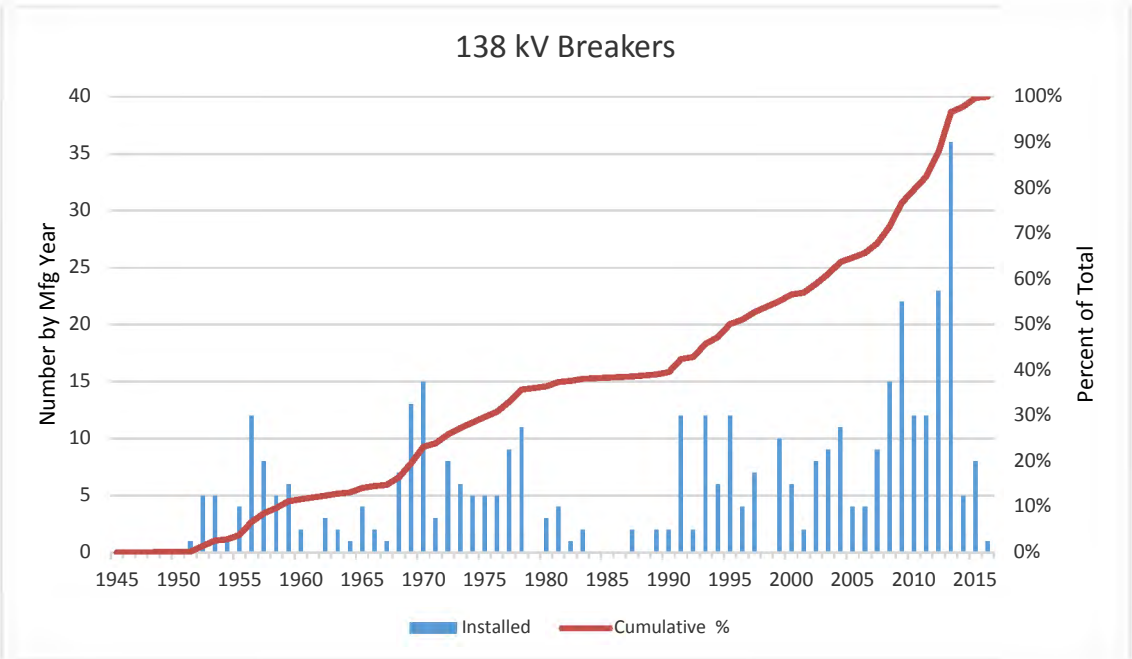


DIAGRAM 1

Investment Proposal 151554 Hardinsburg-Central Hardin EKPC Pole Replacement

Investment Proposal for Investment Committee Meeting on: July 27, 2016

Project Name: Hardinsburg-Central Hardin EKPC Pole Replacement

Total Expenditures: $1,526k
Total Contingency: $139k (10%)

Project Number(s): 151554

Business Unit/Line of Business: Transmission Lines

Prepared/Presented By: Kelly Mefford/Adam Smith

Executive Summary

The proposed project is to replace twenty-four (24) wood structures on the Hardinsburg-Central Hardin EKPC 138kV line with steel, during a routine outage, based on the results of a routine line inspection. Due to the length of time required to receive custom steel structures, along with the limited availability of time to complete the project, eleven (11) structures will be replaced in 2016, and thirteen (13) structures will be replaced in 2017.

This proposal is to proactively replace the structures over the course of the next year, prior to failure, to ensure the integrity and reliability of this line, and to prevent outages resulting from such failures. The alternative of replacing poles upon failure will result in much higher long term replacement costs due to mobilization of crews back to the site each time one fails and the probable overtime work involved in replacing each during an emergency situation. This alternative would also have a negative impact on network reliability.

This project is being accelerated to align with the Hardinsburg-Central Hardin EKPC NRP project (147474). Completing both projects together will allow for resource efficiencies and limit the impacts to property owners. The total project cost is $1,526k and was not included in the 2016 Business Plan, however was approved by the RAC in the 6+6 forecast.

Background
Above ground pole inspections are performed by the company at defined intervals in order to discover problems that may impact the integrity and reliability of the Transmission System. During a routine climbing inspection of the Hardinsburg-Central Hardin EKPC 138kV line, twenty-four (24) structures were identified as priority poles and determined to be in need of replacement in order to ensure the integrity and reliability of this line. There are 228 total structures along this 31.55 mile line.

- **Alternatives Considered (1 –Recommendation, 2 –Do nothing, 3 –Next Best Alt)**
  1. Recommendation: NPVRR: ($000s) $2,066k
     The recommendation is to replace all twenty-four (24) structures during a scheduled outage.
  2. Do Nothing: NPVRR: ($000s) $3,002k
     The alternative of do nothing would result in replacing the poles upon failure, which would result in a much higher long term replacement cost due to contract crew mobilization and overtime costs. This cost was derived by an estimated percentage of failure over the next four years. The failure rate and costs may vary depending on environmental factors. This option would also have a negative impact on reliability.
  3. Next Best Alternative(s): NPVRR: ($000s) $2,395k
     The next best alternative would be to replace the poles with wood structures. The manufacturer's recommended life span of a wood pole is 30-35 years, whereas steel poles have a recommended life span of 90 years. This option also assumes replacement of wood structures in 30 years and an escalation rate of 4% which is in line with market cost increases over the last 15 years.

Project Description

- **Project Scope and Timeline**
  The scope of work will consist of installing nineteen (19) standard H-frames, four (4) custom H-frames, and one (1) 3-pole running corner, and associated hardware and material, and the removal of twenty-four (24) wood structures, and associated hardware and material. The line construction will be based on continuing contracts from our line contractors. B&B, Elliot, Groves and Pike are the four contractors awarded the T&D Overhead Construction and Maintenance contract from the October 2011 Investment Committee meeting. The contract extension was re-approved by the IC in July of 2014. Construction is scheduled to begin in September of 2016 and be completed in March of 2017.

  The construction milestones for this project are provided below:

Construction Milestones	
April 2016	Engineering and Design
July 2016	Steel Poles Ordered
September 2016	Steel Poles Delivered
September 2016	Line Construction Begins
March 2017	Line Construction Completed

A facility map of the Hardinsburg-Central Hardin EKPC 138kV line is shown below:
Line length: 31.55 miles

- **Project Cost**
  The total project cost is $1,526k and was not included in the 2016 Business Plan, however was approved by the RAC in the 6+6 forecast. Historical and existing contract and purchasing agreements were used to estimate the cost of material and contract labor. This project includes 10% contingency which is reasonable based on the level of detailed engineering, confidence in the cost of materials and contractors and potential unknown risks such as weather delays, rocky terrain, outage delays, reclamation, and structure access.

Economic Analysis and Risks

- **Bid Summary**
  Based on preliminary engineering, Transmission Lines has estimated the material packages for construction of this project to be $481k. This project will utilize standard and custom steel structures. The custom steel structures will be purchased through our steel pole alliance partner, Trinity Meyer. Hardware will be purchased through Brownstown Electrical Supply. The line construction will be based on continuing contracts with our line contractors. Davis H. Elliot, Pike Electric, B&B Electric and William E. Groves are the four main contractors which have been awarded the T&D Overhead Construction and Maintenance contracts.

Transmission Lines Material Cost Breakdown	
Material	**Cost**
Steel Poles	$403k
Hardware	$78k
Total	$481k

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	2016	2017	2018	Post 2018	Total
1. Capital Investment Proposed	935	393	-	-	1,328
2. Cost of Removal Proposed	90	108	-	-	198
3. Total Capital and Removal Proposed (1+2)	1,025	501	-	-	1,526
4. Capital Investment 2016 BP	-	-	-	-	-
5. Cost of Removal 2016 BP	-	-	-	-	-
6. Total Capital and Removal 2016 BP (4+5)	-	-	-	-	-
7. Capital Investment variance to BP (4-1)	(935)	(393)	-	-	(1,328)
8. Cost of Removal variance to BP (5-2)	(90)	(108)	-	-	(198)
9. Total Capital and Removal variance to BP (6-3)	(1,025)	(501)	-	-	(1,526)

Financial Detail by Year - O&M ($000s)	2016	2017	2018	Post 2018	Total
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2016 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.49%
Capital Breakdown:	
Labor:	$32k
Contract Labor:	$663k
Materials:	$481k
Local Engineering:	$101k
Burdens:	$110k
Contingency:	$139k
Reimbursements:	($0)
Net Capital Expenditure:	$1,526k

Financial Analysis - By Year	2016	2017	2018	2019	2020	Life 2016-2069
Net Income, $000s	$0	$47	$75	$71	$68	$1,468
ROE	0.0%	3.6%	8.0%	10.0%	10.0%	9.4%

- **Assumptions**

Recommendation - This alternative assumes that the line outage will be available and that all twenty-four (24) structures will be replaced during this timeframe.

Do Nothing alternative – The cost of this alternative would be approximately 60% higher due to overtime labor charges and the cost to mobilize and demobilize construction crews. These poles would fail and require replacement within the next four years.

Next Best alternative – The cost of this alternative assumes the cost of the wood poles is 35% the cost of the steel poles, and that the wood poles would be replaced again in 30 years.

- **Environmental**
  There are no known environmental issues regarding air, water, lead, asbestos, etc., associated with this project.

- **Risks**
  Without the proposed replacement of the priority poles on the Hardinsburg-Central Hardin EKPC 138kV line, the company risks unplanned outages and increased cost of repairs in emergency situations. Inclement weather which affects site access and working conditions could increase the project cost and cause schedule delays. Schedule delays may also occur if the requested outage is not obtained to complete the scheduled work.

Conclusions and Recommendation
It is recommended that the Investment Committee approve the Hardinsburg-Central Hardin EKPC pole replacement project for $1,526k to maintain system integrity, reliability, and to prevent failures and unplanned outages.

Approval Confirmation for Capital Projects Greater Than or Equal to $1 million:

The Capital project spending included in this Investment Proposal has been approved by the members of the LKE Investment Committee. Pursuant to the LKE Authority Limit Matrix, the signatures below are also required for approval of this Capital project spending request.

Kent W. Blake	Victor A. Staffieri
Chief Financial Officer	Chairman, CEO and President

Capital Investment Proposal

Investment Proposal for Investment Committee Meeting on: N/A

Project Name: Fawkes Capacitor Bank Replacement & Firewall Installation

Total Expenditures: $840k (Including $76k of Contingency)

Project Number(s): 151761

Business Unit/Line of Business: Transmission Substation Construction & Maintenance

Prepared/Presented By: Victor Payne – Electrical Engineer

Executive Summary

This project includes installing a firewall between the two 138/69kV transformers and the control house at Fawkes Transmission Substation to reduce the risk of a failure of one transformer damaging the adjacent transformer or control house and the 69kV capacitor bank. The existing 69kV capacitor bank currently located between the two transformers will be relocated to allow installation of the firewall. The oil containment will need to be modified for both transformers. Due to a history of individual capacitor can failures on the existing bank at Fawkes, it will be redesigned and replaced upon its relocation. This project was initiated to follow the IEEE standard Std 979-2012.

The total cost of this project will be $840k. The 2016 spending was approved by the RAC in the 9+3 forecast. $101k will be spent in 2016 and $739k in 2017. No funding was included in the 2016 BP for this project as this capacitor bank has just recently been experiencing more serious equipment issues. This project is however included in the 2017 BP for $666k, with $284k included in 2016 and $383k included in 2017. The 2017 portion was not fully funded in the 2017 BP, so the additional amount above the budgeted amount ($357k) has been covered by a reduction in project #151764 (KU Fence Replacements). The estimated total project figure includes a 10% contingency.

Background
During the failure of a transformer, there is a possibility that the transformer itself could catch on fire. Due to the quantity of oil located within a transformer, a potential fire would be difficult to contain and could damage surrounding equipment. Adding a firewall between the transformers and redesigning the oil containment will greatly reduce the risk of damage to the adjacent equipment during this event. To install the firewall, the existing 69kV capacitor bank will need to be relocated to a new location. This capacitor bank has recently experienced serious operational issues and therefore will be redesigned and replaced upon its move. The new capacitor bank design will reduce the amount of operational issues and potential for future equipment failures. A specialized capacitor switcher that has been specifically designed for the capacitor bank will replace the existing breaker layout. Additionally, the design of the capacitor bank will be changed to a fuseless design in lieu of a fused capacitor type.

- **Alternatives Considered**
  1. Recommendation: NPVRR: ($000s) $1,001k
     It is recommended that the a firewall be installed and the capacitor bank redesigned and relocated to reduce the risk of damaging adjacent equipment during a potential transformer failure. This will increase the reliability of the transmission system.

  2. Alternative #1: NPVRR: ($000s) $1,456k
     Relocate of one of the existing transformers and the capacitor bank. This option is not recommended due to the additional outage requirements of the transformer, higher cost and risks associated with damaging the transformer during its relocation.

  3. Do Nothing: NPVRR: ($000s) $2,652k
     This option is not advisable because of the increased risk of an equipment failure damaging adjacent equipment and additional costs to cleanup and repair any possible damage. Additionally, losing any further equipment during a possible transformer failure would decrease the reliability of the transmission system. IEEE recommended standards to mitigate the risk to an acceptable level was followed. Such an event has a low probability of occurring based on consideration of past failures in our system.

Project Description

- **Project Scope and Timeline**

Description	Date
Project Originally Approved	Nov, 2016
Cap Bank Ordered	Nov, 2016
Other Major and Minor Material Ordered	Jan, 2016
Materials Received	June, 2017
Below Grade Work Begins	May, 2017
Below Grade Work Completed	June, 2017
Above Grade Work Begins	July, 2017
Above Grade Work Completed	Aug, 2017
Project Complete	Oct, 2017

- **Project Cost**

The total cost of this project will be $840k. The 2016 spending was approved by the RAC in the 9+3 forecast. $101k will be spent in 2016 and $739k in 2017. $0k of funding was included in the 2016 BP for this project as this capacitor bank has just recently been experiencing more serious equipment issues. This project is however included in the 2017 BP for $666k, with $284k included in 2016 and $383k included in 2017. The 2017 portion was not fully funded in the 2017 BP, so the additional amount above the budgeted amount ($357k) has been covered by a reduction in project #151764 (KU Fence Replacements). The estimated total project figure includes a 10% contingency.

Economic Analysis and Risks

- **Bid Summary**

  Previously established blanket contract agreements will be utilized for related materials. Bids for any other necessary materials, as well as the below and above grade construction, will be sent out soon after project approval.

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	2016	2017	2018	Post 2018	Total
1. Capital Investment Proposed	101	715	-	-	816
2. Cost of Removal Proposed	-	24	-	-	24
3. Total Capital and Removal Proposed (1+2)	101	739	-	-	840
4. Capital Investment 2016 BP	-	-	-	-	-
5. Cost of Removal 2016 BP	-	-	-	-	-
6. Total Capital and Removal 2016 BP (4+5)	-	-	-	-	-
7. Capital Investment variance to BP (4-1)	(101)	(715)	-	-	(816)
8. Cost of Removal variance to BP (5-2)	-	(24)	-	-	(24)
9. Total Capital and Removal variance to BP (6-3)	(101)	(739)	-	-	(840)

Financial Detail by Year - O&M ($000s)	2016	2017	2018	Post 2018	Total
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2016 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.5%
Capital Breakdown:	
Labor:	$76k
Contract Labor:	$310k
Materials:	$262k
Other:	$0k
Local Engineering:	$47k
Burdens:	$69k
Contingency:	$76k
Reimbursements:	($0k)
Net Capital Expenditure:	$840k

Financial Analysis - Project Summary ($000)	2016	2017	2018	2019	2020	Life of Project
Project Net Income	$ -	$ 25	$ 41	$ 39	$ 38	$ 917
Project ROE	0.0%	5.2%	7.9%	10.0%	10.0%	9.8%

- **Assumptions**
  - Assumes the required outages are obtainable with no extra overtime costs.
  - Assumes the individual capacitor bank cans can be reused.
  - Assumes the existing protection scheme and panel can be reused.

- **Environmental**
  This project does not require permitting and there are no known issues regarding air, water, waste, lead, or asbestos. The transformers oil containments will be revised to accommodate the installation of the wall. There is a standard procedure for oil containment that will be followed. Any final designs will be reviewed by th Environmental group.

- **Risks**
  If this project is not completed, there is risk of a transformer failure damaging adjacent equipment and additional significant costs to cleanup and repair any potential damage. Also, losing an additional transformer and/or capacitor bank during a transformer failure would decrease the reliability of the transmission system.

Conclusions and Recommendation
It is recommended that Management approve the Fawkes Capacitor Bank Replacement & Firewall Installation project for $840k to enhance the reliability of the Transmission system.

Revised Capital Investment Proposal

Investment Proposal for Investment Committee Meeting on: N/A

Project Name: Fawkes Capacitor Bank Replacement & Firewall Installation

Total Approved Expenditures: $840k (76k of Contingency) (Approved on 12/12/2016)

Total Revised Expenditures: $1,079k

Project Number(s): 151761

Business Unit/Line of Business: Transmission Substation Construction & Maintenance

Prepared/Presented By: Bill Williams

Reason for Revision
A large contributing factor would be scope changes and their corresponding material and construction costs. The original design for the project was to use a capacitor switcher with free standing current transformers in series with the capacitor bank, however the scope was changed to use a breaker with the capacitor switcher to protect the equipment. Another scope change necessitated the use of an RTU (Remote Terminal Unit). Due to outage reasons, both capacitor banks had to be in service at all times. Additionally, there wasn't enough space in the control house on the existing panels to add these controls, therefore a new system had to be designed and installed. Lastly, the original scope underestimated the total cost to protect the control house with the new firewalls.

Financial Summary

Financial Summary ($000s):	**Approved**	**Revised**	**Explanation**
Discount Rate:	6.5%	6.32%	
Capital Breakdown:			
Labor:	$76k	$29k	
Contract Labor:	$310k	$546k	Wall and RTU addition
Materials:	$262k	$334k	Additional Breaker & RTU
Other:	$ 0	$5k	
Local Engineering:	$47k	$81k	Additional Scope
Burdens:	$69k	$41k	
Contingency:	$76k	$43k	
Reimbursements:	($0k)	($0)	
Net Capital Expenditure:	$840k	$1,079k	

NPVRR: $1,001k $1,178k

Financial Detail by Year - Capital ($000s)	Pre-2017	2017	2018	Post 2018	Total
1. Capital Investment Proposed	7	1,038	-	-	1,045
2. Cost of Removal Proposed	-	1	-	-	1
3. Total Capital and Removal Proposed (1+2)	7	1,040	-	-	1,047
4. Capital Investment 2017 BP	284	358	-	-	641
5. Cost of Removal 2017 BP	-	25	-	-	25
6. Total Capital and Removal 2017 BP (4+5)	284	383	-	-	666
7. Capital Investment variance to BP (4-1)	277	(681)	-	-	(404)
8. Cost of Removal variance to BP (5-2)	-	24	-	-	24
9. Total Capital and Removal variance to BP (6-3)	277	(657)	-	-	(380)

Financial Detail by Year - O&M ($000s)	Pre-2017	2017	2018	Post 2018	Total
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M Pre-2017 BP	-	-	-	-	-
3. Total Project O&M Variance to BP (2-1)	-	-	-	-	-

Conclusions and Recommendation

It is recommended that Management approve the Fawkes Capacitor Bank Replacement & Firewall Installation project for $1,079k to allow for engineering, material and construction charges associated with the additional scope outlined above which will enhances the protection of the capacitor bank and safety of the control house.

Capital Investment Proposal

Investment Proposal for Investment Committee Meeting on: N/A

Project Name: PCH-Hillside Control House

Total Expenditures: $1,544k (Including $130k of contingency)

Project Number(s): 151775

Business Unit/Line of Business: Transmission Substation Engineering

Prepared/Presented By: Bill Goans-Director, Mesa Associates Inc.

Executive Summary

The Hillside Substation currently houses transmission protection and control (P&C) equipment that is aging past the date of reasonable repair. The existing control house also has size and security concerns. Maintenance of the existing equipment inside the control house is also becoming more difficult as replacement parts are difficult to find.

By installing a new, pre-fabricated control house inside the substation fenced area, with microprocessor relays, the obsolete, aging equipment will be replaced with reliable, digital protective relays while also enhancing safe and reliable performance of the Transmission protective system.

The total cost of this project will be $1,544k with $768k in 2018 and $776k in 2019. This project was included in the 2018 BP for $1,732k with $877k in 2018 and $855k in 2019. The current estimates are based on a more detailed level of engineering than was used to estimate the BP.

Background
The Hillside Substation contains a 69kV bus which connects three transmission lines. The equipment currently used for relaying and controls for the switchyard is located inside an aging control building with no climate control. This affects the lifespan of equipment as weather changes can damage sensitive electronics and battery cells. A new control house would provide a climate controlled environment and ensure that safe working conditions are provided for any individuals working inside.

The existing substation control house is small and has several security concerns. It is located at the corner of the property partially outside the fenced area. It houses transmission P&C equipment that is aging past the date of reasonable repair. Maintenance of said equipment is becoming more difficult as replacement parts are difficult to find. There is not sufficient room in the existing control house to replace the aging equipment.

The existing P&C equipment is composed of electromechanical relays. Replacing these with new microprocessor relays will provide an improvement to reliability along with an increase in functionality, including disturbance monitoring and event reporting. This will allow faults in the area to be studied in greater detail so they can be properly identified with a root-cause, allowing a more specified approach to improving the reliability of the transmission system overall.

- **Alternatives Considered**
    1. Recommendation: NPVRR: ($000s) $1,745k
       It is recommended that all P&C equipment located inside the existing control house be decommissioned and new, microprocessor based relays be installed in a new control house within the substation yard.

    2. Delay Project: NPVRR: ($000s) $1,808k
       This option would be to delay the control replacement by one year. Doing so would also necessitate replacing the existing fence. This not advisable as the possibility of misoperations will increase with time as well as the availability of replacement parts of the existing electromechanical relays will diminish as they become increasingly obsolete.

    3. Do Nothing: NPVRR: ($000s) N/A
       This option is not advisable as the failure of these relays will be imminent over a period of years, which will greatly increase the risk of misoperations. The scarcity of parts will surely increase and the existing control house condition will continue to deteriorate over many years.

Project Description

- **Project Scope and Timeline**

Description	Date
Order Materials	May, 2018
Receive Materials	December, 2018
Begin Below Grade Work	October, 2018

Complete Below Grade Work	January, 2019
Begin Above Grade Work	November, 2018
Complete Above Grade Work	April, 2019
Project Complete	June, 2019

- **Project Cost**
  The total cost of this project will be $1,544k with $768k in 2018 and $776k in 2019. This project was included in the 2018 BP for $1,732k with $877k in 2018 and $855k in 2019. The current estimates are based on a more detailed level of engineering than was used to estimate the BP. The estimated total project figure includes 9% contingency. This contingency is reasonable based on the level of detailed engineering and is expected to cover the uncertainty with the material and contract labor costs based upon variances that have been observed on past projects.

Economic Analysis and Risks

- **Bid Summary**
  Previously established blanket contract agreements will be utilized for related materials. Bids for any other necessary materials, as well as the below and above grade construction, will be sent out at the conclusion of detailed engineering.

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	**2018**	**2019**	**2020**	**Post 2020**	**Total**
1. Capital Investment Proposed	768	754	-	-	1,522
2. Cost of Removal Proposed	-	22	-	-	22
3. Total Capital and Removal Proposed (1+2)	768	776	-	-	1,544
4. Capital Investment 2018 BP	870	855	-	-	1,725
5. Cost of Removal 2018 BP	7	-	-	-	7
6. Total Capital and Removal 2018 BP (4+5)	877	855	-	-	1,732
7. Capital Investment variance to BP (4-1)	102	101	-	-	203
8. Cost of Removal variance to BP (5-2)	7	(22)	-	-	(15)
9. Total Capital and Removal variance to BP (6-3)	109	79	-	-	188

Financial Detail by Year - O&M ($000s)	**2018**	**2019**	**2020**	**Post 2020**	**Total**
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2018 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):	
Discount Rate:	6.58%
Capital Breakdown:	
Labor:	$88
Contract Labor:	$504
Materials:	$570
Local Engineering:	$102
Burdens:	$150
Contingency:	$130
Reimbursements:	($-)
Net Capital Expenditure:	$1,544

- **Assumptions**
  Required outages are assumed to be able to be obtained within the requested timeframe. The control house is assumed to be placed in our initial location with no impact due to hard rocks underground. Weather is assumed to be fair enough to work on schedule with no delays to mobilization of contractors or delivery of material.

- **Environmental**
  This project does not require permitting and there are no know issues regarding air, water, waste, lead, or asbestos.

- **Risks**
  Completing the project involves risks related to high voltage substation construction work and coordination between projects. Not completing the project decreases the reliability of the LKE Transmission system and introduces the risks to the operation of the Hillside Substation. Outages may be delayed due to system loading requirements, weather, or other outages in the area.

Conclusions and Recommendation
It is recommended that Management approve the Hillside Control House Replacement project for $1,544k to enhance the reliability of the Transmission system.

Capital Investment Proposal

Investment Proposal N/A

Project Name: Finchville Control House Replacement

Total Expenditures: $1,478k (Including $130k of Contingency)

Project Number(s): 151777

Business Unit/Line of Business: Transmission Protection & Controls

Prepared/Presented By: Brent Birchell – Manager, Transmission Protection & Controls

Executive Summary

The Finchville Substation currently houses transmission protection and control (P&C) equipment that is aging past the date of reasonable repair. Much of this equipment was installed over fifty years ago and will begin to fail without proactive replacement of these assets. Maintenance of said equipment is also becoming more difficult as replacement parts are difficult to find.

By installing a new, pre-fabricated control house with microprocessor relays, the obsolete, aging equipment will be replaced with reliable, digital protective relays while also enhancing safe and reliable performance of the Transmission protection system. This project is part of the overall 2016 Transmission System Improvement Plan.

The total cost of this project will be $1,478k. $1,024k will be spent in 2017 with the remaining $454k to be spent in 2018. This project was included in the 2017 BP for $100k in 2016, $1,231k in 2017 and $425k in 2018. The proposed estimate is lower than the BP due to a more detailed estimate being completed. The additional funding needed in 2018 will be addressed in the 2018 BP.

Background
The Finchville Substation contains a 69kV bus which connects four transmission lines. The equipment currently used for relaying and controls for the switchyard is located inside an aging control building with no climate control. This affects the lifespan of equipment as weather changes can damage sensitive electronics and battery cells. A new control house would provide a climate controlled environment and ensure that safe working conditions are provided for any individuals working inside.

The existing P&C equipment is composed of electromechanical relays. Twelve of these relays are General Electric GCX type electromechanical relays which have been marked as a priority by the Transmission P&C department to replace, due to the age of these relays and a higher percentage of misoperations caused by these relays. New microprocessor relays will provide an improvement to reliability along with an increase in functionality, including disturbance monitoring and event reporting. This will allow faults in the area to be studied in greater detail so they can be properly identified with a root-cause, allowing a more specified approach to improving the reliability of the transmission system overall.

- **Alternatives Considered**
    1. Recommendation: NPVRR: ($000s) $1,732k
       It is recommended that all P&C equipment located inside the existing control house be decommissioned and new, microprocessor based relays be installed in a new control house within the substation yard. This control house is part of the 2016 Transmission Reliability Plan.

    2. Delay Project NPVRR: ($000s) 1,983k
       This option is not advisable as the possibility of misoperations will increase with time as well as the availability of replacement parts of the existing GCX relays will diminish as they become increasingly obsolete. This option assumes that one panel will fail prior to the house being replaced and will need to be replaced again as part of the house installation.

    3. Do Nothing: NPVRR: ($000s) N/A
       This option is not advisable as the failure of these relays will be imminent over a period of years, which will greatly increase the risk of misoperations. The scarcity of parts will surely increase and the existing control house condition will continue to deteriorate over many years. Additionally, choosing this option puts the company at risk of not being able to accomplish the objectives of the Transmission System Improvement Plan.

Project Description

- **Project Scope and Timeline**

Description	Date
Project Approval	April, 2017
Begin Engineering	April, 2017
Order Materials	June, 2017
Receive Materials	December, 2017
Begin Below Grade Work	October, 2017
Complete Below Grade Work	November, 2017
Begin Above Grade Work	November, 2017
Complete Above Grade Work	March, 2018
Project Complete	May, 2018

- **Project Cost**
  The total cost of this project will be $1,478k. $1,024k will be spent in 2017 with the remaining $454k to be spent in 2018. This project was included in the 2017 BP for $100k in 2016, $1,231k in 2017 and $425k in 2018. The proposed estimate is lower than the BP due to a more detailed estimate being completed. The additional funding needed in 2018 will be addressed in the 2018 BP. The estimated total project figure includes a 10% contingency. This contingency is expected to cover uncertainty with the contract labor costs based upon variances that have been noticed on past similar projects.

Economic Analysis and Risks

- **Bid Summary**
  Previously established blanket contract agreements will be utilized for related materials. Bids for any other necessary materials, as well as the below and above grade construction, will be sent out soon after project approval.

  Because of the expiration of funding of the LG&E and KU control house blanket, control houses were competitively bid and a vendor will be selected upon full funding of this project. Below is a summary table of the received bids for the control house.

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- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	2016	2017	2018	2019	Post 2019	Total
1. Capital Investment Proposed	-	1,015	443	-	-	1,458
2. Cost of Removal Proposed	-	9	11	-	-	20
3. Total Capital and Removal Proposed (1+2)	-	1,024	454	-	-	1,478
4. Capital Investment 2017 BP	100	1,217	425	-	-	1,742
5. Cost of Removal 2017 BP	-	14	-	-	-	14
6. Total Capital and Removal 2017 BP (4+5)	100	1,231	425	-	-	1,755
7. Capital Investment variance to BP (4-1)	100	202	(18)	-	-	284
8. Cost of Removal variance to BP (5-2)	-	5	(11)	-	-	(7)
9. Total Capital and Removal variance to BP (6-3)	100	206	(29)	-	-	277

Financial Detail by Year - O&M ($000s)	2017	2017	2018	2019	Post 2019	Total
1. Project O&M Proposed	-	-	-	-	-	-
2. Project O&M 2017 BP	-	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.5%
Capital Breakdown:	
Labor:	$80k
Contract Labor:	$497k
Materials:	$594k
Other:	$0
Local Engineering:	$98k
Burdens:	$79k
Contingency:	$130k
Reimbursements:	($0)
Net Capital Expenditure:	$1,478

- **Assumptions**
  Required outages are assumed to be able to be obtained within the requested timeframe. The control house is assumed to be placed in our initial location with no impact due to hard rocks underground. Weather is assumed to be fair enough to work on schedule with no delays to mobilization of contractors or delivery of material.

- **Environmental**
  This project does not require permitting and there are no known issues regarding air, water, waste, lead, or asbestos.

- **Risks**
  Poor reliability and potential misoperations is a risk of not doing this project. Weather may pose a risk as most construction work will be performed in the late fall of 2017 to spring of 2018. Outages may be delayed due to system loading requirements or other outages in the area.

Conclusions and Recommendation
It is recommended that the Investment Committee approve the Finchville Control House Replacement project for $1,478k to enhance the reliability of the Transmission system.

Capital Investment Proposal

Investment Proposal for Investment Committee Meeting on: N/A

Project Name: REL-Centerfield 604 Breaker Add

Total Expenditures: $906k (Including $84k of Contingency)

Project Number(s): 152108

Business Unit/Line of Business: Transmission Reliability Performance & Standards

Prepared/Presented By: Keith Yocum – Manager Reliability Performance & Standards

Executive Summary

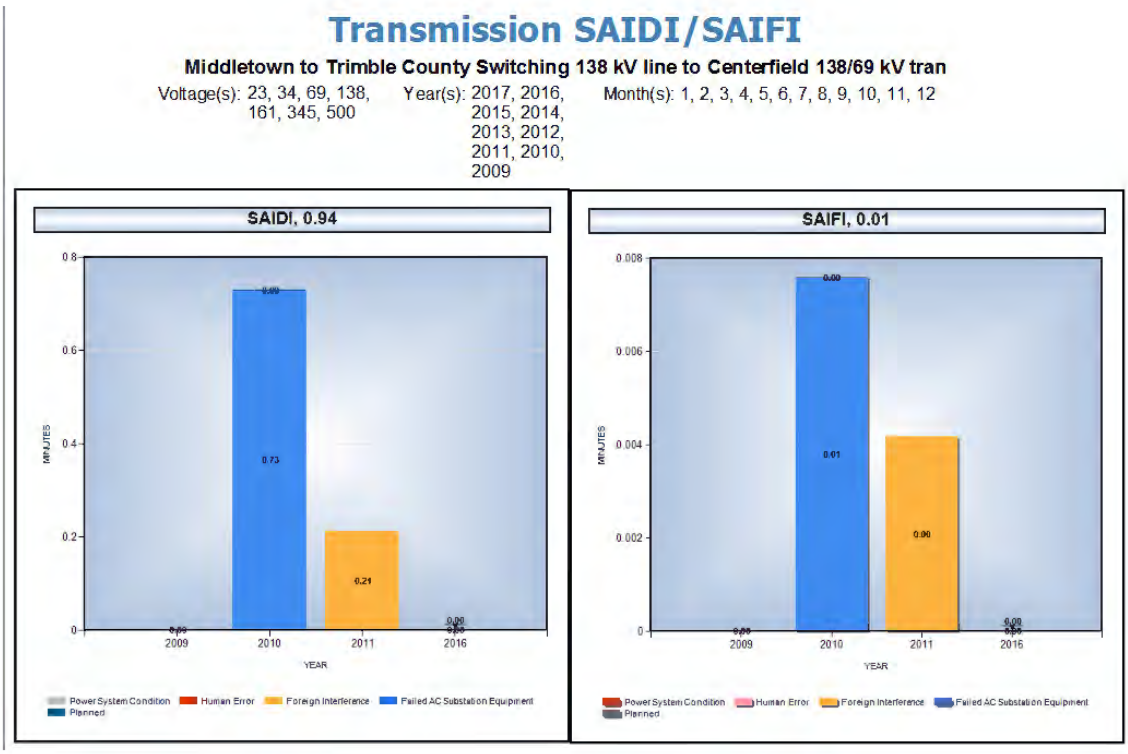
The Transmission Reliability Performance and Standards group identified the need for a breaker at the Centerfield substation to reduce the MegaWatt-Mile (MW-Mile is calculated by multiplying total miles of line exposure times the MWs served from the line) exposure on the Middletown to Trimble County Switching 138 kV line to Centerfield 138/69 kV tran. This line has significant MW-Mile exposure and has had close to a minute of SAIDI since 2009 for Transmission.

Middletown to Trimble County Switching 138 kV line to Centerfield 138/69 kV tran is 28.02 miles long and has 1 distribution transfomer tapped off of it which serve around 4,978 customers and 28.02 MW of load. A fault anywhere along this line will result in an outage on all customers. The placement of a breaker at Centerfield will reduce MW-Mile exposure from 855 to 375, a 56% reduction. Diagram 1 include in Appendix A depicts the configuration for Middletown to Trimble County Switching 138 kV line to Centerfield 138/69 kV tran.

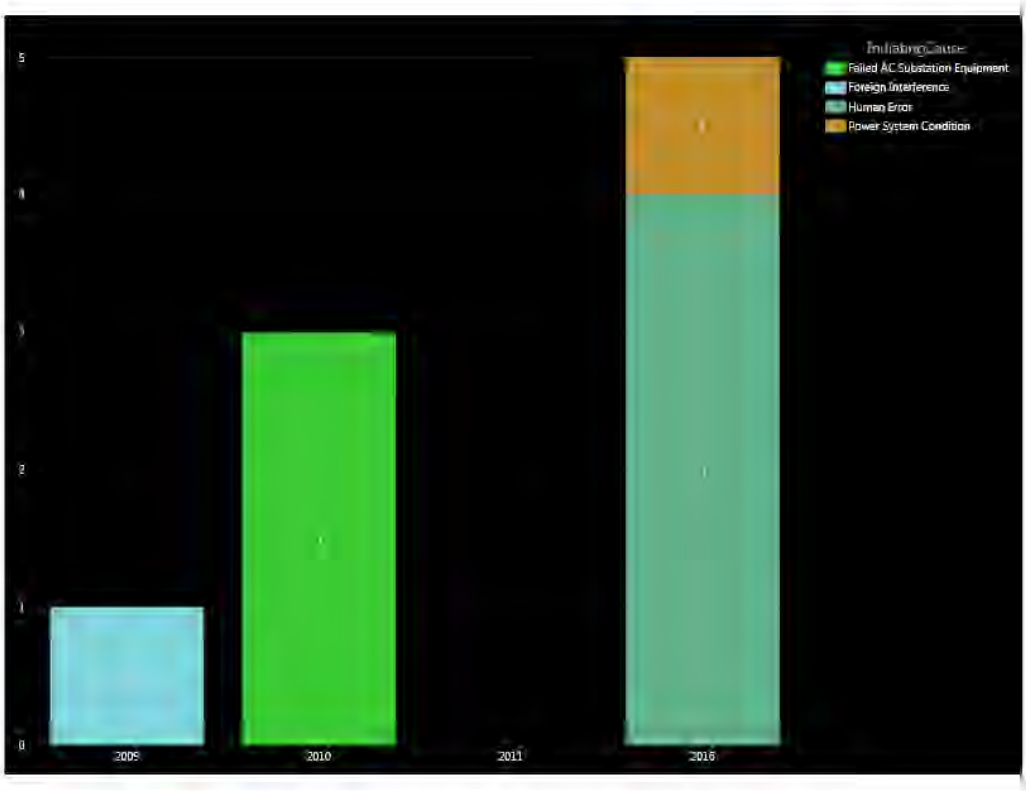
The total cost of this project is estimated at $906k with $149k in 2017, and the remaining $757k in 2018. The 2017 BP included $850k for this project in 2018. The budgeted amount was estimated based on similar projects that have been previously completed and has been updated based on the preliminary scope review and site visit performed. Of the proposed 2017 spending, $100k approved by the RAC in the 8+4 forecast and $49k is being funded by a reduction in project 153370.

Background
Middletown to Trimble County Switching 138 kV line to Centerfield 138/69 kV tranline has been a consistent high contributor to Transmission's SAIDI metric. This breaker will reduce the mileage exposure by half for all of the customers served by this line Therefore, for a given fault, only half as many customers will go out in the case with the breaker, as compared to the case without the breaker. This will also speed up restoration in that the line requiring patrol will also be cut in half.

The chart below shows the historical SAIDI/SAIFI (including MED) for this line:



The following graph shows the number of relay events since 2009 and their associated cause codes on the line



- **Alternatives Considered**
  1. Recommendation: NPVRR: ($000s) $1,018k
     It is recommended that a breaker be installed on the Middletown to Trimble County Switching 138 kV line to Centerfield 138/69 kV tran to limit the exposure of customers on a line that has historically had SAIDI issues. This recommendation assists Transmission in achieving the SAIDI targets established as part of the Transmission Reliability Plan (TRP), as well as reduces the number of customers that would otherwise experience a power outage during an event. In addition, this recommendation provides additional relay data to aid in restoring service quickly that includes information to help determine the cause and location of the event.

  2. Alternative #1: NPVRR: ($000s) $1,835k
     The next best alternative is to add 2 breakers at Centerfield. This includes the recommended breaker and a second breaker on the line to Middletown. This would eliminate line outages from impacting the nearly 5,000 customers at Centerfield. This

second breaker could be added at a later date after the recommended breaker. This alternative would provide greater overall reliability to Centerfield but would most likely double the overall project cost. This option is not the lowest cost alternative and is not recommended at this time.

3. Do Nothing: NPVRR: N/A
   This option is not advisable as this circuit has siginificant MW-Mile (customer outage) exposure and the current state of the line puts Transmission at risk of not being able to accomplish SAIDI targets established as part of the Transmission Reliability Plan which assumed the completion of this project.

Project Description

- **Project Scope and Timeline**

Description	Date
Project Approved for preliminary engineering	September, 2017
Materials Ordered	October, 2017
Materials Received	February - March, 2018
Project Approved for Full Funding	October, 2017
Below Grade Work Begins	March, 2018
Below Grade Work Completed	March, 2018
Above Grade Work Begins	March, 2018
Above Grade Work Completed	March, 2018
Project Complete	June, 2018

- **Project Cost**
  The total cost of this project is $906k with $149k in 2017 and $757k in 2018. The 2017 BP included $850k for this project. The budgeted amount was estimated based on similar projects that have been previously completed and has been updated based on the preliminary scope review and site visit. Of the proposed 2017 spending, $100k approved by the RAC in the 8+4 forecast and $49k is being funded by a reduction in 153370. The estimated total project figure includes a 10% contingency. This contingency is expected to cover uncertainty with the contract labor costs based upon variances that have been noticed on past similar projects, as well as unidentified risks that may come about during detailed engineering and with below grade construction.

Economic Analysis and Risks

- **Bid Summary**
  Previously established blanket contract agreements will be utilized for related materials. Bids for any other necessary materials, as well as the below and above grade construction, will be sent out soon after project approval.

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	2017	2018	2019	Post 2019	Total
1. Capital Investment Proposed	149	744	-	-	893
2. Cost of Removal Proposed	-	13	-	-	13
3. Total Capital and Removal Proposed (1+2)	149	757	-	-	906
4. Capital Investment 2017 BP	-	850	-	-	850
5. Cost of Removal 2017 BP	-	-	-	-	-
6. Total Capital and Removal 2017 BP (4+5)	-	850	-	-	850
7. Capital Investment variance to BP (4-1)	(149)	106	-	-	(43)
8. Cost of Removal variance to BP (5-2)	-	(13)	-	-	(13)
9. Total Capital and Removal variance to BP (6-3)	(149)	93	-	-	(56)

Financial Detail by Year - O&M ($000s)	2016	2017	2018	Post 2018	Total
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2017 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate: 6.32%
Capital Breakdown:
- Labor: $63k
- Contract Labor: $385k
- Materials: $219k
- Other: $0k
- Local Engineering: $89k
- Burdens: $66k
- Contingency: $84k
- Net Capital Expenditure: $906k

Spend (000's)	Substation	P&C	Telecom	Total
Company Labor	$ 23	$ 25	$ 15	**$ 63**
Contract Labor	$ 181	$ 204	$ -	**$ 385**
Materials	$ 107	$ 112	$ -	**$ 219**
Contingency	$ 39	$ 43	$ 2	**$ 84**
Raw total	**$ 350**	**$ 384**	**$ 17**	**$ 751**
Burdens				$ 155
Project Total				**$ 906**

- **Assumptions**
  - Suppliers and contractors will meet reasonable and customary delivery dates for materials and services.
  - The testing and validation for the operation of the new breaker is completed in the time frame scheduled for the project and not delayed due to the availability of resources. Delays could require additional mobilization costs for construction removal and cut-over to the new system.
  - Telecommunications scope to be confirmed during detailed engineering. Approximately $20K included in the estimate based on previous project costs. Additional required funds to be covered by contingency or returned to contingency.
  - Construction costs are estimated and not based on bid pricing.

- **Environmental**
  This project does not require permitting and there are no known issues regarding air, water, waste, lead, or asbestos.

- **Risks**
  - Completing the project involves risk related to construction work within an operating substation. This project involves installing new underground conduits and reconfiguring the existing system.
  - If the breaker is not added, Transmission will not achieve their targeted reduction in MW-Mile exposure as outlined in the Transmission Reliability Plan.

Conclusions and Recommendation

It is recommended that Management approve the Centerfield Breaker Addition project for $906k to enhance the reliability of the Transmission system.

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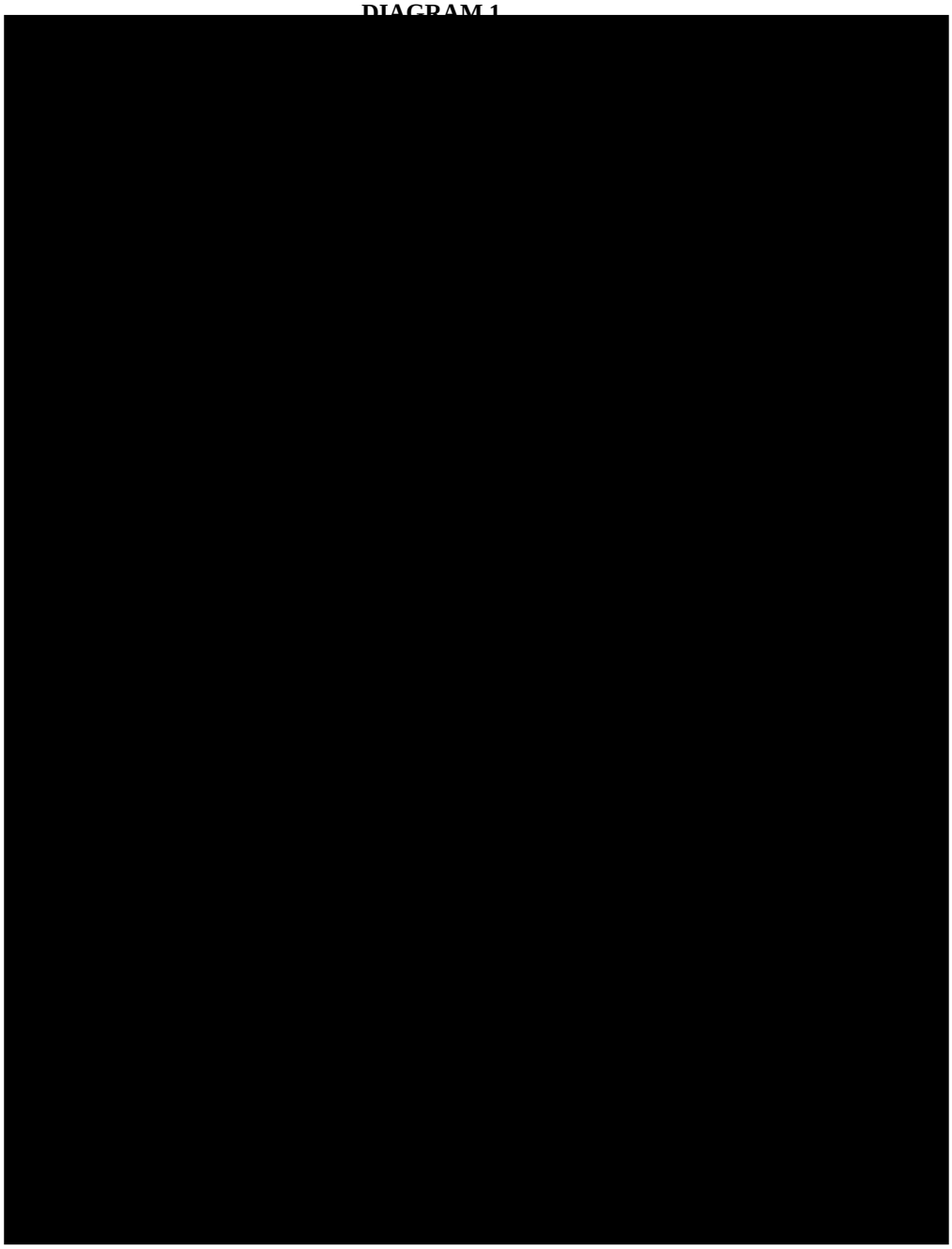
Appendix A

DIAGRAM 1



Capital Investment Proposal

Investment Proposal for Investment Committee Meeting on: N/A

Project Name: REL-Smyrna 604 Brkr Add

Total Expenditures: $987k (Including $92k of Contingency)

Project Number(s): 152109

Business Unit/Line of Business: Transmission Reliability Performance & Standards

Prepared/Presented By: Keith Yocum – Manager Reliability Performance & Standards

Executive Summary

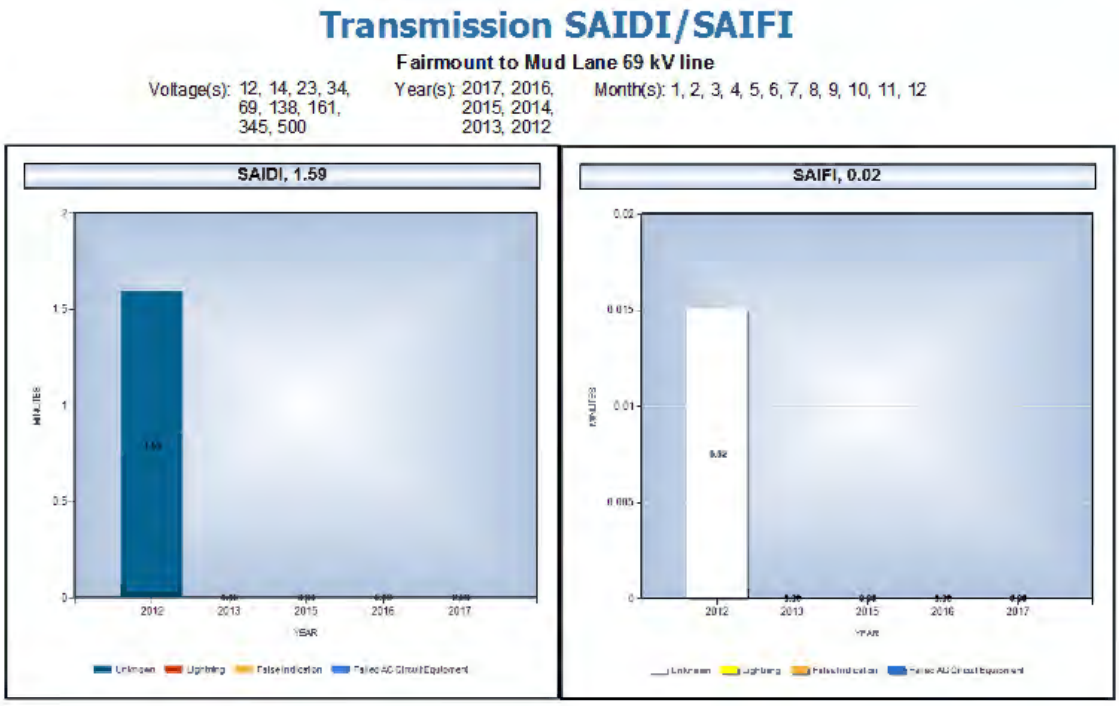
The Transmission Reliability Performance and Standards group identified the need for a breaker at the Smyrna substation to reduce the MegaWatt-Mile (MW-Mile is calculated by multiplying total miles of line exposure times the MWs served from the line) exposure on the Fairmount to Mud Lane 69 kV line.This line has significant MW-Mile exposure and has had 1.6 minutes of SAIDI_MED since 2012 for Transmission.

Fairmount to Mud Lane 69 kV line is 8.16 miles long and has 2 distribution transfomers tapped off of it which serve around 15,117 customers and 59.78 MW of load. A fault anywhere along this line will result in an outage on all Customers. The placement of a breaker at Smyrna will reduce MW-Mile exposure from 488to 226, a 54% reduction. Diagram 1 include in Appendix A depicts the configuration for Fairmount to Mud Lane 69 kV line.

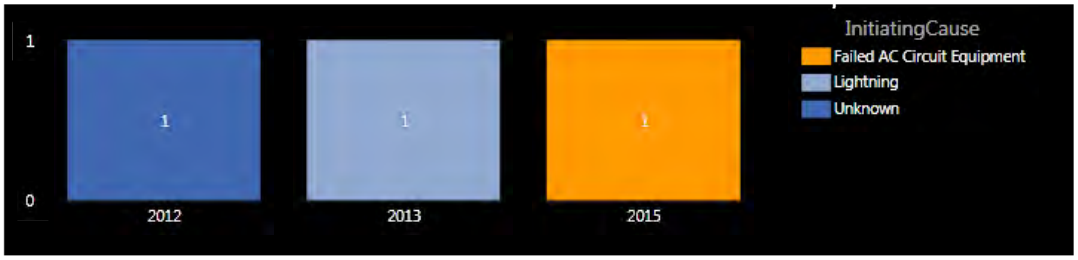
The total cost of this project is estimated at $987k with $34k in 2017 and $954k in 2018. The 2017 BP included $849K for this project in 2018. The 2017 portion was approved by the RAC in the 9+3 forecast. The 2018 portion was partially included in the 2018 BP ($793k) and the $161k remainder in 2018 will be funded by LTFFAIL18. The budgeted amount was estimated based on similar projects that have been previously completed and has been updated based on the preliminary engineering performed.

Background
Fairmount to Mud Lane 69 kV line has been a consistent high contributor to Transmission's SAIDI metric. This breaker will reduce the mileage exposure by half for all of the customers served by this line Therefore, for a given fault, only half as many customers will go out in the case with the breaker, as compared to the case without the breaker. This will also speed up restoration in that the line requiring patrol will also be cut in half.

The chart below shows the historical SAIDI/SAIFI (including MED) for this line:



The following graph shows the number of relay events since 2009 and their associated cause codes on the line:



- **Alternatives Considered**
  1. Recommendation: NPVRR: ($000s) $1,117k
     It is recommended that a breaker be installed on Fairmount to Mud Lane 69 kV line to limit the exposure of customers on a line that has historically had SAIDI issues. This recommendation assists Transmission in achieving the SAIDI targets established as part of the Transmission Reliability Plan (TRP), as well as reduces the number of customers that would otherwise experience a power outage during an event. In addition, this recommendation provides additional relay data to aid in restoring service quickly that includes information to help determine the cause and location of the event.

  2. Alternative #1: NPVRR: ($000s) $1,991k
     The next best alternative is to add 2 breakers, one at Smyrna and one at Fairmount. This includes the recommended breaker and a second breaker on the line at Fairmount. This alternative would provide limited reliability improvement but would most likely double the overall project cost. The additional breaker would be helpful to determine whether a fault is on the line or in the Fairmount substation. This option is not the lowest cost alternative and provides limited improvement and is not recommended at this time.

  3. Do Nothing: NPVRR: N/A
     This option is not advisable as this circuit has siginificant MW-Mile (customer outage) exposure and the current state of the line puts Transmission at risk of not being able to accomplish SAIDI targets established as part of the Transmission Reliability Plan which assumed the completion of this project.

Project Description

- **Project Scope and Timeline**

Description	Date
Project Initially Approved for preliminary engineering	N/A
Materials Ordered	November 2017
Materials Received	April, July-Oct 2018
Project Approved for Full Funding	October 2017
Below Grade Work Begins	September 2018
Below Grade Work Completed	October 2018
Above Grade Work Begins	October 2018
Above Grade Work Completed	November 2018
Project Complete	December 2018

- **Project Cost**
  The total cost of this project is estimated at $987k with $34k in 2017 and $954k in 2018. The 2017 BP included $849K for this project in 2018. The 2017 portion was approved by the RAC in the 9+3 forecast. The 2018 portion was partially included in the 2018 BP ($793k) and the $161k remainder in 2018 will be funded by LTFFAIL18. The budgeted amount was estimated based on similar projects that have been previously completed, and the project cost has been updated based on the preliminary scope review and site visit. The estimated total project figure includes a 10% contingency. This contingency is expected to cover uncertainty with the contract labor costs based upon variances that have been noticed on past similar projects, as well as unidentified risks that may come about during detailed engineering and with below grade construction.

Economic Analysis and Risks

- **Bid Summary**
  Previously established blanket contract agreements will be utilized for related materials. Bids for any other necessary materials, as well as the below and above grade construction, will be sent out soon after project approval.

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	2017	2018	Post 2018	Total
1. Capital Investment Proposed	34	949	-	983
2. Cost of Removal Proposed	-	5	-	5
3. Total Capital and Removal Proposed (1+2)	34	954	-	987
4. Capital Investment 2017 BP	-	849	-	849
5. Cost of Removal 2017 BP	-	-	-	-
6. Total Capital and Removal 2017 BP (4+5)	-	849	-	849
7. Capital Investment variance to BP (4-1)	(34)	(100)	-	(134)
8. Cost of Removal variance to BP (5-2)	-	(5)	-	(5)
9. Total Capital and Removal variance to BP (6-3)	(34)	(105)	-	(138)

Financial Detail by Year - O&M ($000s)	2017	2018	Post 2018	Total
1. Project O&M Proposed	-	-	-	-
2. Project O&M 2017 BP	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.5%
Capital Breakdown:	
Labor:	$55k
Contract Labor:	$435k
Materials:	$249k
Other:	$0k
Local Engineering:	$97k
Burdens:	$59k
Contingency:	$92k
Net Capital Expenditure:	$987k

Spend (000's)	Construction	P&C	Telecom	Total
Company Labor	$ 21	$ 19	$ 15	**$ 55**
Contract Labor	$ 196	$ 239	$ -	**$ 435**
Materials	$ 156	$ 93	$ -	**$ 249**
Contingency	$ 46	$ 44	$ 2	**$ 92**
Raw Total	**$ 419**	**$ 395**	**$ 17**	**$ 831**
Burdens				**$ 156**
Total				**$ 987**

- **Assumptions**
  - Suppliers and contractors will meet reasonable and customary delivery dates for materials and services.
  - The testing and validation for the operation of the new breaker is completed in the time frame scheduled for the project and not delayed due to the availability of resources. Delays could require additional mobilization costs for construction removal and cut-over to the new system.
  - Telecommunications scope to be confirmed during detailed engineering. Approximately $20K included in the estimate based on previous project costs. Additional required funds to be covered by contingency or returned to contingency.
  - Construction costs are estimated and not based on bid pricing.

- **Environmental**
  This project does not require permitting and there are no known issues regarding air, water, waste, lead, or asbestos.

- **Risks**
  - Completing the project involves risk related to construction work within an operating substation. This project involves installing new underground conduits and reconfiguring the existing system.
  - If the breaker is not added, Transmission will not achieve their targeted reduction in MW-Mile exposure as outlined in the Transmission Reliability Plan.

Conclusions and Recommendation

It is recommended that Management approve the Centerfield Breaker Addition project for $987k to enhance the reliability of the Transmission system.

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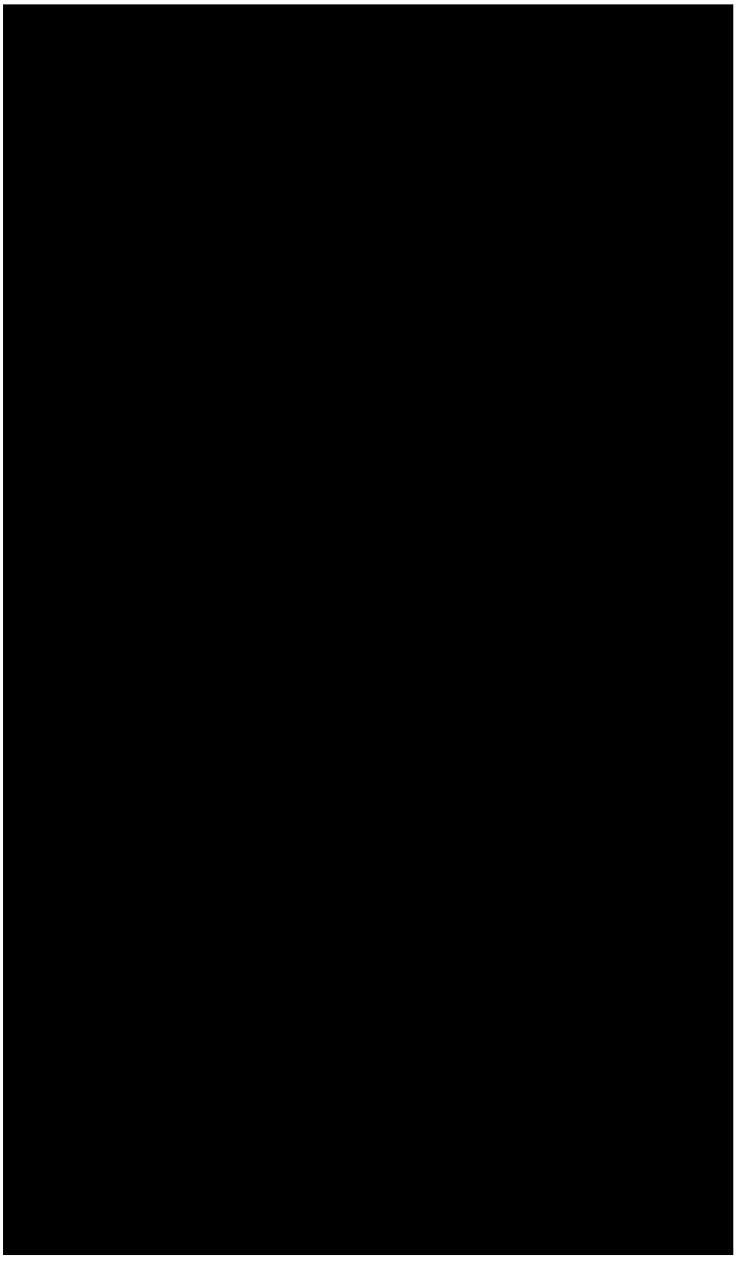
Appendix A



Capital Investment Proposal

Investment Proposal for Investment Committee Meeting on: January 25, 2017

Project Name: Mill Creek 2017 Breaker and Switch Replacements

Total Expenditures: $3,317k (Including $298k of Contingency)

Project Number(s): 152221

Business Unit/Line of Business: Transmission Substation Construction

Prepared/Presented By: Chris Talley – Manager Transmission Substation Construction

Executive Summary

The scope of this project includes the replacement of (2) 345kV and (4) 138kV circuit breakers along with (15) 138kV switches at the Mill Creek substation. The specific equipment that is being replaced is listed below in the "Background" section. All of the equipment being targeted for replacement under this project is part of the overall Transmission System Improvement Plan.

The overall 345kV breaker replacement program targets (12) effectively obsolete breakers across the system that have limited replacement parts, high SF6 leak rates, outdated operating specifications, and difficulties keeping in proper adjustment. Funding has been allocated to replace the remaining ten breakers prior to 2020. The design and construction of these specific breakers prevent them from reaching an average 60 years of useful life that is expected from the remaining in-service breakers.

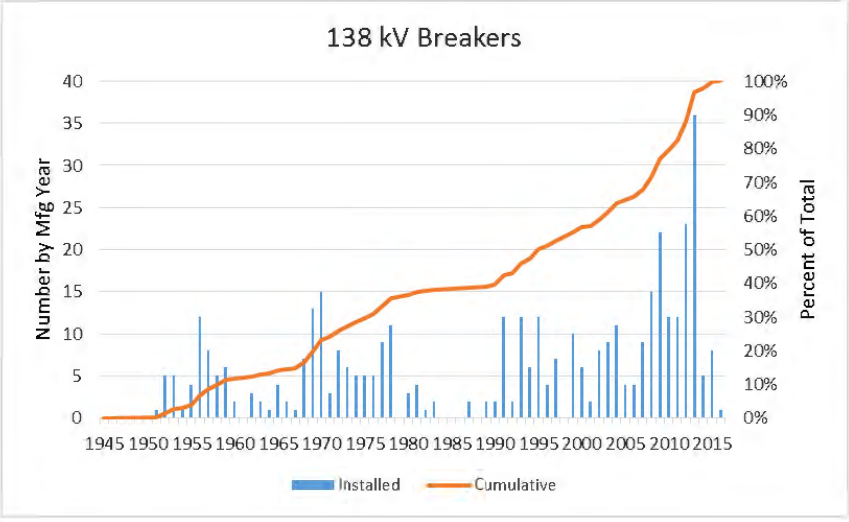
The (4) 138kV breakers being targeted for replacement at Mill Creek are part of a program to replace oil circuit breakers in the LKE system that meet particular criteria developed internally by LKE. The criteria driving the replacements of this equipment include maintenance history, insufficient continuous current capacity, insufficient interrupting current capability, repair vs. replace economics, and management of the age of the breaker fleet.

The (15) 138kV switches at Mill Creek being planned for replacement are associated switches with the (4) 138kV breakers and the remaining bus connected switches. These switches utilize cap and pin insulators, which have a historically high failure rate.

The project was opened for $453k during 2016 for preliminary engineering and materials with the understanding that the project would be presented for approval once detailed engineering was completed. The total cost of this project will be $3,317k, with $928k in 2016 and $2,389k in 2017. This project was included in the 2017 BP for $1,100k, with $453k in 2016 and $647k in 2017 which was for only (2) 345kV breaker replacements. Funding projects 151756 LG&E Breaker Replacements and 152621 LG&E Cap and Pin Replacements were included in the 2017 BP and will be reduced to cover the difference in 2017 and approved through the normal RAC process.

Background
LG&E/KU has seven vintage 1973-1982 dead tank two pressure ITE GA Sulfur Hexafluoride 345kV (SF6) gas breakers in-service. They employ complicated operating systems with two pressures blast valve systems for arc extinguishing, multi-breaker contacts, pre-insertion resistors and grading capacitors across the contacts which predisposes these types of breakers to many failure modes. These types of breakers hold up to 1,800 lbs. of gas compared to new style puffer breakers with around 340 lbs. and have infinitely more places to leak. These breakers have the highest gas leakage rates in our system. Since 2010 the combined leak total of these seven breakers is 1,088.6 pounds per year; the combined total of all remaining gas in our 107 newer style 345kV puffer breakers is 451.8 pounds per year. Currently, there are no regulatory implications as related to these gas leaks. These breakers ceased being manufactured in the late 1980's and are only marginally supported by the manufacturer at this point. There have been a combined 295 corrective maintenance orders since 2005. Parts for these breakers generally have to be made by third party machine shops. It is critical that the MC-4504-60 TIE breaker be replaced to improve the reliability of Mill Creek Unit 4 and reduce the risk of damage to the unit from a breaker failure.

Based on historical data, most circuit breakers reach the end of useful life at 60 years. The chart below outlines the age of the (417) 138kV breakers that are currently in service in the LKE system. Failure to fund this project and others that are similar will contribute to the ongoing concern of an aging infrastructure with equipment in service that has reached the end of its useful life and can no longer be properly maintained. The technology used for the construction of these breakers is antiquated and the high number of moving parts makes it challenging to keep all of the measurements within manufacturers specifications.



The switch replacements are driven by the need to remove cap and pin insulators, which have a history of mechanical failures. Insulators are used to isolate from ground and support energized conductors and substation equipment such as disconnect switches. The entire switch will be

replaced instead of only replacing the insulators and reusing the old switch assembly. Bus insulator failures can lead to an unplanned outage on the Mill Creek 138kV bus, which could impact the operation of the plant.

List of Equipment Being Replaced:

Breakers:
- MC-4532
- MC-4504-60 TIE
- MC-3834
- MC-138KVTR6
- MC-138KVTR5
- MC-138KVBUSTIE&TFR

Switches:
- MC-855 Bus
- MC-857 Bus
- MC-834 Line
- MC-834 Bus
- MC-138KV TR 6 TRANS
- MC-138KV TR 6 BUS
- MC-138KV TR 7 & 8 BUS
- MC-138KV BUS TIE & TFR SEC B
- 138kV BUS TIE
- MC-138KV BUS TIE & TFR SEC A
- MC-838 Bus
- MC-138KV TR 5 TRANS
- MC-138KV TR 5 BUS
- MC-866 BUS
- 138kV TR9 BUS

- **Alternatives Considered**
  1. Recommendation: NPVRR: ($000s) $3,671k
     It is recommended to replace the various 345kV breakers, 138kV breakers, switches and arresters at the Mill Creek substation. Parts from the breakers that are retired will be used to support other similar breakers that are still in service on the system.

  2. Alternative #1: NPVRR: ($000s) $3,891k
     The next best alternative is to replace all of the identified equipment gradually over a period of several years instead of completing the numerous replacements in one time period. Taking a logical approach the (2) 345kV breakers, (4)138kV breaker and (15) 138kV switches would be split into three separate projects completed over the next three years. Intermittently completing the required work is not recommended as inherent risks will remain for extended durations. Additionally, this alternative will ensure higher forecasted costs as well.

3. Do Nothing: NPVRR: ($000s) $4,194k
   This option is not advisable as the breakers currently in-service at Mill Creek have a history of maintenance issues and the parts necessary to alleviate these issues are no longer available, which requires additional maintenance activities as well. Expertise to maintain assets in the field are lacking or are not currently available. Specifically to the 345kV, these breakers historical have high leak rates. SF6 is currently being monitored by the EPA, but there are no compliance risks as of today.

   It is assumed both 345kV breakers will fail within 10 years and four 138kV breakers will fail within a fifteen year period. These assumptions are based on a mechanical failure were a component within the breaker is defective and replacement parts are not available and therefore repairs will not be possible. The current ongoing maintenance costs of the breakers in-service is $3,500 a year. The new breakers will have $500 a year in maintenance costs. If one of these breakers fails at certain time of year, more serious consequences could occur within the system, including the loss of customers.

   The 138kV disconnects currently in-service at Mill Creek are comprised of cap & pin insulators. During operation of these disconnects forces are applied to failing glue joints. If the glue joints catastrophically fail live parts have the potential to shear loose of the insulator, this type of failure poses serious consequences to the operator on the ground. Subsequent outage will impact the system. No maintenance cost are associated with these disconnects. It is assumed that a switch will mechanically fail every 2 years due to operational uses or forces applied during faults.

Project Description

The equipment to be replaced has been highlighted on the single line included in Appendix A.

- **Project Scope and Timeline**

Description	Date
Project Pre-Approved	September, 2016
Breakers Ordered	October, 2016
Breakers Received	December, 2016
Remaining Materials Ordered	February, 2017
345kV MC-4532 Breaker Replacement Work Begins	February, 2017
345kV MC-4532 Breaker Replacement Work Completed	March, 2017
Remaining Materials Received	March, 2017
345kV MC-4504-60 TIE Breaker Replacement Work Begins	October, 2017
345kV MC-4504-60 TIE Breaker Replacement Work Completed	October, 2017
138kV Breaker, Switch Replacement Work Begins	March, 2017
138kV Breaker, Switch Work Completed	April, 2017
Project Complete	December, 2017

- **Project Cost**
  The total cost of this project will be $3,317k, with $928k in 2016 and $2,389k in 2017. This project was included in the 2017 BP for $1,100k, with $453k in 2016 and $647k in 2017. In addition, funding projects 151756 LG&E Breaker Replacements and 152621 LG&E Cap and Pin Replacements were included in the 2017 BP. Reductions in these funding projects will cover the difference in 2017. The estimated total project figure includes a 10% contingency. This contingency is reasonable based on the level of detailed engineering and is expected to cover uncertainty with the contract labor costs based upon variances that have been observed on past similar projects.

Economic Analysis and Risks

- **Bid Summary**
  Previously established blanket contract agreements will be utilized for related materials. Bids for any other necessary materials, as well as the below and above grade construction, will be sent out soon after project approval.

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	2016	2017	2018	Post 2018	Total
1. Capital Investment Proposed	928	2,220	-	-	3,148
2. Cost of Removal Proposed	-	169	-	-	169
3. Total Capital and Removal Proposed (1+2)	928	2,389	-	-	3,317
4. Capital Investment 2017 BP	453	647	-	-	1,100
5. Cost of Removal 2017 BP	-	-	-	-	-
6. Total Capital and Removal 2017 BP (4+5)	453	647	-	-	1,100
7. Capital Investment variance to BP (4-1)	(475)	(1,573)	-	-	(2,048)
8. Cost of Removal variance to BP (5-2)	-	(169)	-	-	(169)
9. Total Capital and Removal variance to BP (6-3)	(475)	(1,742)	-	-	(2,217)

Financial Detail by Year - O&M ($000s)	2016	2017	2018	Post 2018	Total
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2017 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.5%
Capital Breakdown:	
Labor:	$58k
Contract Labor:	$1,277k
Materials:	$1,204k
Other:	$0k
Local Engineering:	$387k
Burdens:	$93k
Contingency:	$298k
Reimbursements:	($0k)
Net Capital Expenditure:	$3,317k

- **Assumptions**
  - Suppliers and contractors will meet reasonable and customary delivery dates for materials and services.
  - Outages required can be obtained with normal working hours

- **Environmental**
  This project does not require permitting and there are no known issues regarding air, water, waste, lead, or asbestos.

- **Risks**
  Completing the project involves risk related to high voltage substation construction work. Not completing the project decreases the reliability of the LKE Transmission system and introduces risks to the operation of the Mill Creek Generating Station.

Conclusions and Recommendation
It is recommended that the Investment Committee approve the Mill Creek 2017 Breaker and Switch Replacements project for $3,317k to enhance the reliability of the Transmission system.

Approval Confirmation for Capital Projects Greater Than or Equal to $1 million:

The Capital project spending included in this Investment Proposal has been approved by the members of the LKE Investment Committee. Pursuant to the LKE Authority Limit Matrix, the signatures below are also required for approval of this Capital project spending request.

Kent W. Blake.	Victor A. Staffieri
Chief Financial Officer	Chairman and CEO

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Appendix A

Capital Investment Proposal

Investment Proposal for Investment Committee Meeting on: N/A

Project Name: PR-Blue Lick (1) 345kV (1) 69kV BKR Project

Total Expenditures: $862k (Including $78k of Contingency)

Project Number(s): 152222

Business Unit/Line of Business: Transmission Substation Construction & Maintenance

Prepared/Presented By: Stephen Miranda

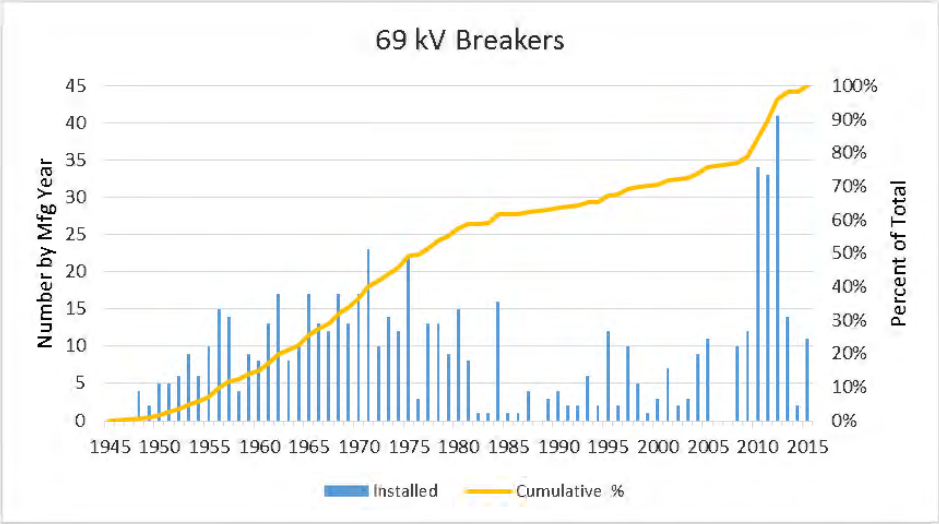
Executive Summary

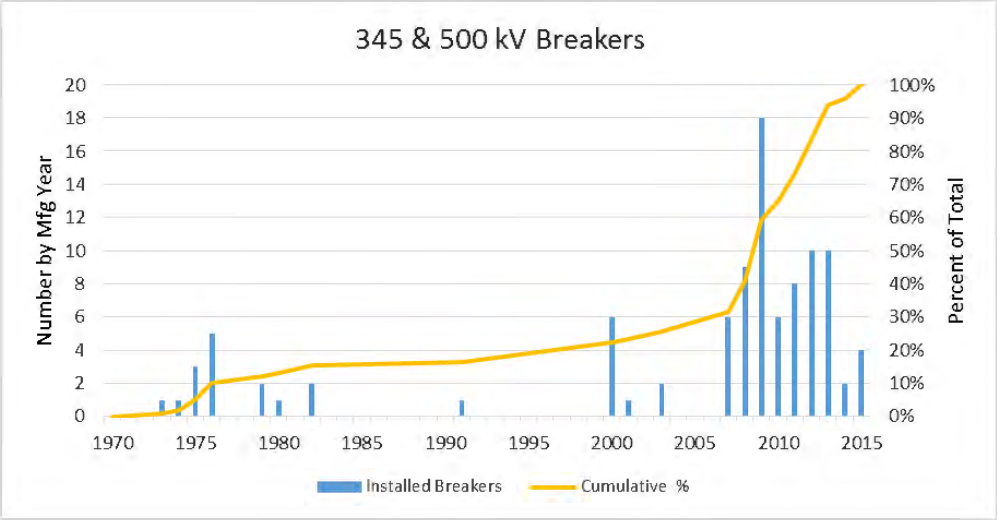
The scope of this project includes the replacement of (1) 345kV and (1) 69kV circuit breaker and associated equipment at the Blue Lick substation. The breakers that will be replaced are BL-4532-38 and BL-6676. This project proposes to proactively replace the cited equipment prior to failure, to ensure the integrity and reliability of the substation, and to prevent potential outages resulting from failure. The alternative of replacing the equipment upon failure will result in much higher long term replacement costs due to mobilization of crews back to the site each time one fails and the probable overtime work involved in replacing each during an emergency situation. This alternative would also have a negative impact on network reliability.

These breakers must be replaced due to a variety of drivers including age, reliability, and availability of replacement parts, known operational issues, and higher maintenance costs. The continued use of the breakers currently in-service is not prudent. The replacement of this equipment will lead to fewer unplanned outages and therefore increased reliability within the Transmission grid system.

This project was opened for preliminary engineering and materials during August 2016 and revised in March 2017 to increase the amount needed for engineering and materials. The project is being resubmitted now for the full amount of $862k based on detailed engineering with $256k in 2016 and $606k in 2017. The 2017 BP included $550k for this project with $200k in 2016 and $350k in 2017. The budgeted amount was estimated based on similar projects that have been previously completed and has been updated based on the preliminary engineering performed. The funding needed above the budgeted amount in 2016 was addressed by the RAC during 2016. The funding needed above the budget in 2017 ($256k) was partially funded by the RAC in the 3+9 forecast ($252k) and partially funded by a reduction in project KRTU-17 ($4k). The estimated total project figure includes a 10% contingency. This contingency is expected to cover uncertainty with the contract labor costs based upon variances that have been noticed on past similar projects.

Background
Based on historical data, most circuit breakers reach the end of useful life at 60 years. The chart below outlines the age of the breakers that are currently in service in the LKE system. Failure to fund this project and others that are similar will contribute to the ongoing concern of an aging infrastructure with equipment in-service that has reached the end of its useful life and can no longer be properly maintained. The technology used for the construction of these breakers is antiquated and the high number of moving parts makes it challenging to keep all of the measurements within manufacturers specifications.





The (1) 345kV circuit breakers, (1) 69kV circuit breaker are being targeted for replacement at Blue Lick are part of a program to replace oil circuit breakers in the LKE system that meet particular criteria developed internally by LKE. The criteria driving these replacements: Age and repair vs. replace economics, the 345kV circuit breaker is vintage 1950's and the 69kV breaker is vintage 1960's.

The associated breaker line arresters are being targeted for replacement at Blue Lick are part of a program to replace silicon carbide type arresters that provide little or no protection and failures typically result in high likelihood of collateral damage.

- **Alternatives Considered**
    1. Recommendation: NPVRR: ($000s) $1,003k
       It is recommended that (1) 345kV and (1) 69kV circuit breakers at (Blue Lick substation) and any associated equipment are replaced.

    2. Next Best Alternative: NPVRR: ($000s) $1,335k
       The next best alternative is to replace all of the identified equipment gradually over a period of several years instead of completing the numerous replacements in one time period. Intermittently completing the required work is not recommended as inherent risks will remain for extended durations. Additionally, this alternative will ensure higher forecasted costs as well.

    3. Do Nothing: NPVRR: ($000s) N/A
       This option is not advisable as the breakers currently in-service at Blue Lick substation have a significant history of maintenance issues and many of the parts necessary to alleviate their known issues are generally no longer available. The equipment in question also have higher maintenance costs as well. If any of this equipment were to fail, it could lead to an unplanned outage in the LKE Transmission system. Additionally, choosing this option puts the company at risk of not being able to accomplish the objectives of the Transmission System Improvement Plan.

Project Description

- **Project Scope and Timeline**

Scope:

- Remove (1) 69kV breaker and (1) 345kV breaker
- Install (1) new 69kV SF6 ABB breaker, 2000A, 40kA
- Install (1) new 345kV SF6 ABB breaker, 3000A, 63kA
- Install (9) new arresters on the 6676, 4532, and 4538 lines

Timeline:

Description	Date
Project Originally Approved	August, 2016

Materials Ordered	February 2017
Materials Received	July 2017
Below Grade Work Begins	August 2017
Below Grade Work Completed	September 2017
Above Grade Work Begins	August 2017
Above Grade Work Completed	September 2017
Project Complete	October 2017

- **Project Cost**
  The total cost of this project will be $862k and was approved by the RAC in the 2017 3+9 forecast for $858k. $4k was funded by a reduction in KRTU-17. The estimated total project figure includes a 10% contingency as the project is in its final stages of completion. This contingency is expected to cover uncertainty with the contract labor costs based upon variances that have been noticed on past similar projects.

Economic Analysis and Risks

- **Bid Summary**
  Previously established blanket contract agreements will be utilized for related materials. Bids for any other necessary materials, as well as the below and above grade construction, will be sent out soon after project approval.

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	2016	2017	2018	Post 2018	Total
1. Capital Investment Proposed	256	536	-	-	792
2. Cost of Removal Proposed	-	70	-	-	70
3. Total Capital and Removal Proposed (1+2)	256	606	-	-	862
4. Capital Investment 2017 BP	200	350	-	-	550
5. Cost of Removal 2017 BP	-	-	-	-	-
6. Total Capital and Removal 2017 BP (4+5)	200	350	-	-	550
7. Capital Investment variance to BP (4-1)	(56)	(186)	-	-	(242)
8. Cost of Removal variance to BP (5-2)	-	(70)	-	-	(70)
9. Total Capital and Removal variance to BP (6-3)	(56)	(256)	-	-	(312)

Financial Detail by Year - O&M ($000s)	2016	2017	2018	Post 2018	Total
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2017 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.5%
Capital Breakdown:	
Labor:	$44
Contract Labor:	$373
Materials:	$196
Other:	$5
Local Engineering:	$120
Burdens:	$46
Contingency:	$78
Reimbursements:	($0)
Net Capital Expenditure:	$862

- **Assumptions**
  - Existing foundations can be reused
  - Existing secondary cables for the 69kV breaker will be reused
  - Primary high side conductors will be replaced
  - TDI to scrap breakers
  - Can install arresters on existing steel
  - Required outages during normal working hours
  - Contract labor to complete equipment testing & relay commissioning
  - Equipment delivery to SSC or site
  - Construction crew to receive misc. equipment & material
  - Existing breakers are PCB free
  - No site/Civil work required
  - RTU points available for new spring discharge

- **Environmental**
  This project does not require permitting and there are no known issues regarding air, water, waste, lead, or asbestos. As a result, consulation with the Enviromental group has not been deemed necessary at this time.

- **Risks**
  Completing the project involves risk related to high voltage substation construction work. If action is not taken, there will continue to be challenges associated with keeping these breakers in good working order. There is also an increased probability of failure, reduction of system reliability through the occurrence of system outages and possible collateral damage in the event of a catastrophic failure.

Conclusions and Recommendation
It is recommended that Management approve the PR-Blue Lick (1) 345kV (1) 69kV BKR Project for $862k to enhance the reliability of the Transmission system.

Capital Investment Proposal

Investment Proposal for Investment Committee Meeting on: N/A

Project Name: PBR-Clifty Creek DL1/DL2 Breaker Replacement

Total Expenditures: $1,306k (Includes $119k (10%) Contingency)

Project Number(s): 152224

Business Unit/Line of Business: Transmission Substation Construction & Maintenance

Prepared/Presented By: Aaron Burns – Sargent & Lundy / Brent Birchell

Executive Summary

This project includes the replacements of (2) 345kV circuit breakers for Clifty Creek Substation.

The (2) 345kV breakers that are being targeted for replacement are part of a program to replace aging and obsolete transmission assets. The replacement of these breakers will reduce the risk of a potential failure and improve reliability of the Transmission system.

The total cost of this project will be $1,306k with $119k in 2018 and $1,187k in 2019. This project was included in the 2018 BP for $100k in 2018 and $1,100k in 2019. The higher 2018 spending has been approved by the RAC in the 7+5 forecast and the 2019 spending is included in the proposed 2019 BP. The proposed 2019 BP includes $111k in 2018 and $1,139k in 2019.

Background

The two (2) 345kV breakers are aging air blast type circuit breaker vintage 1975. In addition to age, these breakers have a history of maintenance issues. Asset Management has identified these two breakers as overdue for replacement. The replacement of these breakers will reduce risk of a potential failure and improve the reliability of the Transmission system.

The two (2) 345kV breakers are LG&E assets, however they are located in the Clifty Creek substation which is owned and operated by Indiana-Kentucky Electric Corporation (IKEC). IKEC is responsible for operation of the DL1 and DL2 circuit breakers, therefore it is recommend that IKEC standard Siemens SPS2-362-63 type circuit breakers are purchased for this project.

- **Alternatives Considered**
  1. Recommendation: NPVRR: ($000s) $1,426k
     It is recommended that the breakers be replaced to reduce the potential risk to the Transmission system.

  2. Alternative #1: NPVRR: ($000s) $1,519k
     The next best alternative is to replace all of the identified equipment gradually over a period of several years instead of completing the numerous replacements in one time period. Intermittently completing the required work is not recommended as inherent risks will remain for extended durations. Additionally, this alternative will result in a loss of efficiency that comes with packaging similar work at one location.

  3. Do Nothing: NPVRR: ($000s) $0k
     This option is not advisable as it puts Transmission at risk of not being able to accomplish targets established as part of the Transmission Reliability Plan.

Project Description

- **Project Scope and Timeline**

Description	Date
Project Approved	August 2018
Materials Ordered	September 2018
Materials Received	February 2019
Construction Complete	April 2019
Project Complete	July 2019

Project Cost

The total cost of this project will be $1,306k with $1119k in 2018 and $1,187k in 2019. The estimated total project figure includes a 10% contingency. This contingency is expected to cover uncertainty with the cost of expediting materials and premium cost for construction due to this being a pull forward project.

Economic Analysis and Risks

- **Bid Summary**
  IKEC is responsible for operation of the DL1 and DL2 circuit breakers, therefore it is recommend that IKEC standard Siemens SPS2-362-63 type circuit breakers are purchased for this project. Siemens does not currently have a blanket contract in place with LG&E/KU supply chain, therefore a Sole Source Award (SSA) will be utilized for procurement of the new circuit breakers. Bids for any other necessary materials, as well as the below and above grade construction, will be sent out soon after project approval.

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	2018	2019	Total
1. Capital Investment Proposed	119	1,168	1,287
2. Cost of Removal Proposed	-	19	19
3. Total Capital and Removal Proposed (1+2)	119	1,187	1,306
4. Capital Investment 2018 BP	100	1,100	1,200
5. Cost of Removal 2018 BP	-	-	-
6. Total Capital and Removal 2018 BP (4+5)	100	1,100	1,200
7. Capital Investment variance to BP (4-1)	(19)	(68)	(87)
8. Cost of Removal variance to BP (5-2)	-	(19)	(19)
9. Total Capital and Removal variance to BP (6-3)	(19)	(87)	(106)

Financial Detail by Year - O&M ($000s)	2018	2019	Total
1. Project O&M Proposed	-	-	-
2. Project O&M 2018 BP	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-

Financial Summary ($000s):
Discount Rate:
Capital Breakdown:

Labor:	$52k
Contract Labor:	$336k
Materials:	$516k
Other:	$0k
Local Engineering:	$174k
Burdens:	$109k
Contingency:	$119k
Net Capital Expenditure:	$1,306k

Assumptions
No major assumptions were included in the capital evaluation model. It is assumed material can be obtained in a timely manner. All assumptions were made prior to site visit.

- **Environmental**

This project does not require permitting and there are no known issues regarding air, water, waste, lead, or asbestos.

- **Risks**
  Completing the project involves risk related to high voltage substation construction work. Delaying this project exposes our system to the continuing risk of impacts from other potential transmission failures.

Conclusions and Recommendation
It is recommended that Management approve the Clifty Creek 345kV DL1 & DL2 breakers project for $1,306k to enhance the reliability of the Transmission system.

Capital Investment Proposal

Investment Proposal for Investment Committee Meeting on: June 26, 2017
Project Name: PBR-Middletown (5) Breaker Replacement
Total Expenditures: $2,478k (Including $200k of Contingency)
Project Number(s): 152226
Business Unit/Line of Business: Transmission Substation Construction
Prepared By: Chris Talley – Director Transmission Construction

Executive Summary

The scope of this project includes the replacement of (5) 345kV circuit breakers at the Middletown 345kV substation. The specific equipment that is being replaced is listed below in the "Background" section. All of the equipment being targeted for replacement under this project is part of the LG&E and KU Energy LLC (LKE) overall Transmission System Improvement Plan.

The Middletown project is part of the transmission system improvement plan to address existing 345kV high pressure live tank breakers prone to issues and failure. The overall 345kV breaker replacement program targeted (12) effectively obsolete breakers across the LKE system that have limited replacement parts, high SF6 leak rates, outdated operating specifications, and difficulties keeping in proper adjustment. Four of these breakers have been replaced, five will be replaced at Middletown in this project and the three remaining breakers have been included in the 2017 BP for replacement in 2019.

LKE will utilize (4) retired ABB breakers from the proposed Trimble Co. Combustion Turbine "TCT" breaker replacement project during the execution of Middletown 345kVA fifth breaker used in this project will be a breaker from another Trimble substation breaker replacement project that is scheduled for completion in the spring of 2018. These breakers will be charged to this proposed project at the remaining net book value amount.This project is scheduled for 2018 in the current business plan. The total cost of this project will be $2,478k, including $287k to fund engineering that will be pulled forward into 2017 and was approved by the RAC in the 5+7 forecast.

Background

LKE has six vintage 1975-1976 GE Type ATB-7 high pressure air blast, live tank breakers still in service. These breakers ceased being manufactured in the late 1970's and the manufacturer no longer supports the product. The technology used for the construction of these breakers is antiquated and the high number of moving parts makes it challenging to keep all of the

measurements within manufacturer's specifications. Parts are not readily available and must be manufactured when needed.

With limited internal expertise to maintain these breakers, LKE must rely on a single third party source for service. Maintenance with this style of breaker is intensive, requiring longer outage time extending up to two weeks versus days for new breaker types. The older style breakers also require additional equipment including cranes and lifts in order to work on the components. These breakers are susceptible to leaks and require consistent attention to ensure correct breaker operation. Since 2005 ATB-7's average 5 corrective maintenance work orders per year versus 1.5 work orders against the entire LKE breaker fleet.

The five breakers to he installed at Middletown 345kV will be ABB 362PMI63-20 breakers retired from the two current projects, Trimble Co. TCT (4) breaker replacement & Trimble Co. 4511 breaker replacement. While the ABB breakers are not suitable for use at Trimble County due to the increased dielectric stress introduced by synchronizing a generator, these breakers are rated for the operating environment at Middletown.

List of Equipment Being Replaced:

Proposed breakers slotted for replacement:

- MT-345kV TR 5
- MT-4531
- MT-4531-43 TIE
- MT-4538
- MT-4543

- **Alternatives Considered**
  1. Recommendation: NPVRR: ($000s) $2,775
     It is recommended to replace the (5) 345kV ATB breakers at the Middletown 345kV substation.

  2. Alternative #1: NPVRR: ($000s) $3,620
     The next best alternative is to replace the (5) 345kV breakers over a period of several years. This project could be divided into (3) projects. Intermittently completing the required work is not recommended as inherent risks will remain for extended durations. Additionally, this alternative will ensure higher overall cost due to inefficiencies with engineering and construction management.

  3. Do Nothing: NPVRR: ($000s) $3,007
     It is assumed that (5) 345kV breakers will fail within 20 years. These assumptions are based on a mechanical failure, where a component within the breaker is defective and replacement parts are not available and or catastrophic failure during fault clearing. This option is not advisable as the breakers currently in-service at Middletown 345kV have a history of maintenance issues.

The current ongoing maintenance costs of the high pressure breakers in-service is $4,000 a year per breaker. Each new breaker will have annual maintenance costs of $500.

Project Description

The equipment to be replaced has been highlighted on the single line included in Appendix A.

- **Project Scope and Timeline**

Description	Date
Project Approved	June, 2017
Breakers Ordered	N/A
Engineering Complete	November, 2017
Breakers Received	Retired from 2 Trimble Co. Projects
Remaining Materials Delivered	March, 2018
345kV MT-4531, 4543, 4531-4543 TIE Work Begins	April, 2018
345kV MT-4531, 4543, 4531-4543 TIE Work Completed	May, 2018
345kV MC-4538, TR7 Breaker Replacement Work Begins	November, 2018
345kV MC-4538, TR7 Breaker Replacement Work Completed	December, 2018
Project Complete	December, 2018

- **Project Cost**

  This project is scheduled for 2018 in the current business plan. The total cost of this project will be $2,478k. 2017 includes $287k to fund engineering and was approved by the RAC in the 5+7 Forecast. Contingency of $200k (9%) is included in this project to account for uncertainties during construction.

Economic Analysis and Risks

- **Bid Summary**

  Previously established blanket contract agreements will be utilized for related materials. Bids for any other necessary materials, as well as the below and above grade construction, will be sent out after project design completed.

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	2016	2017	2018	Post 2018	Total
1. Capital Investment Proposed		287	2,028		2,315
2. Cost of Removal Proposed			163		163
3. Total Capital and Removal Proposed (1+2)		287	2,191		2,478
4. Capital Investment 2017 BP			2,750		2,750
5. Cost of Removal 2017 BP					-
6. Total Capital and Removal 2017 BP (4+5)		-	2,750		2,750
7. Capital Investment variance to BP (4-1)		(287)	722		435
8. Cost of Removal variance to BP (5-2)		-	(163)		(163)
9. Total Capital and Removal variance to BP (6-3)		(287)	559		272

Financial Detail by Year - O&M ($000s)	2016	2017	2018	Post 2018	Total
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2017 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate: 6.5%

Labor:	$160
Contract Labor:	$1,092
Materials:	$680
Other:	
Local Engineering:	$193
Burdens:	$153
Contingency:	$200
Reimbursements:	
Net Capital Expenditure:	$2,478

- **Assumptions**
  - Suppliers and contractors will meet reasonable and customary delivery dates for materials and services.
  - Outages required can be obtained with normal working bours.

- **Environmental**
  This project does not require permitting and there are no known issues regarding air, water, waste, lead, or asbestos.

  This project involves the removal and installation of sulfur hexafluoride (SF6). There are no current environmental regulatory implications related to SF6 gas.

- **Risks**
  Completing the project involves risk related to high voltage substation construction work.

  Not completing the project decreases the reliability of the LKE Transmission system and introduces risks to the operation of the Middletown 345kV Generating Station.

  Breaker replacements are tied to the removal of Trimble Co. unit breakers, delays with the Trimble Co. replacements can impart delays on the Middletown replacements.

Conclusions and Recommendation
It is recommended that the Investment Committee approve the Middletown 345kV 2018 Breaker Replacements project for $2,478k to enhance the reliability of the Transmission system.

Approval Confirmation for Capital Projects Greater Than or Equal to $2 million:

The Capital project spending included in this Investment Proposal has been approved by the members of the LKE Investment Committee. Pursuant to the LKE Authority Limit Matrix, the signatures below are also required for approval of this Capital project spending request.

Kent W. Blake
Chief Financial Officer

Paul W. Thompson
President and Chief Operating Officer

Capital Investment Proposal

Investment Proposal for Investment Committee Meeting on: N/A

Project Name: Green River Plant Switch/Insulator/Arrester Replacements

Total Expenditures: $862k (Including $80k of Contingency)

Project Number(s): 152401

Business Unit/Line of Business: Transmission Substation Construction & Maintenance

Prepared/Presented By: Victor Payne – Electrical Engineer

Executive Summary

This project will include the replacement of cap and pin style insulators that supports the 138kV bus and switches and replacement of surge arresters at the Green River Plant substation. Additionally, equipment no longer in use at the substation including breakers, switches, feeders, and various bus work will be removed. This project is necessary to reduce risk of outages caused by failure of unused or deteriorating equipment. The execution of this project is vital to enhancing the reliability of the Transmission system in the area and was included in the Transmission Reliability Plan (TRP).

This project was initially approved for preliminary engineering during May 2017. Based on detailed engineering, the total cost of this project will be $862k and was approved by the RAC in the 5+7 forecast. $890k of funding was included in the 2017 BP for this project, with $270k in 2016 and $620k in 2017. The estimated total project figure includes a 10% contingency.

Background
There is equipment no longer being used at the substation due to configuration changes related to the retirement of the generating units at the Green River Power Plant (GRPP). Such equipment left in place poses a reliability risk to other equipment at the substation that is still in use. Of the equipment no longer in use, reusable equipment will be transferred to a storage area and out of the substation and Unusable equipment will be scrapped.

Additionally, equipment that will continue to be used will be replaced and/or relocated. (9) 138kV surge arresters will be replaced due to outdated technology being used. (15) 69kV surge arresters will be relocated to meet National Electric Safety Code Specifications (NESC) safety clearances. The new arresters will provide better protection to the equipment in the substation and reduce risk of potential equipment failures. 138kV cap and pin insulators in 7 bays will be replaced with station post insulators. Lastly, (8) 138kV switches and operators will be replaced with cap and pin insulators.

Installations:
- Replace (9) 138kV line arresters in positions 794, 744, 724.
- Replace and relocate (15) 69kV arresters in line positions 604, 614, 634, 644, and 654.
- Replace the (8) 138kV switches and operators with cap and pin insulators for 758T, 758B, 768T, 768B, 778T, 778B, 788T, and 788B.
- Replace the 138kV cap and pin insulators with station post insulators in (7) bays.

Removals:
- Relocate the 009-736 switch to the Earlington Operation Center to utilize as a future spare.
- Scrap 138kV breaker 009-746, 009-626, and TB541 breakers. TB514 is sitting on wood timbers in the 69kV substation.
- Remove 69kV switch and operator for 626G and bus work to the transformer.
- Remove 69kV switch 626B and operator but leave base and top (3) insulators supporting the 69kV bus.
- Remove (1) 138kV bus potential transformer disconnect switch and operator with cap and pin insulators.
- Remove the (4) 138kV breaker disconnect switches and operators 746B, 746G, 736G and 736B and associated tube bus connecting to the main 138kV bus.
- Remove the (7) 138kV transfer bus switches and operators 749, 727, 739 747, 769, 779 and 797.
- Remove transfer bus including (54) steel support structures and foundations, (81) cap and pin insulators and all associated HV bus work.
- Remove feeders between station take-off point position 746 and vertical angle pole in the line to the unit 4 GSU.
- Remove conductor between station take-off point position 736 and the unit 3 generator step-up unit (GSU) transformer take-off structure.

- **Alternatives Considered**
  1. Recommendation: NPVRR: ($000s) $1,001k
     It is recommended that the various switches, insulators, and arresters be replaced and any unnecessary abandoned equipment be retired from the Green River Plant

substation. This option will increase the reliability of the station and eliminate safety hazards.

2. Alternative #1: NPVRR: ($000s) $1,077k
   The next best alternate is to delay the work until additional signs of damage are present using visual inspections or hot spot identification methods. This is not recommended due to sudden failures of equipment that could cause unplanned outages or safety concerns. This option may be able to prevent some unplanned outages, but the increased costs of repairing damage during a failure and increase labor rates during emergency restoration will increase costs in the long term. This option also does not address any immediate safety concerns.

3. Do Nothing: NPVRR: ($000s) N/A
   This option is not advisable due to the risk of equipment failures that can cause unplanned outages and safety hazards. In addition, not doing the project will prevent us from meeting the goals of the TRP.

Project Description

- **Project Scope and Timeline**

Description	Date
Project Originally Approved	May 2017
Materials Ordered	July 2017
Materials Received	October, 2017
Above Grade Work Begins	October, 2017
Above Grade Work Completed	December, 2017
Project Complete	December, 2017

- **Project Cost**
  This project was initially approved for preliminary engineering during May 2017. Based on detailed engineering, the total cost of this project will be $862k and was approved by the RAC in the 5+7 forecast. $890k of funding was included in the 2017 BP for this project, with $270k in 2016 and $620k in 2017. The estimated total project figure includes a 10% contingency.

Economic Analysis and Risks

- **Bid Summary**
  Previously established blanket contract agreements will be utilized for related materials. Bids for any other necessary materials, as well as the below and above grade construction, will be sent out after project approval.

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	2017	2018	2019	Post 2019	Total
1. Capital Investment Proposed	713	-	-	-	713
2. Cost of Removal Proposed	149	-	-	-	149
3. Total Capital and Removal Proposed (1+2)	862	-	-	-	862
4. Capital Investment 2017 BP	206	437	-	-	643
5. Cost of Removal 2017 BP	64	183	-	-	247
6. Total Capital and Removal 2017 BP (4+5)	270	620	-	-	890
7. Capital Investment variance to BP (4-1)	(507)	437	-	-	(70)
8. Cost of Removal variance to BP (5-2)	(85)	183	-	-	98
9. Total Capital and Removal variance to BP (6-3)	(592)	620	-	-	28

Financial Detail by Year - O&M ($000s)	2016	2017	2018	Post 2018	Total
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2017 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

Financial Summary ($000s):

Discount Rate:	6.5%
Capital Breakdown:	
Labor:	$71k
Contract Labor:	$453k
Materials:	$137k
Other:	$0k
Local Engineering:	$55k
Burdens:	$66k
Contingency:	$80k
Reimbursements:	($0k)
Net Capital Expenditure:	$862k

- **Assumptions**
  - The requested outages for construction will be granted. The labor estimate assumes 4 day/week, 10 hour/day work week, with no special construction considerations to minimize the required outage window.
  - Suppliers and contractors will meet reasonable and expected delivery dates for materials and services

- **Environmental**
  This project does not require permitting and there are no known issues regarding air, water, waste, lead, or asbestos.

- **Risks**
  If the project is not completed there is increased risk of equipment failures that can cause unplanned outages and safety hazards. If the project is delayed those increased risks will remain. Also, due to the outages required to compete the work there is a risk that overtime rates or extra mobilizations could increase costs.

Conclusions and Recommendation
It is recommended that Management approve the Green River Plant Switch/Insulator/Arrester Replacements project for $862k to enhance the reliability of the Transmission system.

Investment Proposal Project 153346 Brown CT-Bardstown Pole Replacement

Investment Proposal for Investment Committee Meeting on: November 29, 2016

Project Name: Brown CT-Bardstown Pole Replacement

Total Expenditures: $5,221k
Total Contingency: $475k (10%)

Project Number(s): 153346

Business Unit/Line of Business: Transmission Lines

Prepared/Presented By: Ashley Burns/Adam Smith

Executive Summary

The proposed project is to replace eighty-six (86) wood structures on the Brown CT-Bardstown 138kV line with steel based on the results of a routine line inspection. The recommendation is to replace the structures energized due to the difficulty in obtaining an extended outage. If the opportunity to complete the project de-energized would occur, we would pursue this option and it would reduce the cost by $1,016k As such, this proposal is to proactively replace them over the course of the next year, prior to failure, to ensure the integrity and reliability of this line and to prevent outages resulting from such failures.

The alternative of replacing poles upon failure will result in much higher long term replacement costs due to mobilization of crews back to the site each time one fails and the probable overtime work involved in replacing each during an emergency situation. This alternative would also have a negative impact on network reliability.

This project is not included in the 2016 Business Plan, however is included in the proposed 2017 Business Plan under the K9-2017 Priority Pole Replacement Blanket. All spending will occur in 2017.

Background
Above ground pole inspections are performed by the company at defined intervals in order to discover problems that may impact the integrity and reliability of the Transmission System. During a routine climbing inspection of the Brown CT-Bardstown 138kV line, eighty-six (86) structures were identified as priority poles and found to be in need of replacement. All eighty-six (86) structures need to be replaced in order to ensure the integrity and reliability of this line. There are 271 total structures along this 39.19 mile line.

- **Alternatives Considered**
  1. Recommendation: NPVRR: ($000s) $6,549k
     The recommendation is to replace the structures energized due to the difficulty in obtaining an extended outage. If the opportunity to complete the project de-energized would occur, we would pursue this option and it would reduce the cost by $1,016k and the NVPRR by $1,274k.
  2. Alternative #1: NPVRR: ($000s) $10,211k
     The alternative of do nothing would result in replacing the poles upon failure, which would result in a much higher long term replacement cost due to contract crew mobilization and overtime costs. This cost was derived by an estimated percentage of failure over the next four years. The failure rate and costs may vary depending on environmental factors. This option would also have a negative impact on reliability.
  3. Alternative #2: NPVRR: ($000s) $8,120k
     The next best alternative would be to replace the eighty-six (86) structures with wood. The manufacturer's recommended life span of a wood pole is 30-35 years, whereas steel poles have a recommended life span of 90 years. This option assumes replacement of wood structures in 30 years and an escalation factor of 4% which is in line with market cost increases over the last 15 years.

Project Description

- **Project Scope and Timeline**
  The scope of work will consist of installing sixty-one (61) standard steel H-frames, twenty-one (21) custom steel H-frames, three (3) custom three-pole steel dead end structures, one (1) custom three-pole steel running corner, and associated hardware and material, and the removal of eighty-six (86) wood structures, and associated hardware and material. The line construction will be based on continuing contracts from our line contractors. B&B, Elliot, Groves, and Pike are the four contractors awarded the T&D Overhead Construction and Maintenance contract from the October 2011 Investment Committee meeting. The contract extension was re-approved by the IC in July of 2014. Construction is scheduled to begin in February of 2017 and be completed in August of 2017.

  The construction milestones for this project are provided below:

Construction Milestones	
November 2016	Engineering and Design
December 2016	Steel Poles Ordered
February 2017	Steel Poles Received

February 2017	Line Construction Begins
August 2017	Line Construction Completed

A facility map of the Brown CT-Bardstown 138kV line is shown below:
Line length: 39.19 miles

- **Project Cost**
  The total project cost is $5,221k and was not included in the 2016 Business Plan, however is included in the proposed 2017 Business Plan under the K9-2017 Priority Pole Replacement blanket. All spending will occur in 2017. Historical and existing contract and purchasing agreements were used to estimate the cost of material and contract labor. This project contains a 10% contingency which is reasonable based on the level of detailed engineering, confidence in cost of materials and contractors, and potential unknown risks such as weather delays, rock, structure access, and potential outage restrictions.

Economic Analysis and Risks

- **Bid Summary**
  Based on preliminary engineering, Transmission Lines has estimated the material package for construction of this project to be $1,788k. This project will utilize standard and custom steel structures. The steel structures will be purchased through our steel pole alliance partner, Trinity Meyer. Hardware will be purchased through Brownstown Electric Supply. The line construction will be based on continuing contracts with our line contractors. Davis H. Elliot,

Pike Electric, B&B Electric and William E. Groves are the four main contractors which have been awarded the T&D Overhead Construction and Maintenance contracts.

Transmission Lines Material Cost Breakdown	
Material	**Cost**
Steel Poles	$1,689k
Hardware	$99k
Total	$1,788k

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	**2017**	**2018**	**2019**	**Post 2019**	**Total**
1. Capital Investment Proposed	4,802	-	-	-	4,802
2. Cost of Removal Proposed	419	-	-	-	419
3. Total Capital and Removal Proposed (1+2)	5,221	-	-	-	5,221
4. Capital Investment 2016 BP	-	-	-	-	-
5. Cost of Removal 2016 BP	-	-	-	-	-
6. Total Capital and Removal 2016 BP (4+5)	-	-	-	-	-
7. Capital Investment variance to BP (4-1)	(4,802)	-	-	-	(4,802)
8. Cost of Removal variance to BP (5-2)	(419)	-	-	-	(419)
9. Total Capital and Removal variance to BP (6-3)	(5,221)	-	-	-	(5,221)

Financial Detail by Year - O&M ($000s)	**2016**	**2017**	**2018**	**Post 2018**	**Total**
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2016 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

This project was not included in the 2016 BP, however is included in the proposed 2017 BP under the K9-2017 Priority Pole Replacement Blanket. All spending will occur in 2017.

Financial Summary ($000s):

Discount Rate:	6.49%
Capital Breakdown:	
Labor:	$120k
Contract Labor:	$2,351k
Materials:	$1,788k
Local Engineering:	$331k
Burdens:	$156k
Contingency:	$475k
Reimbursements:	($0k)
Net Capital Expenditure:	$5,221k

Financial Analysis - Project Summary ($000)	2017	2018	2019	2020	2021	Life of Project
Project Net Income	$ 111	$ 210	$ 202	$ 195	$ 188	$ 4,656
Project ROE	5.1%	7.5%	10.0%	10.0%	10.0%	9.8%

- **Assumptions**

  Recommendation – The cost of this alternative assumes that the line outage will not be available and the structure replacements will need to be completed with the 138kV line energized.

  Do nothing alternative – The cost of this alternative would be approximately 60% higher due to overtime labor charges and the cost to mobilize and demobilize the construction crews. These poles would fail and require replacement within the next four years.

  Next best alternative - The cost of this alternative assumes the cost of the wood poles is 42% of the cost of the steel poles, and that the wood poles would be replaced again in 30 years.

- **Environmental**
  There are no known environmental issues regarding air, water, lead, asbestos, etc., associated with this project.

- **Risks**
  Without the proposed replacement of the priority poles on the Brown CT-Bardstown 138kV line, the company risks unplanned outages and increased cost of repairs in emergency situations. Inclement weather which affects site access and working conditions could increase the project cost and cause schedule delays.

Conclusions and Recommendation
It is recommended that the Investment Committee approve the Brown CT-Bardstown 138kV project for $5,221k to maintain system integrity, reliability, and to prevent failures and unplanned outages.

Approval Confirmation for Capital Projects Greater Than or Equal to $1 million:

The Capital project spending included in this Investment Proposal has been approved by the members of the LKE Investment Committee. Pursuant to the LKE Authority Limit Matrix, the signatures below are also required for approval of this Capital project spending request.

Kent W. Blake Chief Financial Officer	Victor A. Staffieri Chairman, CEO and President

Investment Proposal 153347 Clinton-South Paducah Pole Replacement

Investment Proposal for Investment Committee Meeting on: October 26, 2016

Project Name: Clinton-South Paducah Pole Replacement

Total Expenditures: $4,080k
Total Contingency: $375k (10%)

Project Number(s): 153347

Business Unit/Line of Business: Transmission Lines

Prepared/Presented By: Ronnie Bradford/Adam Smith

Executive Summary

The proposed project is to replace ninety-five (95) wood structures on the Clinton-South Paducah 69kV line with steel, during a routine outage, based on the results of a routine line inspection. To ensure construction of the project will begin in January of 2017, the project is being submitted for approval so material can be ordered in November of 2016 and received in January of 2017.

This proposal it to proactively replace the structures over the course of the next year, prior to failure, to ensure the integrity and reliability of this line and to prevent outages resulting from such failures. The alternative of replacing poles upon failure will result in much higher long term replacement costs due to mobilization of crews back to the site each time one fails and the probable overtime work involved in replacing each during an emergency situation. This alternative would also have a negative impact on network reliability.

The total project cost is $4,080k and is included in both the 2016 Business Plan and the proposed 2017 Business Plan under the K9-2017 priority pole replacement blanket. All spending will occur during 2017. The project was included in the 2016 BP under the K9-2017 priority pole replacement blanket.

Background
Above ground pole inspections are performed by the company at defined intervals in order to discover problems that may impact the integrity and reliability of the Transmission System. A routine climbing inspection of the Clinton-South Paducah 69kV line was completed in 2014, and ninety-five (95) structures were identified as priority poles and determined to be in need of replacement in order to ensure the integrity and reliability of this line. There are 274 total structures along this 36.58 mile line.

- **Alternatives Considered**
  1. Recommendation: NPVRR: ($000s) $5,552k
     The recommendation is to replace all ninety-five (95) structures during a scheduled outage.
  2. Alternative #1-Do Nothing: NPVRR: ($000s) $7,999k
     The alternative of do nothing would result in replacing the poles upon failure, which would result in a much higher long term replacement cost due to contract crew mobilization and overtime costs. This cost was derived by an estimated percentage of failure over the next four years. The failure rate and costs may vary depending on environmental factors. This option would also have a negative impact on network reliability.
  3. Alternative #2-Next Best Alternative: NPVRR: ($000s) $5,583k
     The next best alternative would be to replace the poles with wood structures. The manufacturer's recommended life span of a wood pole is 30-35 years, whereas steel poles have a recommended lifespan of 90 years. This option assumes replacement of wood structures in 30 years and an escalation rate of 4% which is in line with market cost increases over the last 15 years.

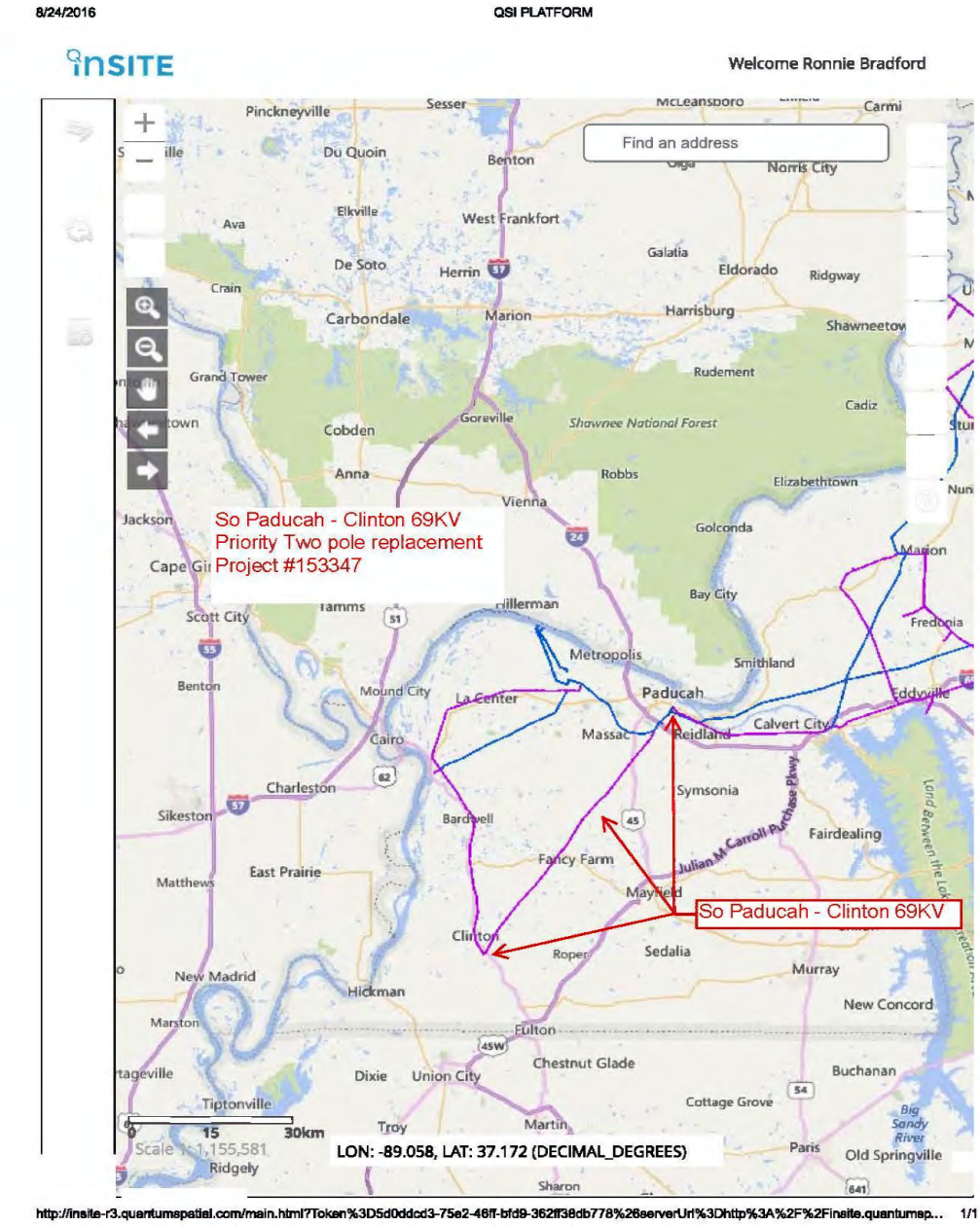
Project Description

- **Project Scope and Timeline**
  The scope of work will consist of installing ninety-two (92) standard steel H-frame structures, two (2) steel 3-pole running corners, one (1) steel 1-pole horizontal post structure, and associated hardware and material, and the removal of ninety-five (95) wood structures, and associated hardware and material. The line construction will be based on continuing contracts from our line contractors. B&B, Elliot, Groves and Pike are the four contractors awarded the T&D Overhead Construction and Maintenance contract from the October 2011 Investment Committee meeting. The contract extension was re-approved by the IC in July of 2014. Construction is scheduled to begin in January of 2017 and be completed in April of 2017.

  The construction milestones for this project are provided below:

Construction Milestones	
October 2016	Engineering and Design
November 2016	Steel Poles Ordered
January 2017	Steel Poles Received
January 2017	Line Construction Begins
April 2017	Line Construction Completed

A facility map of the Clinton-South Paducah 69kV line is shown below:
Line length: 36.58 miles



- **Project Cost**
  The total project cost is $4,080k and is included in both the 2016 Business Plan and the proposed 2017 Business Plan under the K9-2017 priority pole replacement blanket. Historical and existing contract and purchasing agreements were used to estimate the cost of material and contract labor. This project contains a 10% contingency which is reasonable based on the level of detailed engineering, confidence in cost of materials and contractors, and potential unknown risks such as weather delays, rock, structure access, and potential outage restrictions. This level of contingency is consistent with similar projects completed in recent years.

Economic Analysis and Risks

- **Bid Summary**
  Based on preliminary engineering, Transmission Lines has estimated the material packages for construction of this project to be $1,964k. This project will utilize standard steel structures. The steel structures will be purchased through our steel pole alliance partner, Trinity Meyer. The line construction will be based on continuing contracts with our line contractors. Davis H. Elliot, Pike Electric, B&B Electric and William E. Groves are the four main contractors which have been awarded the T&D Overhead Construction and Maintenance contracts.

Transmission Lines Material Cost Breakdown	
Material	**Cost**
Steel Poles	$1,792k
Hardware	$172k
Total	$1,964k

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	**2017**	**2018**	**2019**	**Post 2019**	**Total**
1. Capital Investment Proposed	3,889	-	-	-	3,889
2. Cost of Removal Proposed	191	-	-	-	191
3. Total Capital and Removal Proposed (1+2)	4,080	-	-	-	4,080
4. Capital Investment 2016 BP	3,889	-	-	-	3,889
5. Cost of Removal 2016 BP	191	-	-	-	191
6. Total Capital and Removal 2016 BP (4+5)	4,080	-	-	-	4,080
7. Capital Investment variance to BP (4-1)	0	-	-	-	0
8. Cost of Removal variance to BP (5-2)	-	-	-	-	-
9. Total Capital and Removal variance to BP (6-3)	0	-	-	-	0

Financial Detail by Year - O&M ($000s)	**2017**	**2018**	**2019**	**Post 2019**	**Total**
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2016 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

This project was included in both the 2016 BP and 2017 BP under K9-2017.

Financial Summary ($000s):

Discount Rate:	6.49%
Capital Breakdown:	
Labor:	$61k
Contract Labor:	$1,295k
Materials:	$1,964k
Local Engineering:	$261k
Burdens:	$124k
Contingency:	$375k
Reimbursements:	($0)
Net Capital Expenditure:	$4,080k

Financial Analysis - Project Summary ($000)	2017	2018	2019	2020	2021	Life of Project
Project Net Income	$63	$200	$190	$181	$173	$3,926
Project ROE	6.0%	8.0%	10.0%	10.0%	10.0%	9.8%

- **Assumptions**

  Recommendation – This alternative assumes that the line outage will be available and that all ninety-five (95) structures will be replaced during this timeframe.

  Alternative #1 – This cost of this alternative would be approximately 60% higher due to overtime labor charges and the cost to mobilize and demobilize construction crews. These poles would fail and require replacement within the next four years.

  Alternative #2 – The cost of this alternative assumes the cost of the wood poles is 36% the cost of the steel poles, and that the wood poles would be replaced again in 30 years.

- **Environmental**
  There are no known environmental issues regarding air, water, lead asbestos, etc., associated with this project.

- **Risks**
  Without the proposed replacement of the priority poles on the Clinton-South Paducah 69kV line, the company risks unplanned outages and increased cost of repairs in emergency situations. Inclement weather, which affects site access and working conditions, could increase the project cost and cause schedule delays. Schedule delays may also occur if the requested outage is not obtained to complete the scheduled work.

Conclusions and Recommendation
It is recommended that the Investment Committee approve the Clinton-South Paducah Pole Replacement project for $4,080k to maintain system integrity, reliability, and to prevent failures and unplanned outages.

Approval Confirmation for Capital Projects Greater Than or Equal to $1 million:

The Capital project spending included in this Investment Proposal has been approved by the members of the LKE Investment Committee. Pursuant to the LKE Authority Limit Matrix, the signatures below are also required for approval of this Capital project spending request.

Kent W. Blake Chief Financial Officer	Victor A. Staffieri Chairman, CEO and President

Investment Proposal Project 153348 Crittenden County Tap Pole Replacement

Investment Proposal for Investment Committee Meeting on: December 19, 2016

Project Name: Crittenden County Tap Pole Replacement

Total Expenditures: $2,347k
Total Contingency: $215k (10%)

Project Number(s): 153348

Business Unit/Line of Business: Transmission Lines

Prepared/Presented By: Ronnie Bradford/Adam Smith

Executive Summary

The proposed project is to replace sixty-eight (68) wood structures on the Crittenden County Tap 69kV line with steel based on the results of a routine line inspection. The recommendation is to replace the structures energized due to the difficulty in obtaining an extended outage. If the opportunity to complete the project de-energized would occur, we would pursue this option and it would reduce the cost by $405k. As such, this proposal is to proactively replace them over the course of the next year, prior to failure, to ensure the integrity and reliability of this line and to prevent outages resulting from such failures. This project also includes installation of a new switch at the Dycusburg Tap point, which will facilitate construction through enhanced switching capabilities and limit customer impacts during project execution. A transmission reliability improvement project to install a switch at Dycusburg was included in the 2016 Business Plan for 2018 under project 147492. Accelerating the switch to align with the pole replacement project will limit customer impacts from this project and provide future reliability benefits.

The alternative of replacing poles upon failure will result in much higher long term replacement costs due to mobilization of crews back to the site each time one fails and the probable overtime work involved in replacing each during an emergency situation. This alternative would also have a negative impact on network reliability.

The total project cost is $2,347k. The proposed pole replacement was not included in the 2016 BP, however is included in the proposed 2017 Business Plan under the K9-2017 priority pole replacement blanket. The portion of the project related to the switch installation ($21k) was also not included in the 2016 BP under this project, however, as noted, was included in the Dycusburg Switch installation project (147492) for $351k in 2018. All spending will occur during 2017.

Background
Above ground pole inspections are performed by the company at defined intervals in order to discover problems that may impact the integrity and reliability of the Transmission System. A routine climbing inspection of the Crittenden County Tap 69kV line was completed in 2014, and sixty-eight (68) structures were identified as priority poles and determined to be in need of replacement in order to ensure the integrity and reliability of this line. There are 299 total structures along this 24.60 mile line. This project also includes installation of a new switch at the Dycusburg Tap point, which will facilitate construction through enhanced switching capabilities and limit customer impacts during project execution. Accelerating the switch to align with the pole replacement project will limit customer impacts from this project and provide future reliability benefits.

- **Alternatives Considered**
  1. Recommendation: NPVRR: ($000s) $2,944
     The recommendation is to replace the structures, and complete the switch installation energized due to the difficulty in obtaining an extended outage. If the opportunity to complete the project de-energized would occur, we would pursue this option and it would reduce the cost by $405k and the NVPRR by $508k.
  2. Alternative #1: NPVRR: ($000s) $4,509k
     The alternative of do nothing would result in replacing the poles upon failure, which would result in a much higher long term replacement cost due to contract crew mobilization and overtime costs. This cost was derived by an estimated percentage of failure over the next four years. The failure rate and costs may vary depending on environmental factors. This option would also have a negative impact on network reliability.
  3. Alternative #2: NPVRR: ($000s) $3,472k
     The next best alternative would be to replace the poles with wood structures. The manufacturer's recommended life span of a wood pole is 30-35 years, whereas steel poles have a recommended lifespan of 90 years. This option assumes replacement of wood structures in 30 years and an escalation rate of 4% which is in line with market cost increases over the last 15 years.

Project Description

- **Project Scope and Timeline**
  The scope of work will consist of installing eighteen (18) standard and custom steel H-frame structures, one (1) custom steel switch structure, two (2) custom steel vertical dead end structures, forty-seven (47) steel davit arm structures, and associated hardware and material, and the removal of sixty-eight (68) wood structures, and associated hardware and material. The line construction will be based on continuing contracts from our line contractors. B&B, Elliot, Groves and Pike are the four contractors awarded the T&D Overhead Construction and Maintenance contract from the October 2011 Investment Committee meeting. The contract extension was re-approved by the IC in July of 2014. Construction is scheduled to begin in March of 2017 and be completed in June of 2017.

Construction Milestones	
December 2016	Engineering and Design
December 2016	Steel Poles Ordered
February 2017	Steel Poles Received
March 2017	Line Construction Begins
June 2017	Line Construction Completed

A facility map of the Crittenden County Tap 69kV line is shown below:
Line length: 24.6 miles

- **Project Cost**
  The total project cost is $2,347k. The proposed pole replacement was not included in the 2016 BP, however is included in the proposed 2017 Business Plan under the K9-2017 priority pole replacement blanket. The portion of the project related to the switch installation ($21k) was also not included in the 2016 BP under this project, however, as noted, was included in the Dycusburg Switch installation project (147492) for $351k in 2018. All spending will occur during 2017. Historical and existing contract and purchasing agreements were used to estimate the cost of material and contract labor. This project contains a 10% contingency which is reasonable based on the level of detailed engineering, confidence in cost of materials and contractors, and

potential unknown risks such as weather delays, rock, structure access, and potential outage restrictions.

Economic Analysis and Risks

- **Bid Summary**
  Based on preliminary engineering, Transmission Lines has estimated the material packages for construction of this project to be $789k. This project will utilize standard and custom steel structures. The steel structures will be purchased through our steel pole alliance partner, Trinity Meyer. The line construction will be based on continuing contracts with our line contractors. Davis H. Elliot, Pike Electric, B&B Electric and William E. Groves are the four main contractors which have been awarded the T&D Overhead Construction and Maintenance contracts.

Transmission Lines Material Cost Breakdown	
Material	**Cost**
Steel Poles	$721k
Hardware	$68k
Total	$789k

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	**2017**	**2018**	**2019**	**Post 2019**	**Total**
1. Capital Investment Proposed	2,217	-	-	-	2,217
2. Cost of Removal Proposed	130	-	-	-	130
3. Total Capital and Removal Proposed (1+2)	2,347	-	-	-	2,347
4. Capital Investment 2016 BP	-	-	-	-	-
5. Cost of Removal 2016 BP	-	-	-	-	-
6. Total Capital and Removal 2016 BP (4+5)	-	-	-	-	-
7. Capital Investment variance to BP (4-1)	(2,217)	-	-	-	(2,217)
8. Cost of Removal variance to BP (5-2)	(130)	-	-	-	(130)
9. Total Capital and Removal variance to BP (6-3)	(2,347)	-	-	-	(2,347)

Financial Detail by Year - O&M ($000s)	**2017**	**2018**	**2019**	**Post 2019**	**Total**
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2016 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

The proposed pole replacement was not included in the 2016 BP, however is included in the proposed 2017 Business Plan under the K9-2017 priority pole replacement blanket. The portion of the project related to the switch installation ($21k) was also not included in the 2016 BP under

this project, however, as noted, was included in the Dycusburg Switch installation project (147492) for $351k in 2018. All spending will occur during 2017.

Financial Summary ($000s):

Discount Rate:	6.49%
Capital Breakdown:	
Labor:	$65k
Contract Labor:	$1,044k
Materials:	$789k
Local Engineering:	$147k
Burdens:	$87k
Contingency:	$215k
Reimbursements:	($0k)
Net Capital Expenditure:	$2,347k

- **Assumptions**

  Recommendation – The cost of this alternative assumes that the line outage will not be available and the structure replacements and switch installation will need to be completed with the 69kV line energized.

  Alternative #1 – This cost of this alternative would be approximately 60% higher due to overtime labor charges and the cost to mobilize and demobilize construction crews. These poles would fail and require replacement within the next four years.

  Alternative #2 – The cost of this alternative assumes the cost of the wood poles is 34% the cost of the steel poles, and that the wood poles would be replaced again in 30 years.

- **Environmental**
  There are no known environmental issues regarding air, water, lead asbestos, etc., associated with this project.

- **Risks**
  Without the proposed replacement of the priority poles on the Crittenden County Tap 69kV line, the company risks unplanned outages and increased cost of repairs in emergency situations. Inclement weather which affects site access and working conditions could increase the project cost and cause schedule delays. Schedule delays may also occur if the requested outage is not obtained to complete the scheduled work.

Conclusions and Recommendation
It is recommended that the Investment Committee approve the Crittenden County Tap Pole Replacement project for $2,347k to maintain system integrity, reliability, and to prevent failures and unplanned outages.

Approval Confirmation for Capital Projects Greater Than or Equal to $1 million:

The Capital project spending included in this Investment Proposal has been approved by the members of the LKE Investment Committee. Pursuant to the LKE Authority Limit Matrix, the signatures below are also required for approval of this Capital project spending request.

Kent W. Blake	Victor A. Staffieri
Chief Financial Officer	Chairman, CEO and President

Investment Proposal Project 153349 Leitchfield-Stephensburg Pole Replacement

Investment Proposal for Investment Committee Meeting on: N/A

Project Name: Leitchfield-Stephensburg Pole Replacement

Total Expenditures: $936k
Total Contingency: $85k (10%)

Project Number(s): 153349

Business Unit/Line of Business: Transmission Lines

Prepared/Presented By: John Doll/Adam Smith

Executive Summary
The proposed project is to replace twenty-eight (28) wood structures on the Leithcfield-Stephensburg 69kV line with steel based on the results of a routine line inspection. To ensure construction of the project will begin in January of 2017, the project is being submitted for approval to ensure the project will be approved and active beginning January 1, 2017.

This proposal it to proactively replace the structures over the course of the next year, prior to failure, to ensure the integrity and reliability of this line and to prevent outages resulting from such failures. The alternative of replacing poles upon failure will result in much higher long term replacement costs due to mobilization of crews back to the site each time one fails and the probable overtime work involved in replacing each during an emergency situation. This alternative would also have a negative impact on network reliability.

The total project cost is $936k and is not included in the 2016 Business Plan for 2017. This project is included in the proposed 2017 Business Plan under the K9-2017 priority pole replacement blanket. All spending will occur in 2017.

Background
Above ground pole inspections are performed by the company at defined intervals in order to discover problems that may impact the integrity and reliability of the Transmission System. A routine climbing inspection of the Leithfield-Stephensburg 69kV line was completed in 2014, and twenty-eight (28) structures were identified as priority poles and determined to be in need of replacement in order to ensure the integrity and reliability of this line. There are 354 total structures along this 23.74 mile line.

- **Alternatives Considered**
  1. Recommendation: NPVRR: ($000s) $1,174k
     The recommendation is to replace all twenty-eight (28) structures during a scheduled outage.
  2. Alternative #1: NPVRR: ($000s) $1,829k
     The alternative of do nothing would result in replacing the poles upon failure, which would result in a much higher long term replacement cost due to contract crew mobilization and overtime costs. This cost was derived by an estimated percentage of failure over the next four years. The failure rate and costs may vary depending on environmental factors. This option would also have a negative impact on network reliability.
  3. Alternative #2: NPVRR: ($000s) $1,387k
     The next best alternative would be to replace the poles with wood structures. The manufacturer's recommended life span of a wood pole is 30-35 years, whereas steel poles have a recommended lifespan of 90 years. This option assumes replacement of wood structures in 30 years and an escalation rate of 4% which is in line with market cost increases over the last 15 years.

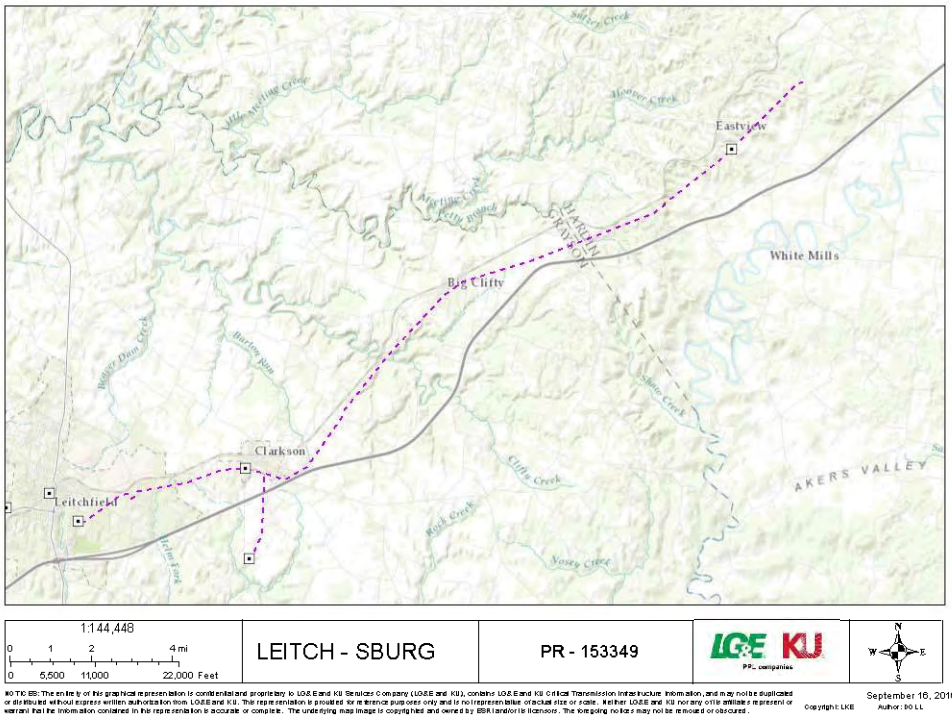
Project Description

- **Project Scope and Timeline**
  The scope of work will consist of installing twenty (20) single pole steel structures, eight (8) standard steel H-frame structures, and associated hardware and material, and the removal of twenty-eight (28) wood structures, and associated hardware and material. The line construction will be based on continuing contracts from our line contractors. B&B, Elliot, Groves and Pike are the four contractors awarded the T&D Overhead Construction and Maintenance contract from the October 2011 Investment Committee meeting. The contract extension was re-approved by the IC in July of 2014. Construction is scheduled to begin in January of 2017 and be completed in March of 2017.

  The construction milestones for this project are provided below:

Construction Milestones	
November 2016	Engineering and Design
January 2017	Steel Poles Charged
January 2017	Line Construction Begins
March 2017	Line Construction Completed

A facility map of the Leitchfield-Stephensburg 69kV line is shown below:
Line length: 23.74 miles



- **Project Cost**
  The total project cost is $936k and is included in the proposed 2017 Business Plan under the K9-2017 priority pole replacement blanket. Historical and existing contract and purchasing agreements were used to estimate the cost of material and contract labor. This project contains a 10% contingency which is reasonable based on the level of detailed engineering, confidence in cost of materials and contractors, and potential unknown risks such as weather delays, rock, structure access, and potential outage restrictions.

Economic Analysis and Risks

- **Bid Summary**
  Based on preliminary engineering, Transmission Lines has estimated the material packages for construction of this project to be $293k. This project will utilize standard steel structures. The line construction will be based on continuing contracts with our line contractors. Davis H. Elliot, Pike Electric, B&B Electric and William E. Groves are the four main contractors which have been awarded the T&D Overhead Construction and Maintenance contracts.

Transmission Lines Material Cost Breakdown	
Material	**Cost**
Steel Poles	$285k
Hardware	$8k
Total	$293k

- **Budget Comparison and Financial Summary**

Financial Detail by Year - Capital ($000s)	**2016**	**2017**	**2018**	**Post 2018**	**Total**
1. Capital Investment Proposed	-	843	-	-	843
2. Cost of Removal Proposed	-	93	-	-	93
3. Total Capital and Removal Proposed (1+2)	-	936	-	-	936
4. Capital Investment 2016 BP	-	-	-	-	-
5. Cost of Removal 2016 BP	-	-	-	-	-
6. Total Capital and Removal 2016 BP (4+5)	-	-	-	-	-
7. Capital Investment variance to BP (4-1)	-	(843)	-	-	(843)
8. Cost of Removal variance to BP (5-2)	-	(93)	-	-	(93)
9. Total Capital and Removal variance to BP (6-3)	-	(936)	-	-	(936)

Financial Detail by Year - O&M ($000s)	**2016**	**2017**	**2018**	**Post 2018**	**Total**
1. Project O&M Proposed	-	-	-	-	-
2. Project O&M 2016 BP	-	-	-	-	-
3. Total Project O&M variance to BP (2-1)	-	-	-	-	-

This project was not included in the 2016 BP, however is included in the proposed 2017 BP under the K9-2017 Priority Pole Replacement Blanket. All spending will occur in 2017.

Financial Summary ($000s):

Discount Rate:	6.49%
Capital Breakdown:	
Labor:	$9k
Contract Labor:	$421k
Materials:	$293k
Local Engineering:	$57k
Burdens:	$71k
Contingency:	$85k
Reimbursements:	($0k)
Net Capital Expenditure:	$936k

Financial Analysis - Project Summary ($000)	2017	2018	2019	2020	2021	Life of Project
Project Net Income	$ 20	$ 38	$ 36	$ 35	$ 34	$ 834
Project ROE	5.1%	7.5%	10.0%	10.0%	10.0%	9.8%

- **Assumptions**

  Recommendation – This alternative assumes that the line outage will be available and that all twenty-eight (28) structures will be replaced during this timeframe.

  Alternative #1 – This cost of this alternative would be approximately 60% higher due to overtime labor charges and the cost to mobilize and demobilize construction crews. These poles would fail and require replacement within the next four years.

  Alternative #2 – The cost of this alternative assumes the cost of the wood poles is 39% the cost of the steel poles, and that the wood poles would be replaced again in 30 years.

- **Environmental**
  There are no known environmental issues regarding air, water, lead asbestos, etc., associated with this project.

- **Risks**
  Without the proposed replacement of the priority poles on the Leitchfield-Stephensburg 69kV line, the company risks unplanned outages and increased cost of repairs in emergency situations. Inclement weather which affects site access and working conditions could increase the project cost and cause schedule delays. Schedule delays may also occur if the requested outage is not obtained to complete the scheduled work.

Conclusions and Recommendation
It is recommended that Management approve the Leitchfield-Stephensburg Pole Replacement project for $936k to maintain system integrity, reliability, and to prevent failures and unplanned outages.