ICF
CONSULTING

August 15, 2005

Mr. John A. Rogness III
Manager
Management Audit Branch
Kentucky Public Service Commission
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Frankfort. Kentucky 40602
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Dear Mr. Rogness:

ICF Resources, L.L.C. (ICF) has enclosed our technical review of East Kentucky Power proposed Cooperative's (EKPC) proposed new transmission line through Barren County Kentucky Case No. 2005-00207. This technical review provides our analysis of the EKPC filing in areas including:

- Review of utility application for reasonableness
- Review of analysis related to Impact on reliability of electric system
- Review of analysis of impact on flow patterns and congestion
- Review of reasonableness of alternatives considered

As per the procedural schedule, this report was due on August 12, 2005. The report was delayed due to the lateness of delivery of EKPC's response to ICF's initial data requests. Upon receipt of the data responses, ICF had informed Commission staff of a potential delay. ICF requests that the Commission accept this report for filing on August 15, 2005.

Sincerely,

Maria F Scheller

Maria F. Scheller
Director and Vice President

ICF CONSULTING

The Application of East Kentucky Power Cooperative, Inc. for a Certificate of Public Convenience and Necessity for the Construction of a 161 kV Electric Transmission Project in Barren, Warren, Butler, and Ohio Counties, Kentucky

Technical Appraisal

Prepared by:
ICF Resources LLC.

August 15, 2005

Outline Page

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SECTION 1: INTRODUCTION

ICF Resources LLC ("ICF") was engaged by the Public Service Commission of the Commonwealth of Kentucky to assist the Kentucky Public Service Commission ("KPSC") with a technical appraisal of East Kentucky Power Cooperative Inc.'s[1] ("EKPC") application for a Certificate of Public Convenience and Necessity (CPCN) for the Construction of a 161 kV Electric Transmission Project in Barren, Warren, Butler, and Ohio Counties, Kentucky. EKPC intends to use the proposed transmission project to supply power to its newest member - Warren Rural Electric Cooperative Corporation ("WRECC") beginning April 2008.

Warren Rural Electric Cooperative ("Warren RECC" or "WRECC") is an electric power distribution cooperative serving around 54,000 customers in South Central Kentucky. It operates approximately 5,000 miles of 13 KV distribution facilities, 200 miles of 69 KV transmission facilities and 37 substations for power distribution and transmission in Warren County, Kentucky. The Tennessee Valley Authority ("TVA") currently provides power to WRECC through its transmission system to WRECC's five bulk power delivery points – Aberdeen Gap, East Bowling Green, Bristow; Memphis Junction and Franklin. WRECC has decided to terminate its power supply agreement with TVA effective April 2008 and switch wholesale power supply service to EKPC under a 33 year contract.

EKPC's existing transmission system is not directly connected to WRECC's bulk power delivery locations nor does it have high capacity transmission facilities that interconnect the systems. Therefore in preparation to meet their obligations under their wholesale power contract with WRECC, EKPC explored the option of wheeling power through TVA's transmission system but this request was declined. Thus EKPC's alternative option to meeting their obligation was to physically interconnect their transmission facilities to WRECC's bulk power delivery points.

EKPC's proposed plan to meet its obligation to WRECC under the new wholesale power agreement is the construction of a 161 kV transmission project. The project comprises a new 161 kV transmission line with a total length of 97.55 miles that will be constructed in 4 transmission line segments. This report provides a technical assessment of the EKPC's proposed plan to meet its power supply obligations to WRECC.

The remainder of this report is organized under 5 additional sections. Section 2 provides a brief background of Kentucky and the wholesale power market, including descriptions of the EKPC and WRECC transmission systems. Section 3 provides an assessment of the need for the project as well as a detailed description of EKPC's

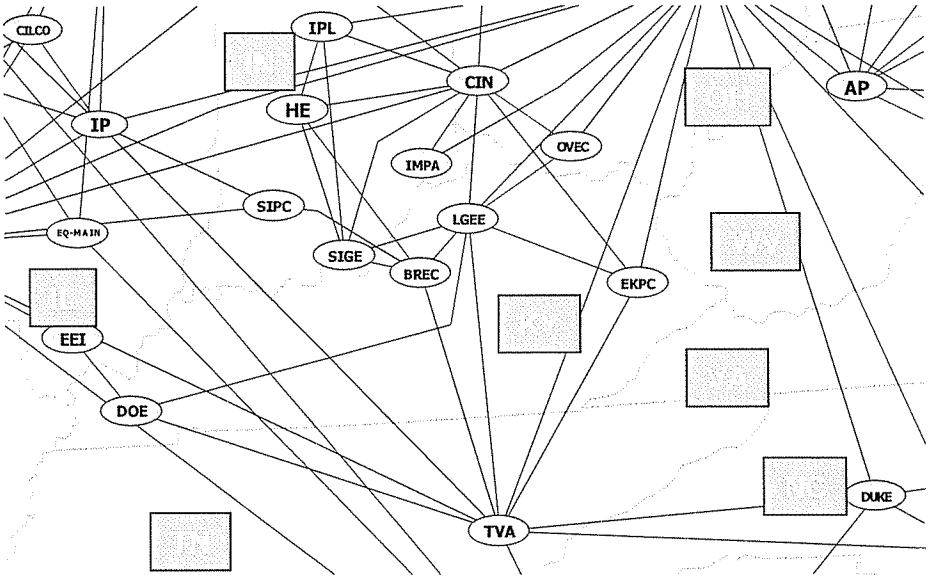
[1] Sixteen member cooperatives established East Kentucky Power Cooperative (EKPC) as a not-for-profit generation and transmission utility. Founded in 1941, EKPC's purpose is to generate energy and transmit it to co-ops that subsequently distribute the power to retail customers. EKPC provides wholesale energy and services to 16 distribution cooperatives through its power plants (including peaking units and hydro power) and more than 2,500 miles of transmission lines. Together, EKPC and its member cooperatives are known as Kentucky's Touchstone Energy Cooperatives. The distribution cooperatives supply energy to about 468,000 Kentucky homes, farms, businesses and industries across 89 Counties.

proposed plan. Section 4 examines the technical and financial feasibility of the proposed plan and Section 5 provides recommendations and conclusions.

SECTION 2: KENTUCKY AND THE WHOLESALE POWER MARKET

The Kentucky bulk power transmission system comprises a primary backbone of 345 kV lines and a secondary system of 161 kV, 138 kV and 69 kV lines. The power system interconnects neighbouring systems in Indiana, Illinois, Tennessee, Ohio, Virginia and West Virginia, as shown in Exhibit 1.2. EKPC is one of five[2] major transmission companies that provide high voltage power transmission services in the Commonwealth of Kentucky. The other four are Louisville Gas and Electric (LGE), Kentucky Power[3] (KP), Kentucky Utilities (KU) and Big Rivers Electric Cooperative Corporation (BREC).[4]

Exhibit 2.1: Interconnected Control Areas in the State of Kentucky



EKPC's service territory covers the greater portions of central and eastern Kentucky. EKPC currently provides bulk power generation and transmission services on behalf of its sixteen member systems. The member systems receive bulk power from EKPC at high voltage bulk power distribution substations and then distribute the power to their customers. EKPC's transmission system interconnects transmission systems of Louisville Gas and Electric (LGE) and Cinergy, which is a major transmission provider in Ohio and Indiana.

[2] This excludes the TVA who provides transmission services for a few counties in southwestern Kentucky.
[3] Kentucky Power provides service to approximately 175,000 customers in all or part of 20 eastern Kentucky counties.
[4] Big Rivers Electric Corporation (BREC) is an electric generation and transmission cooperative supplying the wholesale power needs of its three member cooperatives and marketing power to non-member utilities and power markets. These members provide retail electric power and energy to industrial, residential and commercial customers in portions of 22 western Kentucky counties.

Exhibit 2.2: EKPC's Service Territory and the Location of Warren County

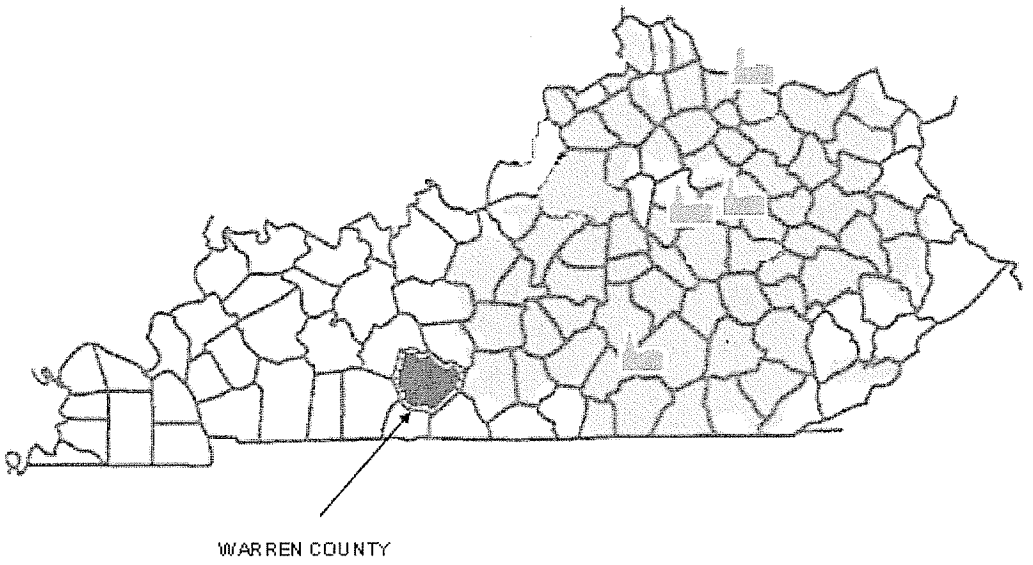
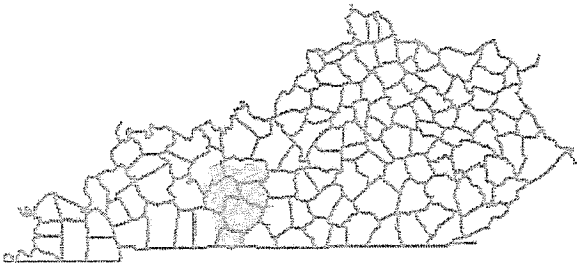


Exhibit 2.3: WRECC's Service Area

WRECC serves 54,000 consumers in Barren, Butler, Edmonson, Grayson, Logan, Ohio, Simpson and Warren counties as shown in Exhibit 2-3. WRECC currently has more than 5,800 miles of electric lines and 32 substations.



Due to the large network externalities in interconnected transmission systems, any major changes to the grid such as proposed by EKPC must be coordinated with other transmission providers especially those within its immediate operating area and those to whom it has direct interconnections. The Midwest Independent System Operator (MISO) provides reliability and security coordination of the interconnected power system in the mid-western states including Kentucky. MISO is the largest single energy market operator in middle America and the market extends across 15 states including Kentucky. Participation in MISO is voluntary and currently, LGE is the only Kentucky utility that participates in MISO. The other Kentucky utilities are non members of MISO's energy markets but operate under MISO's security coordination. TVA[5] provides security coordination for its service territory, part of which covers the southwestern

[5] Tennessee Valley Authority ("TVA") is a wholly owned corporate agency and instrumentality of the United States Government organized under the Tennessee Valley Authority Act of 1933. TVA extends across eight different states and sells electric power to large industrial customers and government facilities. TVA also owns an extensive transmission system that is interconnected with the transmission system of all the neighboring electric utilities including EKPC.

region of Kentucky. Service in the eastern part of Kentucky is provided by Kentucky Power, which is part of the American Electric Power (AEP) transmission system.[6] AEP's security coordinator is the PJM Regional Transmission Organization.

Combined, MISO, PJM and TVA provide security coordination for the entire interconnected transmission system of Kentucky. Thus, any major significant topological changes to the grid such as proposed by EKPC must be coordinated with these two entities which have overall responsibility for the security of the transmission system.

[6] American Electric Power, based in Columbus, Ohio, is the nation's largest electricity generator. AEP is also one of the largest electric utilities in the United States, with more than 5 million customers linked to its extensive transmission and distribution network that covers 11 states, including Kentucky.

SECTION 3: ASSESSMENT OF NEED AND EKPC'S PROPOSED PLAN

EKPC has a performance requirement to supply WRECC with power beginning April 2008 under their full requirements wholesale power contract. EKPC has no transmission interconnection with any of WRECC's bulk power distribution substations. Therefore in order for EKPC to meet its obligations to WRECC under the contract, EKPC would have to:

- Seek transmission service from a third party transmission provider's system to serve load; and/or
- Connect its transmission system to WRECC's bulk power delivery substations.

TVA is the only transmission provider with direct transmission interconnection with WRECC. Therefore, EKPC initially chose to seek power wheeling services from TVA to supply WRECC with wholesale power. TVA denied EKPC's request as per the testimony of Paul C. Atchison, EKPC's Vice President of Power Delivery and corroborated by the testimony of Mary Jane Warner, EKPC's Manager of Power Delivery Expansion. As a result of TVA's denial of EKPC's transmission service request, EKPC decided to pursue the only other alternative of extending its transmission facilities to interconnect with WRECC's bulk power delivery substations.

EKPC has proposed to build approximately 98 miles of 161 kV transmission facilities to meet this goal. These transmission facilities comprise four segments described below.

- Segment 1 is a single circuit 161 kV transmission line from the EKPC Barren County substation through the Warren Rural Electric Cooperative Corporation Oakland substation to WRECC's Magna substation. The length of this segment is 28.29 miles, of which 11.67 miles will be on new right of way, 1.48 miles will be parallel to an existing line and 15.14 miles will rebuild an existing transmission line.

- Segment 2 is a single circuit 161 kV transmission line connecting the WRECC GM and Memphis Junction substations. The length of this segment is 14.96 miles, of which 3.93 miles will be on new right of way, 2.22 miles will be parallel to an existing line and 8.81 miles will rebuild an existing transmission line.

- Segment 3 is a single circuit 161 kV transmission from the WRECC Memphis Junction substation to the WRECC Aberdeen substation. The length of this segment is 23.48 miles, of which 9.36 miles will be on new right of way and 14.12 miles will be a rebuilt existing transmission line. This includes a 3.93 mile section that will be constructed on a shared right of way with a double circuit line from the Memphis Junction substation to WRECC's West Bowling Green Junction substation.

- Segment 4 is a single circuit 161 kV transmission line connecting the WRECC Aberdeen and Big Rivers Electric Corporation ("BREC") Wilson substations. The length of this segment is 26.79 miles, of which 22.66

miles will be on new right of way and 4.13 miles will be parallel to an existing line.

The schematic diagram of EKPC's proposed plan is shown in Exhibit 3.1. Exhibit 3.2 shows the physical layout.

EKPC has limited their proposal to this single plan alternative. Other options were considered in the early planning stages (which will be discussed in Section 4), however, these options were generally ruled out in the initial stages and the level of detail available regarding these options is not comparable to that provided for the proposed plan (also referred to as Plan C).

Exhibit 3.1: Schematic of the Proposed Plan

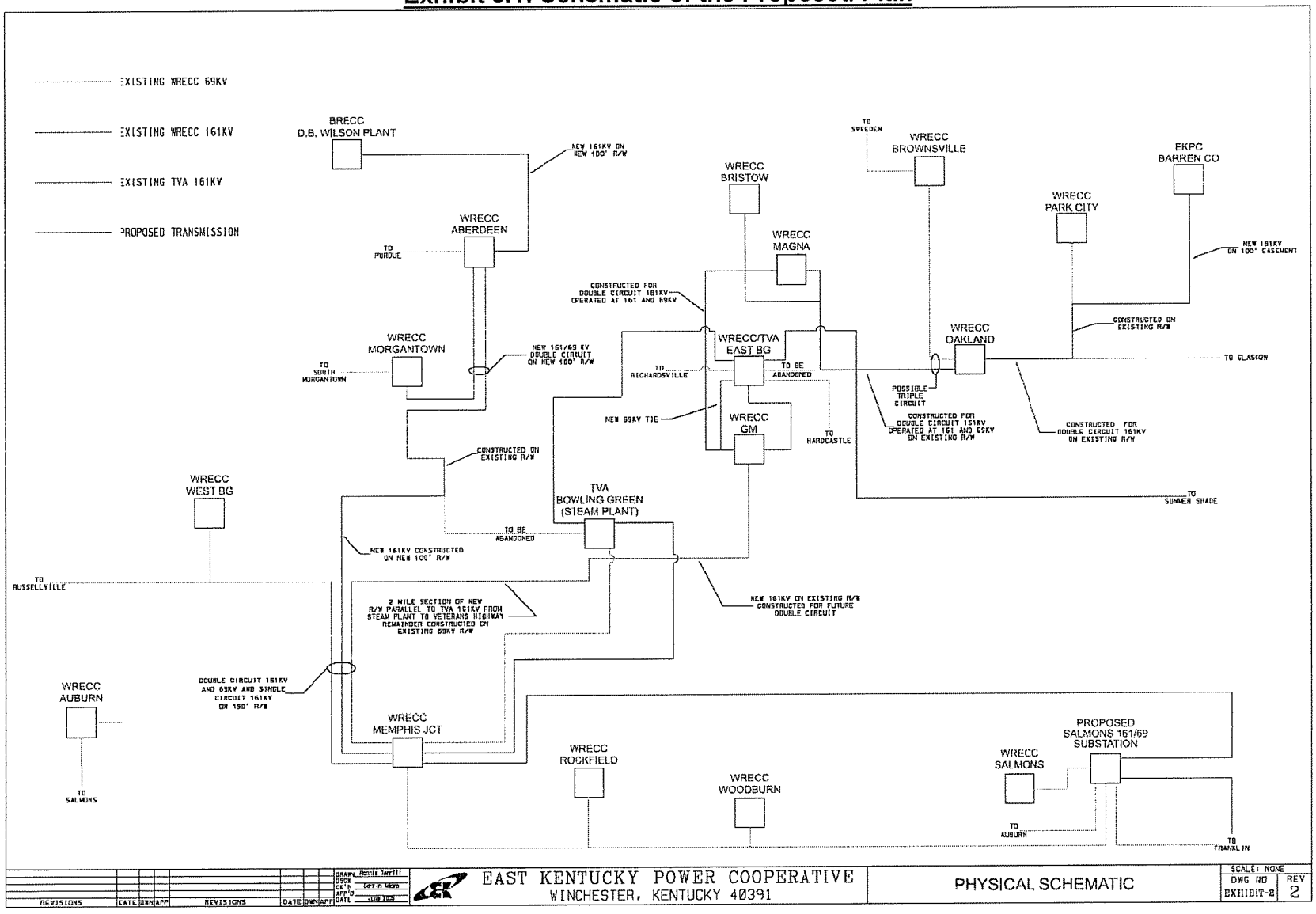
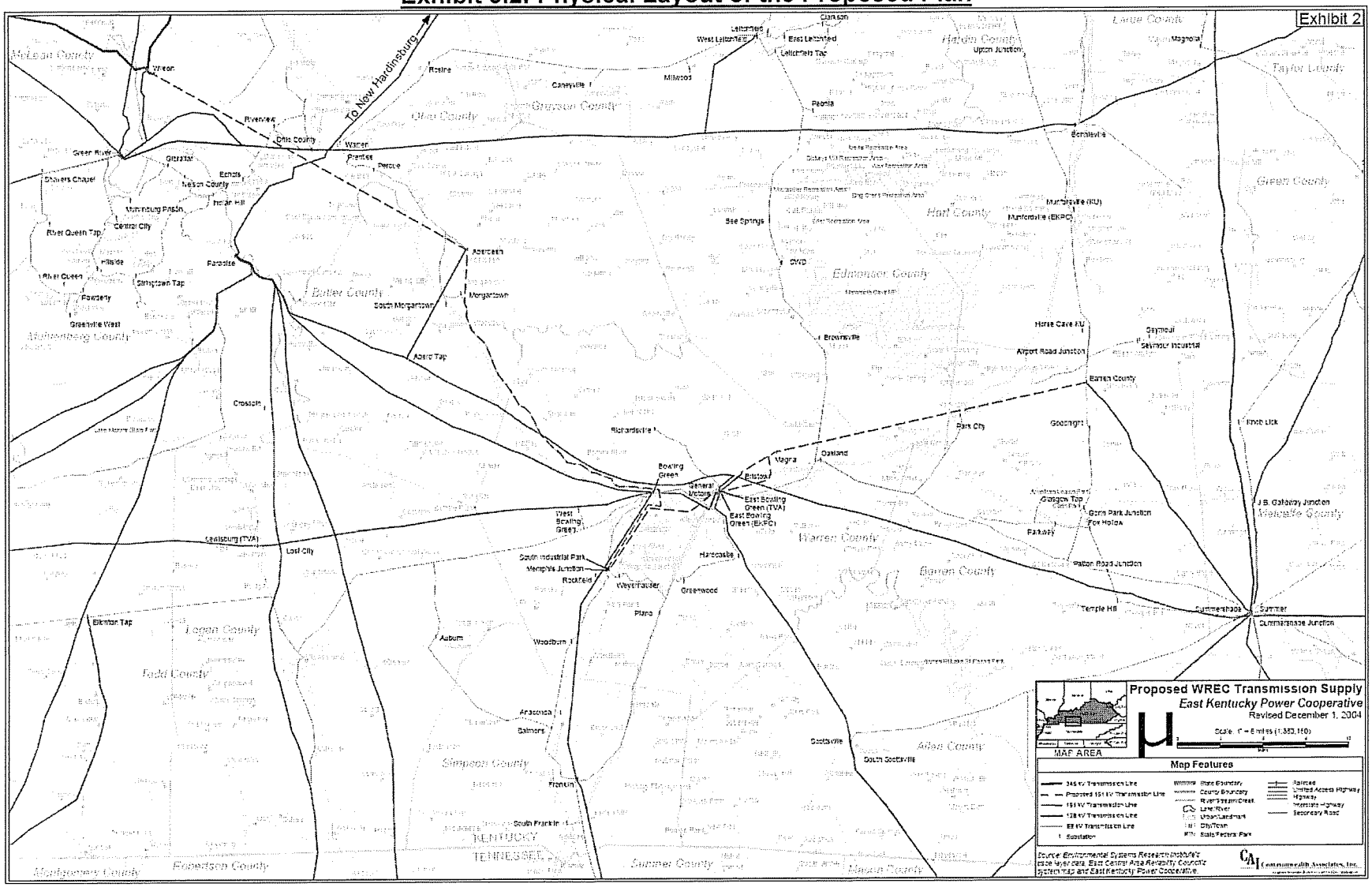


Exhibit 3.2: Physical Layout of the Proposed Plan



SECTION 4: ASSESSMENT OF THE PROPOSED PLAN

The proposed plan to interconnect the WRECC power system should meet some generally accepted minimum standards. The proposed plan must be technically feasible and economic, must provide for future expansion and easy maintenance, and where possible should minimize adverse environmental impacts. Each of these factors is discussed below.

ICF reviewed analysis performed by EKPC to develop the proposed plan. EKPC engaged the services of an external consultant[7] to perform a power flow analysis to:

- Determine the transmission facilities needed to reliably serve the WRECC load;
- Demonstrate the adequacy of the proposed plan;
- Provide a short circuit analysis to assess the expected magnitude of fault currents and ensure all existing and proposed new equipment are rated to withstand potential fault currents;
- Provide a transient stability study to measure the dynamic response of the new EKPC power system under fault conditions.

EKPC provided ICF with reports and analysis on their proposed plan and specific responses to questions provided to EKPC by ICF. ICF's assessment of EKPC's proposed plan is based exclusively on material provided by EKPC to ICF. ICF did not perform any modeling of their own in providing this assessment. Our assessment has been discussed under the following sub headings:

- Approach and technical feasibility of proposed plan;
- Plan alternatives;
- Capital and operating costs;
- Supply and demand balance;

Approach and technical feasibility:

EKPC performed power flow analyses to develop the plan. The external consultant used their proprietary power flow software called Transmission 2000 for this analysis. This software is not as known and widely used as other power flow software commonly used in the industry. However, we note that since this firm has conducted many analyses for clients in the past and uses a format similar to industry standard software, as such, their software must be comparable to some of the widely known software in the industry.

The representation of the interconnected transmission system used for the analysis was the official 2010 summer base case from the ECAR[8] 2003 series. This representation of the interconnected transmission system provides data on the electrical location of all generators, transmission facilities and connected loads and they are prepared by ECAR and made available to members such as EKPC. The use of an official base case representation of the grid provides credibility to the data on transmission, generation

[7] EKPC engaged Commonwealth Associates, Incorporated to perform the technical analysis and to develop the proposed plan.

[8] East Central Area Reliability Council. ECAR is one of ten reliability councils under the North American Electric Reliability Councils.

and load assumptions used in the technical analysis to develop the plan. However, ICF questioned why a 2010 summer case from a more recent series such as the 2004 series was not used. In the response, EKPC mentioned that the analysis began in 2004 and at a time when the ECAR official base cases from the 2004 series were not available.

EKPC made the following modifications to the 2010 base case model:

- An expanded and more detailed BREC transmission system was used instead of the slightly simplified BREC transmission system that was in the base case model;
- A detailed WRECC model was inserted in the model. Generally, the official base cases provide data for only wholesale level transmission lines rated at 69 kV or higher. Loads connected to lower voltage substations are upward aggregated to the 69 kV level or higher. Since the goal of this work is to connect WRECC's distribution system, it was prudent to have WRECC's expanded transmission and distribution system in the model.

The approach used by EKPC for the analysis to identify the needed transmission facilities is standard in the industry. There are many ways of designing transmission interconnections from one system to another. The power flow models used for this analysis are not designed to predict the most reliable and cost effective interconnection option by themselves. Therefore, the entire analysis of determining the best transmission interconnection option is often performed through several iterations in the model from an initial assumption of one or more interconnection options. These initial interconnection options are assumptions on the transmission elements that would be needed to economically and reliably serve the purpose for which they are required, i.e. to economically and reliably serve the WRECC load. The initial interconnection options are developed by the transmission planning engineer based on experience and tested in the model by examining each interconnection option.

Iteration of the model provides information about either existing or new transmission elements that showed indications of potential reliability violations. Note that these violations could also occur in existing transmission elements as a result of the new additions. The transmission planning engineer may implement corrective actions to eliminate the violations. The corrective actions may be the addition, removal or alteration of one or more transmission elements. Several iterations may be performed for each interconnection option until there are no more reliability violations.

The capital and operating costs of all reliable interconnection options are determined and the most economical option is selected with due regard to other factors such as ease of maintenance and future expansion needs.

EKPC performed four types of simulations to develop its final proposed plan. These simulations were performed sequentially and each simulation provided information about necessary modifications to meet established reliability criteria. EKPC's proposed plan was designed to meet ECAR, NERC and EKPC's reliability standards. Each of the four simulations is briefly described below:

- The first was a power flow simulation that assumes all transmission facilities in the network are in service.
- The second was a stress test (commonly referred to as a contingency analysis) on the transmission system by assuming various combinations of single contingency events such as the outage of a transmission line or equipment or the outage of a generation unit.
- The third was a short circuit analysis to observe how the new and existing elements of the transmission system would perform under fault conditions such as a line-to-ground fault.
- The fourth was a transient stability study to observe the dynamic response of the new transmission system to faults. A stable transmission system should be able to naturally dampen potential oscillations during fault conditions.

Based on the analysis and the study results provided by EKPC to ICF, the proposed plan had some contingency overloads such as the Salmons/K30 69 kV line. It is not unusual to have potential contingency overloads in any transmission system but there should be clearly established operating procedures or remedial action schemes designed to specifically deal with such potential overloads. EKPC has provided a potential operating procedure that would reduce this overload from 118 percent to 102 percent but also recommended upgrading this line. We would like to mention that since the planned operating procedure does not eliminate the overload entirely, EKPC should confirm that the planned operating procedure alone does not entirely eliminate the overload. Therefore, EKPC should confirm whether they plan to upgrade the line.

Although EKPC indicated that their proposed plan follows the transmission planning criteria and would ensure that EKPC would reliably service WRECC without causing reliability violations of limits that affect the electrical service in the surrounding electrical system, there were overloads reported for some transmission system elements in the LGE, TVA, Hoosiers Energy (HE) and Cinergy (CIN) transmission systems.

EKPC reported that they brought MISO and LGE into the process of developing the proposed plan in August 2004 where a draft of the study report and the coordinated powerflow models were provided. MISO further invited HE, CIN and Vectren to participate, but only HE chose to do so. LGE provided input and these were reflected in subsequent updates. EKPC reported that LGE was provided with the opportunity to review and comment on the final draft report.

EKPC reported that LGE raised one issue that EKPC has chosen not to address. In its modeling, EKPC included expected summer 2010 peak demand of the WRECC load that would be served via LGE's Leitchfield substation. LGE expected EKPC to model the contractual limit with TVA, rather than the actual forecast demand. Note that the contractual limit is about 75 percent of the forecast demand. EKPC expects to make the transmission request from LGE at the end of 2005, but did not indicate whether the issue has subsequently been resolved, or whether it plans to resolve it prior to making the transmission request.

EKPC also indicated that MISO performed an independent assessment of the EKPC service to WRECC and concluded that the proposed project has little impact on LGE voltages.

BREC found the proposed plan to be mutually beneficial to EKPC and BREC and found no adverse impacts.

TVA rejected EKPC's proposed plan on the basis that it was unwilling to permit those interconnections with TVA associated with the plan. This issue has been the subject of a recent FERC ruling asking TVA to permit the required interconnections with the plan.[9] As a result of this dispute, TVA has not been an active participant in working with EKPC to develop this plan.

There is no information provided by EKPC as to whether HE, CIN and Vectren were given the opportunity to comment of the final report.

The final report shows some transmission element overloads as a direct result of the proposed plan, especially in the transmission systems of CIN, HE and TVA. We note here that EKPC has made reasonable efforts to coordinate with neighboring transmission providers. However, we conditionally accept EKPC's findings that the proposed plan will reliably service WRECC without causing violations of limits that affect the electrical service in the surrounding electrical system.

Faults in power systems occur mainly because of insulation failures which may be caused by over-voltages such as a switch surge or lightning stroke, or broken insulators or conductors. A short circuit study is basically an analysis to study the magnitude of fault current likely to flow within the transmission system should there be a fault. When faults occur, abnormally high currents flow through the various elements of the transmission system. These currents must be detected by the protective gear such as relays and interrupted by circuit breakers strategically deployed within the transmission system. The calculation of short circuit fault currents helps to ensure that the transmission system elements such as transformers, lines and busbars will be capable of withstanding the forces which arise due to the fault currents prior to being interrupted by protective devices.

There are usually two types of faults – symmetrical faults and un-symmetrical faults. In symmetrical faults all three phases of a transmission circuit short circuit each other and often to ground. The fault currents involved in these types of faults are often the highest under any fault or load condition. Therefore they are used in determining the ratings of circuit breakers in the transmission system. One of the two faults simulated by EKPC in preparing their proposed plan was a symmetrical three-phase-to-ground fault.

There are three types of unsymmetrical faults – single line-to-ground, line–to-line and line-to-line-to ground. These are faults that involve one or two of the phases in a three phase circuit. The magnitude of the fault currents are often less than the symmetrical faults but the results of these studies are used to calculate the settings of protective

[9] FERC ruling of August 3, 2005 relating to Docket Numbers TX05-1-000, TX05-1-001 and TX-05-1-002.

equipment. EKPC simulated one of these three types of unsymmetrical faults -- single line-to-ground. For the purposes of developing this proposed plan we consider choice to simulate one type of unsymmetrical fault adequate.

EKPC provided the results of the short circuit study for both types of faults simulated and mentioned that none of EKPC or WRECC transmission system elements needed any upgrades. This means that the fault currents were within the fault current ratings of all the installed transmission elements in the two systems. EKPC did not provide ICF with data on the fault current ratings of their facilities therefore ICF did not independently corroborate this finding. However, a review of the fault currents provided in the study results were not unusually high. Therefore, ICF will accept EKPC's statement that none of their equipment or the WRECC equipment would need to be upgraded.

In a power system it is important to maintain synchronism between all generators for the system to be stable. That property of the system which develops restoring forces between any disturbed transmission elements (due to a fault or loss of system elements) and restores equilibrium is essentially what is referred to as stability. During faults, oscillations occur in the system which if not adequately controlled, can cause instability in the power system and cause blackouts. Therefore it is important to measure the maximum power that can flow through a power system without causing instability should there be a fault or any major disturbance such as the loss of a generator, load or transmission circuits. Alternatively, at a given power transfer level, a stability analysis could be performed to determine if there are adequate restoring forces to dampen any oscillations that may arise due to a major disturbance. Each time major changes are proposed in the network, it is important to perform such an analysis to measure the dynamic response of the system to major disturbances. EKPC performed a stability study and the results provided indicated that there was sufficient restoring forces in the transmission system to dampen any oscillations that may arise.

Plan Alternatives

There are several ways of interconnecting to power systems so it is prudent to consider several alternatives. Ultimately the most reasonably economical of the technically feasible options should be selected after considering ease of expansion, ease of maintenance and environmental impacts. Two important issues are to be considered when planning alternative interconnection options. The first is the technical alternative in electrical terms, such as the choice of transmission voltage. The second is the routing options to interconnect the two systems. We discuss each of these issues separately and assess the choices made by EKPC in arriving at the proposed plan.

The choice of transmission voltage depends on the load to be served and the potential for load growth. A higher transmission voltage allows for load growth and extension of the system. Sufficient consideration is also given to the voltage of the existing transmission system. EKPC's transmission system comprises a network with a primary back bone of 345 kV lines and secondary transmission systems rated at 161 kV, 138 kV and 69 kV. However the EKPC transmission facilities closely located to the WRECC system include only 161 kV and 69 kV systems. The initial WRECC load to be supplied

is 450 MW over an estimated distance of about 100 miles. Both a 69 kV and a 161 kV transmission solution can be technically feasible but given the limited throughput capacity of a 69 kV system, it would require much larger cables or multiple transmission circuits. Although 69 kV facilities are cheaper on an element by element basis than 161 kV facilities, the use of multiple circuits in the 69 kV system would make that option significantly more expensive than the 161 kV system on a cost per megawatt basis.

The 161 kV system has other advantages over the 69 kV system. The need for future expansion makes the 161 kV option more attractive because the 69 kV transmission solution is more likely to reach its capacity limits in a shorter period than a 161 kV transmission subsystem. Operationally, a 69 kV solution would also have more transmission losses per megawatt of power transmitted than a 161 kV system. These factors rule out a choice of a 69 KV transmission system.

A 345 kV system will be technically feasible but may provide significantly more transmission capacity than would be needed immediately for a load of 450 MW and future load growth. Additionally, the location of the EKPC 345 kV substation closest to the WRECC system is more than twice the distance from the nearest 161 kV substation. Since 345 kV transmission facilities are more expensive than 161 kV facilities on an element by element basis, a 345 kV solution is likely to be more expensive than a 161 kV system. Thus, based on the proximity of the EKPC 161 kV subsystem to the WRECC system, it is likely to be the most cost effective transmission solution.

In preparing their proposal, however, EKPC performed preliminary screening and economic analyses on several potential alternatives to provide service to WRECC that did not maintain one or more interconnections with TVA. As reported in EKPC's response to ICF's questions, their analyses indicated that all the alternatives would require the components of the proposed EKPC Plan and additional transmission facilities. EKPC ruled out these technically feasible options on the basis of cost. Specifically EKPC considered six potential alternatives described below[10]:

- Alternative X1 Description: Construct 23 miles of 345 kV line from LGE's Smith-Hardin County 345 kV line to the Meredith area. Construct a 345 kV switching substation at the tap point of the 345 kV line and a 345-161-138-69 kV substation at Meredith. Construct 29 miles of 161 kV line from Meredith to General Motors. The estimated cost for this plan in 2008$ is $95.0 million.
- Alternative X2 Description: Construct 23 miles of 345 kV line from LGE's Smith-Hardin County 345 kV line to the Meredith area. Construct a 345 kV switching substation at the tap point of the 345 kV line and a 345-138-69 kV substation at Meredith. Construct 29 miles of 345 kV line from Meredith to General Motors. Construct a 345-161 kV substation at General Motors. The estimated cost for this plan in 2008$ is $106.8 million.
- Alternative X3 Description: Construct 55 miles of 161 kV line from BREC's

[10] All plans include the 161 kV lines in the proposed EKPC Plan and a new 13.2-mile 161 kV line from Memphis Junction to Salmons in lieu of the interconnection with TVA at Salmons that is part of the proposed EKPC Plan. All alternatives also require the addition of at least 200 MVAR of 161 kV capacitor banks in the Bowling Green area.

Wilson Substation to General Motors. The estimated cost for this plan in 2008$ is $87.6 million.

- Alternative X4 Description: Construct 55 miles of 345 kV line from BREC's Wilson Substation to General Motors. Construct a 345-161 kV substation at General Motors. The estimated cost for this plan in 2008$ is $101.6 million.
- Alternative X5 Description: Construct 54 miles of 345 kV line from Marion County to Barren County. Construct a 345-161 kV substation at Marion County and a 345-161 kV substation at Barren County. Construct 26 miles of 161 kV line from Barren County to General Motors. The estimated cost for this plan in 2008$ is $117.0 million.
- Alternative X6 Description: Construct 81 miles of 345 kV line from Marion County to Magna. Construct a 345-161 kV substation at Marion County and a 345-161 kV substation at Magna. The estimated cost for this plan in 2008$ is $126.0 million.

A preliminary examination of capital costs of these alternatives confirms the general view that the 161 kV transmission option was in this case, the most favorable electrical solution.

In terms of routing options, EKPC engaged the services of another external consultant to determine the best routing options for the proposed interconnection.[11] The approach used was the Electric Power Research Institute (EPRI) overhead electric transmission line siting methodology. This is a detailed approach that uses several parameters or factors to determine the most favorable line route within a general macro transmission corridor. The approach selects sample routes within this corridor and ranks each according to these key factors. Some of the factors considered are proximity to residences, commercial and industrial buildings, forests, wetlands, and line length co-location opportunities with roads and existing transmission lines. The approach then assigns weights to each of these factors and ranks the various routing options to select the best option. Based on this approach, EKPC selected a preliminary route subject to further refinements and enhancements based on local input and detailed data.

The approach used by EKPC for the preliminary line route is analytically detailed and reasonable. ICF recognizes that the first three transmission line segments use co-location on existing rights-of-way and/or rebuilds of existing transmission lines. However the fourth transmission line segment uses significantly more new ROWs than co-location and rebuilds. A review of the transmission map in of the area shows opportunities for co-location or rebuilds for the fourth segment and potentially additional opportunities for the third segment. Since ICF did not perform any ROW site visits and relied upon data and reports provided by EKPC in preparing this report, we cannot say definitively that these co-location and rebuild opportunities exist. However, we would suggest that EKPC should explore the routing of the line with the additional goal of minimizing *to the extent possible*, the need for new ROWs. Such an analysis with cost estimates will provide valuable information to the Commission and Stakeholders in

[11] EKPC engaged Photo Science Geospatial Solutions (Photo Science) of Lexington, Kentucky to perform aerial data collection, field reconnaissance and modeling for comparison of viable alternative routes over which the new transmission lines would be built.

assessing trade-offs. It should also provide answers to the Commission and Stakeholders about the incremental costs of avoiding the need for new ROWs when compared to the proposed plan. We would also like to caution that by this example, ICF is not suggesting that all future transmission projects should be routed on existing transmission ROWs. Rather, we are encouraging project sponsors to recognize the fact that providing additional information to the Commission and Stakeholders on a key issue such as the need for new rights of way should be helpful in assessing important tradeoffs.

Capital Cost Calculations and Assumptions

ICF has reviewed EKPC's proposed capital outlay for the proposed plan, both in its original and modified plans. Cost details for other alternative plans were not provided. In its original plan, EKPC had proposed $38.8 MM (2004$) of capital expenditures[12] including costs for new transmission lines, reconductoring and terminal facilities. The capital expenditures also included costs for acquiring rights of way. These costs were about 6 percent lower compared to the estimates for the same project components provided by EKPC's independent consultant. In its revised plan since the consultant's report, EKPC's capital costs have increased by about 13 percent to $43.84 MM (2004$) from its original proposal. Compared to the consultant's estimates, the revised EKPC costs are about 6 percent higher. This review concentrated on EKPC's revised cost estimates since they are expected to be currently the best available information.

ICF examined how the unit costs excluding rights of way were developed under EKPC's original cost proposal.[13] As shown in Exhibit 4.1, the cost per mile of new transmission ranges between $247,000 and $257,000 (2004$) excluding rights of way. ICF believes that EKPC's proposed per unit costs for the transmission lines and terminal facilities fall within the range of reasonableness.

Exhibit 4.1: Per Unit Cost of New Lines under EKPC's Original Cost Proposal

Item	2004$/Mile[1]
Bristow - Magna 161 kV Line (1 miles 954 MCM)	257,050
GMC - Magna 161 kV Line (2.87 miles 954 MCM)	257,050
Barren Co - Magna 161 kV Line (28.29 miles 954 MCM)	247,108
GMC – BGMU Tap (Steam Plant) 161 kV Line (5.14 miles 954 MCM)	257,050
Aberdeen - Wilson 161 kV Line (26.79 miles 954 MCM)	247,108

[1]Excludes Right of Way and includes a 15% contingency.
Source: Exhibit 15-1, Response to ICF Data Request

[12] Source: Table 1 of EKPC application.
[13] The revised plan did not contain per unit costs and so the original proposal costs were used. Insufficient information was available for ICF to determine if unit costs under the revised cost proposal were modified. As a proxy for costs in the revised plan, per unit costs as per the original plan are shown for only those lines which were included in the revised plan.

Exhibit 4.2: Implied Right of Way Costs

Item	2004$/Mile with ROW	2004$/Mile[1]	Implied ROW Costs 2004$/Mile
Bristow - Magna 161 kV Line (1 miles 954 MCM)	325,000	257,050	67,950
GMC - Magna 161 kV Line (2.87 miles 954 MCM)	425,000	257,050	167,950
Barren Co - Magna 161 kV Line (28.29 miles 954 MCM)	335,445	247,108	88,337
GMC – BGMU Tap (Steam Plant) 161 kV Line (5.14 miles 954 MCM)	350,000	257,050	92,950
Aberdeen - Wilson 161 kV Line (26.79 miles 954 MCM)	325,009	247,108	77,901

Note: ROW = Right of Way.
[1]Excludes Right of Way and includes a 15% contingency.
Sources: Exhibit 15-1, Response to ICF Data Request; Exhibit 9-2, Response to ICF Data Request.

Exhibit 4.2 illustrates the expected cost for rights of way for the lines included in EKPC's revised plan. The costs range from $67,050/mile for the 1 mile Bristol-Magna area, to $167,950/mile for the 2.87 mile area from GMC-Magna. This reflects a significant cost difference for the right of way costs across lines. The GMC-Magna line is by far the most costly per mile expenditure with the next highest at $92,950 for 5.14-mile GMC-BGMU tap line.

Exhibit 4.3: Capital Investment Costs[1] for the Proposed Plan (Revised)

Item	2004$	Mile / Unit	Per Unit Cost
New Lines			
Bristow - Magna 161 kV Line (1 miles 954 MCM)	325,000	1	325,000
GMC - Magna 161 kV Line (2.87 miles 954 MCM)	1,219,750	2.87	425,000
Barren Co - Magna 161 kV Line (28.29 miles 954 MCM)	9,489,750	28.29	335,445
GMC - BGMU Tap (Steam Plant) 161 kV Line (5.14 miles 954 MCM)	1,799,000	5.14	350,000
BGMU Tap (Steam Plant)-West Bowling Green Jct. 161 kV Line (5.89 miles 954 MCM)	2,117,000	5.89	359,423
West Bowling Green Jct.-Memphis Jct. 161 kV Line (3.93 miles 954 MCM, Double Circuit 161 & 69 kV)	1,392,000	3.93	354,198
West Bowling Green Jct.-Memphis Jct. 161 kV Line (3.93 miles 954 MCM, Single Circuit)	685,740	3.93	174,489
West Bowling Green Jct.-Aberdeen 161 kV Line (23.48 miles 954 MCM)	8,174,000	23.48	348,126
Aberdeen - Wilson 161 kV Line (26.79 miles 954 MCM)	8,707,000	26.79	325,009
Dewey Lake Junction-Plano 69 kV Line (1.1 miles 556 MCM)	341,000	1.1	310,000
Re-conductor			
E.Bowling Green - GMC 161 kV Line (.15 miles, 954 MCM, reconductor)	24,000	0.15	160,000
Salmons-City OF Franklin 69 kV Line (3.9 miles, reconductor with 556 MCM)	357,000	3.9	91,538
Terminal Facilities			
69 kV Line Retirements (Steam Plant-Natcher Parkway Jct., etc.)	250,000		
Caneyville 69 kV Tap Line (Purchase or Lease of TVA's Existing Tap Line)	225,000		
Magna Substation Terminal Facilities (161 kV)	618,000	2	309,000
GMC Substation Terminal Facilities - Phase 1	290,000		
GMC Substation Terminal Facilities - Phase 2 (161 kV)	870,000	3	290,000
Barren Co Substation Terminal Facilities (161 kV)	715,000	2	357,500
Memphis Jct Substation Terminal Facilities (161 kV)	556,000	1	556,000
Aberdeen Substation 161 kV Terminal Facilities	618,000	2	309,000
Aberdeen Substation 69 kV Terminal Facilities	200,000		
Wilson (BREC) Substation Terminal Facilities	1,100,000		
East Bowling Green Substation Terminal Facilities (161 kV)	313,000	1	313,000
Summershade-Barren County 161 kV Line Temp. Upgrade (20.14 miles, upgrade 795 ACSR operating temp. to 212F)	17,000		
New Salmons 161-69 kV Substation	2,825,000		
Plano Switching Substation 69 kV	612,000	3	204,000
Total	43,840,240		

[1] Includes Right of Way

Source: Exhibit 9-2, Response to ICF Data Request

Further detail on the various cost components of EKPC's revised plan is provided in Exhibit 4.3. The cost per mile for new lines including right-of-way ranges from $175,000 to $425,000 (2004$). As illustrated in Exhibit 4.2 above, much of the cost difference is due to the range surrounding the cost for rights-of-way with the equipment cost typically in a much narrower band consistent with industry typical estimates.

Also shown in Exhibit 4.3, for terminal facilities, the cost per unit of circuit breaker ranges from $204,000 to $556,000 (2004$). ICF assumed the same number of circuit

breakers as used in EKPC's original cost proposal would be installed since the revised cost proposal did not provide that information.

Exhibit 4.4 shows EKPC's financing assumptions for new lines and transmission facilities. EKPC's proposed discount rate of 7.3 percent is consistent with current discount rates and the weighted average cost of capital for many companies in the utility sector. Similarly, a 5 percent assumption for interest during construction and an amortization period of 30 years appear to be reasonable assumptions for similar utility investments.

Exhibit 4.4: Financing Assumptions

Parameter	Assumption
Discount Rate	7.3%
Interest During Construction	5%
Fixed Charge Rate	
- New Lines	12.57%
- Terminal Facilities/Reconductor	9.02%
Amortization Years	30

Source: East Kentucky Power Cooperative Present Worth Cash Analysis, Plan C (Rev).

In response to ICF's data request, EKPC provided information[14] that shows fixed charge rates for new transmission lines, reconductor, and terminal facilities that were used to determine the annual levelized costs (the annuity value of the project based on the lifetime and fixed charge rate, i.e. the annual carrying charge) for the line item investments considered in the proposed line. EKPC assumed a 12.57 percent fixed charge rate for new lines and a 9.02 percent fixed charge rate for terminal facilities and reconductor. The relative order of magnitude difference between the two values is reasonable as one would expect less operations and maintenance costs to contribute to the fixed carrying cost of a reconductor than a new line as the incremental costs from the original would be minimal. Overall, while the fixed charge rates appear to be reasonable, details on derivation of fixed charge rates were not made available for review. Provided the values are consistently applied to all alternatives that could be considered, little bias would be introduced in a comparative assessment.

In addition to the proposed capital expenditures, EKPC filed a first-year cost of operation of $3,053,812 in its application to the Public Utility Commission[15]. This cost did not include the cost of transmission wheeling to serve the 59.8 MW load of Warren Rural Electric Cooperative Corporation (WRECC) that would be incurred by EKPC, and also did not include all components of the EKPC proposed plan for service to Warren. In EKPC's Response to ICF data request question 4, EKPC projects the first-year cost of transmission wheeling for the WRECC load to be $651,222.[16] Adding in the wheeling charges to the initial cost would result in a total cost of $3,705,034. In the same response, EKPC states that the previously filed cost of operation also did not include "all

[14] In a table labeled "East Kentucky Power Cooperative Present Worth Cash Analysis: PLAN C (Revised): Proposed WRECC Service Alternative – Revised to represent updated plans, routing, etc.

[15] Paragraph 15 of EKPC's CPCN Application, Case No. 2005-00207.

[16] Using the MISO/LGEE transmission rate for network service of $1.21 per kW-month and a diversity factor of 0.75.

components of the EKPC Plan for service to Warren" and that the total first year of operation including the transmission wheeling charge and the above-mentioned components would amount to $4,871,819. It is unclear from the EKPC's response to ICF data request question 9 as to what those components are that account for remaining cost of operations of $1,166,785 (the difference between $4,871,819 and $3,705,034). If this additional cost is an approximate estimate of the incremental maintenance and operations costs, the total first-year cost of operations is about 11 percent of the total EKPC capital investment and appears to be a reasonable projection when compared with a typical (rule-of-thumb) transmission O&M cost of roughly 10 percent of transmission book value for transmission operation and maintenance costs.

Supply and Demand Balance

EKPC used a comprehensive load forecasting technique to forecast the load growth in the Warren area over the next 10 years. ICF has reviewed the WRECC Load Forecast prepared by WRECC and EKPC and found the projections to be reasonable.

Based on EKPC's installed generation capacity and projected facility additions, ICF is of the view that EKPC will likely be able to meet the summer peak demand of WRECC over the forecast period. EKPC's forecast of winter peak demand, on the other hand, shows very thin reserve margins during the winter peak periods from 2008 to 2010. The implied reserve margin is below 5 percent in each of those years. ICF therefore recommends that EKPC review its installed capacity projections to ensure that it has enough reserve generation capacity to serve the load of its existing members and the projected addition from WRECC reliably in all years.

SECTION 5: CONCLUSION

ICF's technical review of EPKC's proposed plan indicates that although the proposed plan may be technically feasible to provide the service requirements of WRECC, there are some transmission facility overloads especially in neighboring transmission systems. EKPC has involved most of its neighboring transmission providers in the entire plan development process. Reports from EKPC indicated that some of these entities have chosen not to participate. Based on this report, ICF is inclined to conditionally accept EKPC's studies and assertions that the proposed plan is technically feasible; meets acceptable reliability criteria and will reliably service WRECC without causing violations of limits that affect the electrical service in the surrounding electrical system.

ICF agrees with EKPC's choice of 161 kV as the transmission voltage to serve the WRECC loads. This is mainly because given the current load of WRECC, 161 kV transmission is a better fit from the point of view of throughput capacity than either 69 kV or 345 kV. Given the capital and operational costs and the expected load, 69 kV would be too little capacity and 345 kV would probably be too much capacity. Additionally the existing EKPC 161 kV system is much closer to the WRECC system and would be more cost effective than the nearest available 345 kV substation.

ICF finds the approach used by EKPC to develop the preliminary line route to be detailed and reasonable. However, we also note that since the single largest opposition to transmission line builds in the continental US has been environmental concerns, an assessment of a line routing alternative that adds the goal of minimizing the need for new rights-of-way to the extent possible should be worth considering. Such an analysis would provide valuable insights as to the costs and benefits of avoiding the need for new rights-of-way (to the extent possible) if compared to the current proposed plan. We caution that this request should not be interpreted to mean all future transmission builds must be routed along existing rights of way only.

EKPC provided estimated costs for individual components of the proposed plan. The cost estimates are consistent and appear to be reasonable. Further, the data provided for capital charge rate for the new equipment appear to be reasonable and consistent with debt and ROE rates that comparable utilities to EKPC would expect.

In terms of generation adequacy to serve the combined load of EKPC and WRECC, a review of EKPC's generation installed capacity and the projected peak demand of the combined systems indicates an implied reserve margin roughly of 0 percent to 5 percent during the winter seasons of 2008 through 2011. This reflects a precariously low installed generation capacity. EKPC would have to plan for more generation capacity or arrange for firm power purchases to meet the projected.

In summary:

- ICF supports EKPC's choice of expansion at the 161 KV level and we also support their modeling approach. However, we find there to be insufficient

information available to examine EKPC's selection of path to minimize the need to acquire new rights-of-way.

- We conditionally accept EKPC's findings that the proposed plan will reliably service WRECC without causing violations of limits that affect the electrical service in the surrounding electrical system. EKPC needs to provide a statement that demonstrates that they have provided these results to the affected neighboring systems over a reasonable time period and have either received their "no objection" or their failure to comment.
- ICF finds that the estimates for equipment and financing costs are reasonable. Information on the determination of the costs of rights-of-way is limited and ICF believes it would be worth additional review to understand the source of this information and if estimates of ROW costs are available for alternative routing.
- Further, though not a direct part of the transmission adequacy review, ICF notes that the generation resources available to fulfill load requirements appear limited.