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# **Interconnection Facility Study Report**

**Project G243 (MISO Queue#37384-01)**

**120MW Coal Unit at Estill County, KY**



**January 2004**

Prepared by

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## TABLE OF CONTENTS

1	Executive Summary.....	1
2	Introduction.....	1
3	Review of Interconnection Evaluation Study.....	2
4	Location and Connection Point.....	3
5	Interconnection Facilities and Construction Cost.....	6
6	Schedule of Activities.....	8
7	Conclusion.....	9
Appendix A	Notes for Brown Plant Units Sensitivity Studies.....	10
Addendum†	Amendment to the Report	11

**†: The report was amended based on the latest information provided by the Transmission Owner and the Generator on 03/25/2004.**

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## **1. Executive Summary**

MISO completed an Evaluation Study for the Generator Interconnection project, G243, in July 2003. The interconnection customer requested a Facility Study for this project. The scope of this facility study was to determine the good faith estimate and schedule to construct required facilities for the new interconnection. This report focuses on the detailed engineering analysis for the interconnection of the new generator at LG&E Energy's West Irvine 161 kV substation. The study results show a good faith estimate of \$3,992,448 in 2006 dollars for total construction cost. The study also determined the following construction schedule for the major milestones of this project:

December 1, 2004	West Irvine Tap to West Irvine 161 kV line - Begin Engineering Design
March 1, 2005	West Irvine Tap to West Irvine 161 kV line - Begin Right-of-way acquisition
September 1, 2005	West Irvine Substation Construction - Order Materials
December 1, 2005	West Irvine Tap to West Irvine 161 kV line - Line Material Acquisition
June 1, 2006	West Irvine Tap to West Irvine 161 kV line - Begin Line Construction

## **2. Introduction**

The project is based on a waste coal fueled circulating fluidized bed boiler powering a steam turbine generator of 120 MW in Estill County, Kentucky. It entered in the MISO Generation Interconnection Queue on Aug. 16, 2002, with an initial in-service date of April 2006. During the Interconnection Evaluation Study, the interconnection customer indicated that the in-service date could be delayed to sometime in 2007.

An Interconnection Evaluation Study was performed for this project. The study report was posted in MISO Generation Interconnection Queue in July 2003 ([http://www.midwestiso.org/plan\\_inter/documents/G243\\_IES\\_Final\\_Report.pdf](http://www.midwestiso.org/plan_inter/documents/G243_IES_Final_Report.pdf)). The scope of the evaluation study is to perform load flow, short circuit, and stability analysis. The purpose of load flow study is to provide an indication of the thermal problems when delivering power out from the plant. Short circuit analysis is done to determine the impact of the new generator on the interrupting capability of the breakers at the interconnection point and other substations nearby. Stability study determines the ability of the proposed generator to remain in synchronism after a disturbance in the system. It

also evaluates the impact of the new generation on the system-wide stability performance.

This report is for the Interconnection Facility Study of project G243. The study scope is to explore further the solution options identified in the Interconnection Evaluation Study. The objectives are:

- To determine the facilities necessary to interconnect the proposed generation to the Transmission Network
- To determine the facilities necessary to remove thermal, short circuit, and stability constraints identified in the Interconnection Evaluation Study
- To determine Good Faith cost estimates, following preliminary design, of the facilities determined as a result of Evaluation Study, along with the estimated time for construction

This Interconnection Facility Study evaluates one of the two system upgrade options identified in the Interconnection Evaluation Study to mitigate the thermal overloading problems caused by the proposed interconnection. The solutions analyzed in this study are in addition to the guidelines provided (for consideration in future Transmission Service Request study or operating study) in the Interconnection Evaluation Study (Appendix A).

### **3. Review of Interconnection Evaluation Study**

Interconnection Evaluation Study for project G243 was completed in July 2003. Details can be found from the MISO Generation Interconnection Queue.

In the study, thermal analysis identified several constraints associated with the proposed interconnection. Two solutions were proposed to eliminate these constraints:

**Option 1:** Double circuit the line from West Irvine Substation to West Irvine Tap and upgrade the 161/69kV transformer at West Irvine Substation

**Option 2:** Double circuit the line from West Irvine Substation to West Irvine Tap and add a parallel 161/69kV transformer at West Irvine Substation

In one of the conference calls during the Evaluation Study, the ad hoc group decided to focus only on Option 1 in the following phases of the Interconnection process (Facility Study and IA). In addition, the group agreed to use the existing Right of Way for the new double circuit line, considering the fact that the additional right of way would not increase the reliability of the system significantly, on the other hand it would cost more to the customer.

Short circuit analysis showed the need to replace three existing 69 kV breakers at West Irvine substation. Results did not show any significant fault current increase in EKPC's system caused by the new generator interconnection.

There were no identified significant impacts on system stability due to interconnection of the proposed generator with the proposed upgrades identified in Option 1. However, the protection scheme at West Irvine substation will require breaker-failure protection to maintain clearing times within the critical values identified in stability study. Critical Clearing Time for a three-phase fault at West Irvine 161kV substation was found to be 16.0 cycles.

#### 4. Location and Connection Point

The proposed plant is located about 1.9 miles northeast of West Irvine substation. The interconnection is to be achieved by building a new 161 kV line from the plant site to the West Irvine substation, thus connecting the generator to LG&E Energy's transmission system. A system map of the surrounding area is shown in Figure 1. A black symbol on the map shows approximate location of the new generator. Network representation with the system upgrades, identified in the evaluation study, is shown in Figure 2, and a plan view of West Irvine substation is shown in Figure 3.

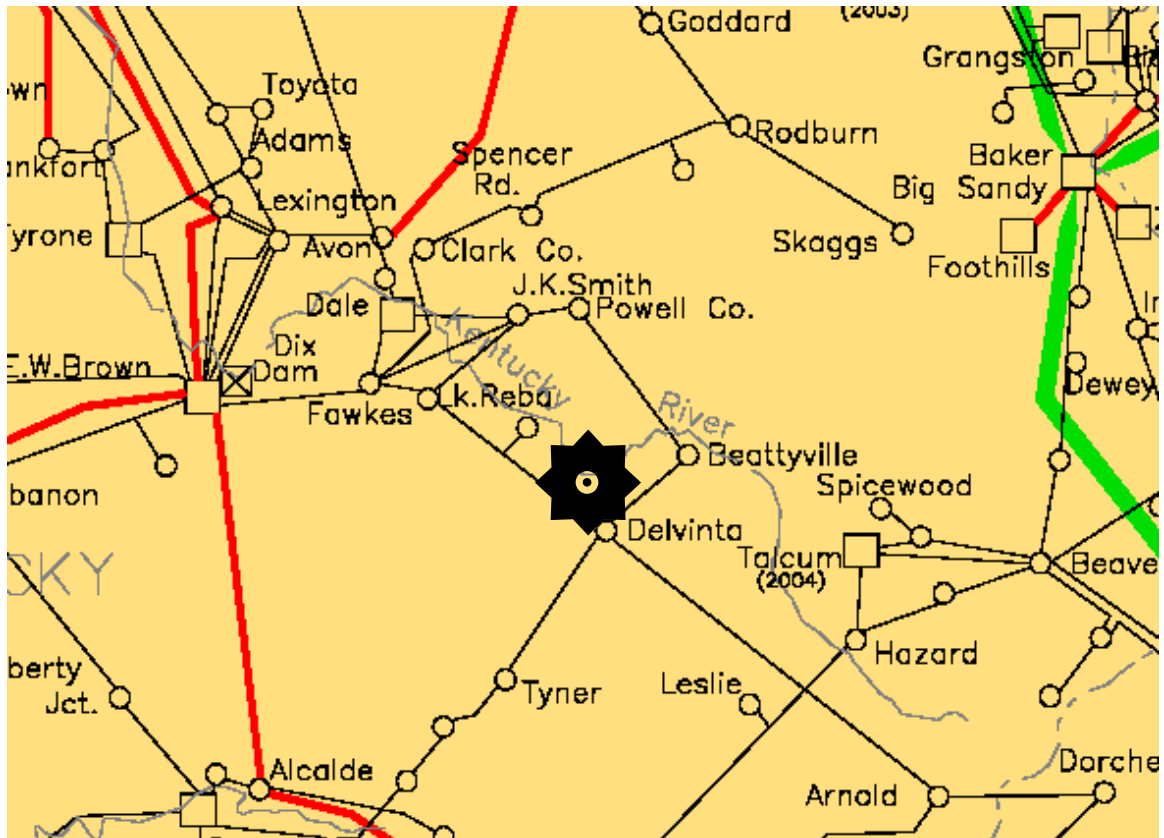


Figure 1 Transmission system map of the area, near the point of interconnection

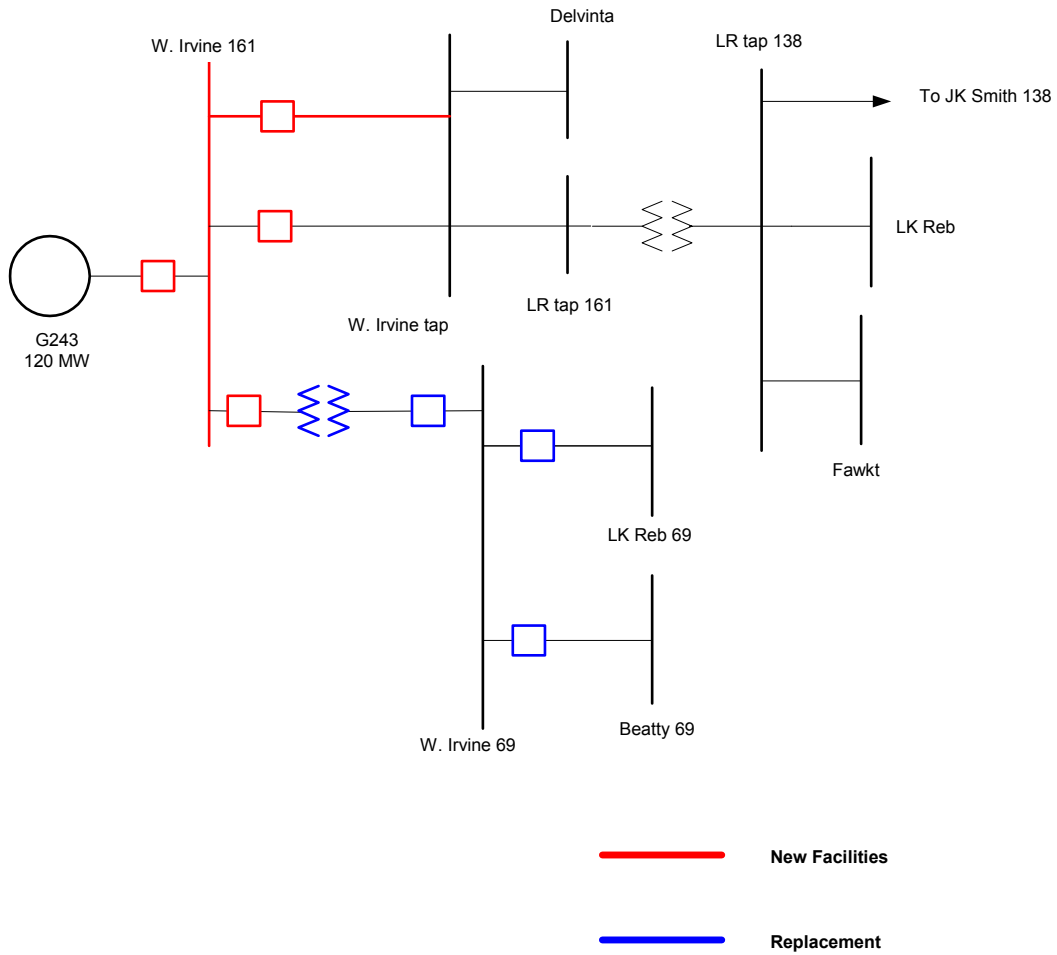


Figure 2 Representation of system upgrades, analyzed in the Facility Study

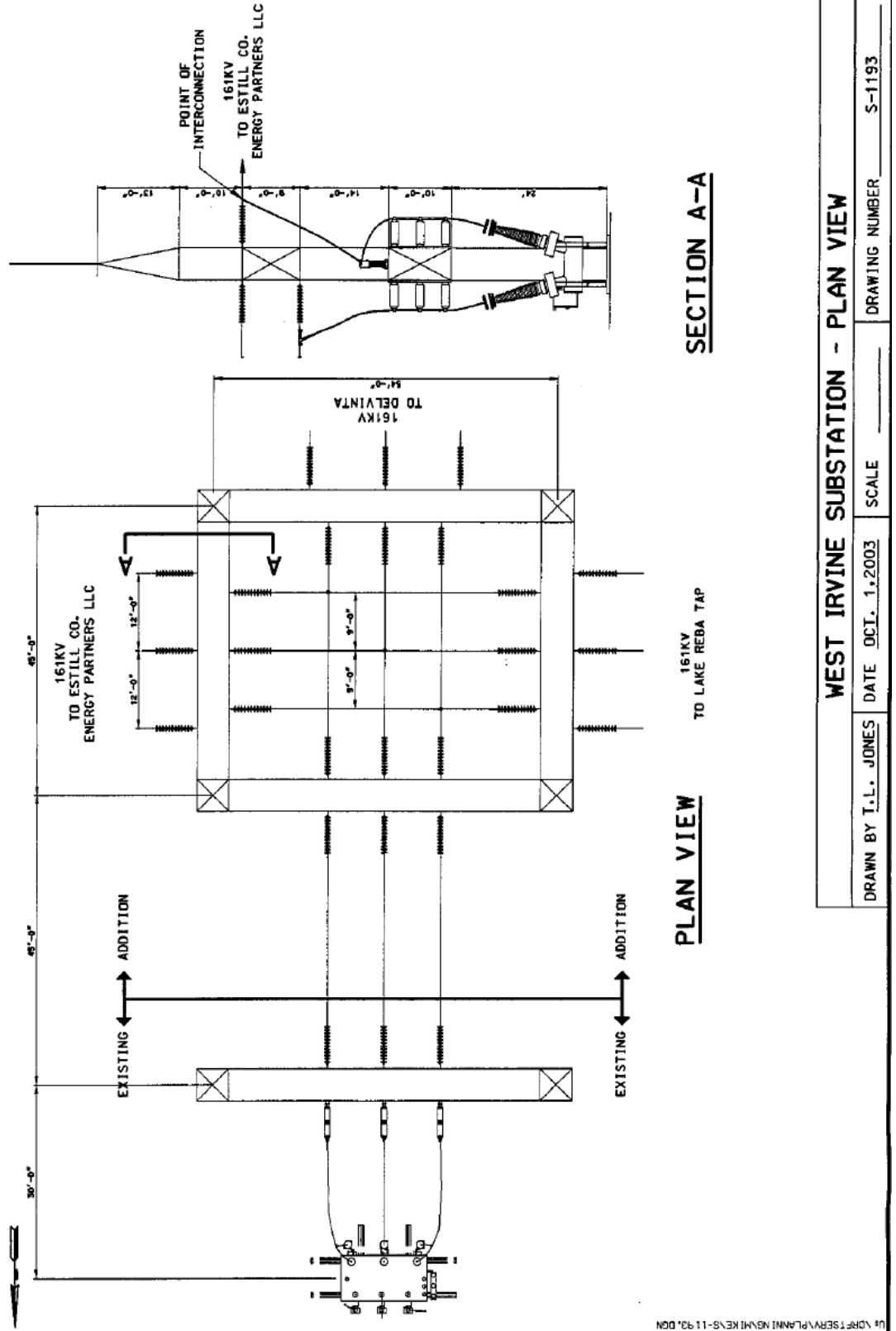


Figure 3 West Irvine Substation – Plan View

## **5. Interconnection Facilities and Construction Cost**

LG&E Energy performed the Facility Study for this project and determined the cost estimates and construction schedule to implement the system upgrades. One of the upgrades, identified in the Evaluation Study, was to double circuit the 161 kV line from West Irvine to West Irvine Tap. It was decided, during the Evaluation Study, to use the existing Right of Way to build this new line. However, LG&E Energy identified in the Facility Study, that double circuiting the line on the existing Right of Way would cost about the same as acquiring the land for a separate ROW and building the new line on it. In addition to that, LG&E Energy found the following benefits of building the line on a separate ROW:

- Existing 161 kV tap line to West Irvine would not be out for an extended period of time to construct a double-circuit line
- Maintenance of these lines will be much easier if they are not on the same poles. Maintenance outages of both lines simultaneously can be avoided.
- The reliability is slightly higher from the standpoint that a failure of a pole will not outage both lines.
- The tradeoff in tearing down the existing line and installing double circuit steel poles versus acquiring additional ROW to construct a parallel line using wooden H-frame structures is about equal. Therefore, the cost is no more to build the line on parallel ROW.

For these reasons, LG&E Energy decided, with costs being equivalent, to design the line on separate structures on adjacent ROW. Therefore, the estimate for the new line was developed considering a separate ROW and it includes the cost of acquiring the ROW.

The following tables show the good faith cost estimates of facilities required for proposed generator interconnection. All cost estimates in the tables include a 10% contingency margin. All these facilities are required to be completed before connecting the generator to the power network. LG&E Energy transmission facility estimates do not include any cost for construction of facilities between the generator and the insulator bells at the take-off structure in the West Irvine substation.

The estimates presented in the Table 1 have been split to show the interconnection facilities and network upgrades based on the FERC's definition of these terms. The FERC Order 2003, paragraph 21 says "Network Upgrades include only facilities at or beyond the point where the Interconnection Customer's Generating Facility interconnects to the Transmission Provider's Transmission System." In addition, paragraph 22 of the FERC Order 2003 says that Network Upgrade facilities are eligible for future transmission credits while Interconnection Facilities are Generator's direct assignment and are not eligible for credits. For this project, one (out of four) 161 kV breaker at the point of interconnection and the breaker failure protection scheme are considered Interconnection Facilities.



Table 1. Construction cost estimates split based on FERC's definition

Item		Cost in 2003 Dollars	Cost in 2006 Dollars
Network Upgrades	1. Substation work, including the construction of a 161 kV bus at West Irvine, installing three 161 kV breakers and replacing the three 69 kV breakers at West Irvine	1,178,109	1,298,633
	2. Construct 3 miles of 161 kV line using 556 kcm ACSR from the West Irvine Tap point to West Irvine. Includes the cost of acquiring additional right of way.	1,292,939	1,425,210
	3. Replace the West Irvine 161/69 kV, 56 MVA transformer with a 90 MVA transformer	870,952	960,053
Interconnection Facilities	4. Install one 161 kV breakers at West Irvine leading to the proposed generator and Install a breaker-failure protection scheme at West Irvine	279,916	308,552
<b>Total Cost</b>		<b>3,621,916</b>	<b>3,992,448</b>

LG&E Energy does not agree with the way the estimates have been split between Network upgrades and Generator's direct assignment and believe that FERC's definition is very much uncertain. They believe that any upgrades, required to solve the Stability and Short circuit problems, caused by the proposed interconnection, should be assigned to the generator and are not eligible for any future transmission credits. Table 2 shows the estimates split based on LG&E Energy's definition.

Table 2. Construction cost estimates split based on LG&E Energy's definition

Item		Cost in 2003 Dollars	Cost in 2006 Dollars
Interconnection facilities	1. Substation work, including the construction of a 161 kV bus at West Irvine, installing four 161 kV breakers and a breaker failure protection scheme, and replacing the three 69 kV breakers at West Irvine	1,458,024	1,607,184
	2. Construct 3 miles of 161 kV line using 556 kcm ACSR from the West Irvine Tap point to West Irvine. Includes the cost of acquiring additional right of way	1,292,939	1,425,210
Network upgrades	3. Replace the West Irvine 161/69 kV, 56 MVA transformer with a 90 MVA transformer	870,952	960,053
<b>Total Cost</b>		<b>3,621,916</b>	<b>3,992,448</b>

## 6. Schedule of Activities

All of the identified facilities in Table 1 must be completed 6 months before the commercial operation date. Assuming a commercial operation date of June 1 2007, all transmission facility constructions should be complete by December 1, 2006. A schedule of major milestones is given in Table 3.

Table 3. Construction Schedule

Start date	Major Milestones
December 1, 2004	West Irvine Tap to West Irvine 161 kV line - Begin Engineering Design
March 1, 2005	West Irvine Tap to West Irvine 161 kV line - Begin Right-of-way acquisition
September 1, 2005	West Irvine Substation Construction - Order materials
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## **7. Conclusion**

The total cost to interconnect the proposed generator to the network has been estimated to be \$3,992,448 in 2006 US dollars. The study also identified the schedule for major milestones in order to achieve a commercial operation date of June 1, 2007.

## **Appendix A. Notes for Brown Plant Units Sensitivity Studies**

In Interconnection Evaluation Study, additional load flow runs were made to honor LG&E Energy's planning criteria. LG&E Energy's planning guidelines specify testing the adequacy of the transmission system with a single element outaged in conjunction with a generation unit outage. The following worst-case generation dispatch scenarios were considered as advised by LG&E Energy:

- Maximum generation in the Brown area
- Minimum generation in the Brown area.

N-1 analysis was performed in conjunction with the above scenarios, with inclusion of upgrade option 1. Some overloads were identified in Appendix A of the Interconnection Evaluation Study. According to Section 2.3 in Attachment R of MISO OATT, Generation Interconnection study process does not assure deliverability from the plant, the purpose of these additional runs is to provide an indication of the thermal problems, the proposed generator could cause (during periods when LG&E Energy is operating under these dispatch scenarios) when delivering power out from this plant.

Finding solutions to the thermal overloading problems identified under Brown maximum and minimum dispatch scenario was not included in the Interconnection Evaluation Study. If a delivery or operating study identifies any system constraints, the delivery/operating study will identify a solution (required upgrade or an operating guideline) before granting of any type of transmission service out of the plant. If a long-term transmission service request is not submitted for this generator, an operating study will be required to address this issue before the project is allowed to deliver power into the grid.

## **Addendum Amendment to the Report**

### **Ad.1 Commercial Operation Date**

Generator notified Midwest ISO on 03/25/2004 that the estimated new Commercial Operation Date for this project should be considered as January 2008 and all schedules for this project should be adjusted based on the new in-service date.

### **Ad.2 Construction Schedule**

After subsequent review of the construction schedule, prepared for this Facility Study, LG&E Energy believe that the Right of Way acquisition schedule for the new line is not practical for meeting the in-service date for this project. They indicated to MISO on 03/25/04 that based on their past experience, ROW acquisition is the reason of delay in the line completion in most cases. LG&E Energy also indicated to MISO and ECEP about the potential legislation being considered in Kentucky, which would require a Certificate of Convenience & Necessity for all line construction 138 kV and above. Due to these reasons LG&E Energy feel additional time is required for regulatory approval process and for the routing and design of the new line. Therefore, the construction schedule presented in this report is being revised based on LG&E Energy's recommendation. Table Ad.1 shows the revised construction schedule for this project.

Table Ad.1 Revised Construction Schedule

Time Frame: Months, prior to Operation date	Activity
41	Begin Engineering Design of 161 kV line
35	Finalize the routing and design
24	Begin R/W acquisition
20	Begin the condemnation process, if necessary
13	Begin acquisition of materials
8	Begin construction of the line
18	Begin Substation Engineering and Design work
13	Begin Substation construction