# LG&E/KU – Mill Creek Station

# Phase II Air Quality Control Study

# Auxiliary Electrical System

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**Revision B – Issued For Client Review**

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# 1.0 Introduction

Mill Creek Units 1-4 are generating facilities owned by LG&E/KU located near Louisville, Kentucky. Mill Creek Units 1-4 are coal fired electrical generating stations currently producing 1,608 MW gross. The addition or refurbishment of emissions controls technologies for nitrogen oxide ($NO_x$) (Units 1 & 2), sulfur dioxide ($SO_2$), mercury (Hg), hydrogen chloride (HCl), carbon monoxide (CO), Dioxin/Furan, sulfuric acid ($SO_3$), and particulate matter (PM) is being evaluated to ensure that there is compliance with the emissions limitations that Unit 1-4 may be required to meet in the future.

The addition of these new emissions control technologies will require installation of new auxiliary electric system equipment to provide power. Each of the potential air quality control equipment alternatives, composed of an SCR for Units 1 and 2, a Pulse Jet Fabric Filter (PJFF) for all units, and Wet Flue Gas Desulfurization (WFGD) for Unit 4, presents a unique demand upon the auxiliary electric system. This report will identify the expected impact to the auxiliary electric system and propose a method of meeting the demand.

# 2.0 System Requirements

## 2.1 Existing Auxiliary Electrical System

The existing Mill Creek auxiliary power systems includes outdoor 13.8 kV switchgear in a main-tie-main bus configuration fed at each end by one of two 345/138/13.8 kV Auto transformers. The outdoor 13.8 kV switchgear provides startup/backup power for each unit and the station auxiliary electrical systems. The outdoor 13.8 kV switchgear bus A feeds 13.8/4.16 kV reserve auxiliary transformer A and U1/U2 scrubber transformer A, and bus B feeds 13.8/4.16 kV reserve auxiliary transformer B and U1/U2 scrubber transformer B. Each 13.8/4.16 kV transformer has three windings. The two reserve auxiliary transformers are connected in an "A" or "B" fashion to each of the units' 4.16 kV auxiliary electrical alternate/back-up incoming circuit breakers for startup and backup power. In addition, the two reserve auxiliary transformers feed the 4.16 kV station feeder switchgear which is arranged in a main-tie-main bus configuration.

Units 1 and 2 auxiliary electrical system 4.16 kV switchgear buses are fed from their own respective one three-winding main auxiliary transformer that is powered from their respective generator leads. Units 3 and 4 auxiliary electrical system 4.16 kV switchgear buses are fed from their own respective two three-winding main auxiliary transformers that are powered from their respective generator leads. All units have four auxiliary electrical system 4.16 kV switchgear buses. Units 3 and 4 each have their own respective 4.16 kV scrubber switchgear in a main-tie-main bus configuration that are fed from their respective unit auxiliary electrical system 4.16 kV switchgear buses. Unit 1 and 2 4.16 kV scrubber switchgear buses are fed from the U1/U2 scrubber transformers A and B described above.

The WFGD (Unit 4 only) and PJFF will require the addition of new booster or ID fans at all units. The existing main auxiliary transformers, reserve auxiliary transformers, and 4.16 kV switchgear buses were determined to have insufficient spare capacity, short circuit rating, and voltages to power the AQC options that include new technology and booster/ID fan electrical loads.

## 2.2 New AQC Auxiliary Electrical System

The proposed new AQC auxiliary electrical system is shown on one-line drawings 168908-M1DE-E1001, 168908-M2DE-E1002, 168908-M3DE-E1003, 168908-M4DE-E1004, and 168908-MCDE-E1005, which are referenced in Appendix A. The transformer and switchgear ratings are based upon the load lists referenced in Appendix A. The locations of the new electrical equipment and buildings are shown on site

arrangement drawings 168908-MCDS-1001, 168908-MCDS-1002A, and 168908-MCDS-1002B referenced in Appendix A. Based on using variable frequency drives for the booster/ID fans, Units 1, 2, and 3 will require one new two-winding 22 kV-4.16 kV AQC main auxiliary transformer (MAT) that will be fed from their respective generator leads. Based on using variable frequency drives for the booster fans, Unit 4 will require one new three-winding 22 kV -4.16 kV- 4.16 kV AQC MAT that will be fed from the Unit 4 generator leads. The secondary windings will power the new AQC 4.16 kV switchgear buses for the fans and other various AQC loads. The alternate/backup power for new AQC 4.16 kV switchgear buses will be fed from new AQC 4.16 kV reserve switchgear and two new AQC 13.8 kV – 4.16 kV two winding reserve auxiliary transformers (RATs) fed from the existing outdoor 13.8 kV switchgear described above. The existing 13.8kV switchgear will need to be modified. Two vertical sections and two breakers will be added to the existing 13.8kV switchgear. This will require the extension of the existing bus. The new main and reserve auxiliary transformers will be sized such that one of the two transformers feeding the buses could be taken out of service, with the other transformer supplying the entire load. Unit 4 will require both AQC RATs to be in service if the Unit 4 MAT is taken out of service. Also, Unit 3 in the final arrangement will use the existing Unit 4 scrubber and auxiliary systems. The power feeds to the existing Unit 4 scrubber and auxiliaries will need to be switched over from Unit 4 to Unit 3 during conversion in order to maintain power to the scrubber system while Unit 4 is off-line. Further electrical studies (short circuit, motor starting, etc.) will be performed during detailed design to determine the final transformer impedance and MVA ratings.

# 3.0 Summary

The recommended location of the two new AQC reserve auxiliary transformers that will be connected to the existing outdoor 13.8 kV switchgear will be in proximity to the tie-in points on the east side of the Units 1 & 2. The recommended locations of each of the four new AQC main auxiliary transformers will be in proximity to each of their respective generator leads. Proposed locations of the new equipment are shown on the site arrangement drawings referenced in Appendix A. Cable bus will be routed during detailed design from the secondary windings of these auxiliary transformers to the new AQC electrical buildings at each unit. The new electrical AQC buildings would be located in the vicinity of the PJFF equipment as shown in the site arrangement drawings. The buildings will contain the new medium voltage (MV) and low voltage (LV) switchgear, motor control centers (MCCs), and distributed control system (DCS) cabinets. A DC and UPS system will also be included in the electrical buildings to provide control power to the switchgear and DCS system. Motor control centers and DCS I/O cabinets may be installed in a small electrical building adjacent to remote AQC equipment to minimize cable lengths for the equipment in this area.

# Appendix A
# Reference Drawings, Diagrams and Lists

Site Arrangements

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|---|---|
| 168908-MCDS-1001 | Site Arrangement Unit 1 and Unit 2 |
| 168908-MCDS-1002A | Site Arrangement Unit 3 and Unit 4, Arrangement A |
| 168908-MCDS-1002B | Site Arrangement Unit 3 and Unit 4, Arrangement B |

Equipment and Load Lists

Unit 1 Load List
Unit 2 Load List
Unit 3 Load List
Unit 4 Load List

One-Line Diagrams

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|---|---|
| 168908-M1DE-E1001 | One-Line Diagram, Conceptual Overall – Unit 1 AQCS |
| 168908-M2DE-E1002 | One-Line Diagram, Conceptual Overall – Unit 2 AQCS |
| 168908-M3DE-E1003 | One-Line Diagram, Conceptual Overall – Unit 3 AQCS |
| 168908-M4DE-E1004 | One-Line Diagram, Conceptual Overall – Unit 4 AQCS |
| 168908-MCDE-E1005 | One-Line Diagram, Conceptual Overall –AQCS Reserve |