LG&E/KU – E.W. Brown Station

Phase II Air Quality Control Study

Auxiliary Electrical System

April 08, 2011
Revision B – Issued For Client Review

B&V File Number 41.0809

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1.0 Introduction

E.W. Brown Units 1-3 are generating facilities owned by LG&E/KU located near Shakertown, Kentucky. E.W. Brown Units 1-3 are coal fired electrical generating stations currently producing 747 MW gross. The addition or refurbishment of emissions controls technologies for nitrogen oxide (NO_x) (Units 1&2), mercury (Hg), hydrogen chloride (HCl) (Unit 1&2), 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 1-3 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 Unit 1&2, a Pulse Jet Fabric Filter (PJFF) for all units, sorbent injection (Unit 1&2), Neural Network, and Powdered Activated Carbon (PAC) injection for all units, 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.

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2.0 System Requirements

2.1 Existing Auxiliary Electrical System

The existing E.W. Brown auxiliary power systems includes main plant auxiliary electrical system 2.4 kV or 4.16 kV auxiliary switchgear buses UA and UB which are fed from their own respective two-winding unit auxiliary transformer (UAT) that are powered from their respective generator leads. UAT 1 is rated 10,000 kVA, 13.2 kV-2.4 kV supplying 2.4 kV auxiliary switchgear buses 1A and 1B, UAT 2 is rated 10,000/12,500 kVA, 17.1 kV-2.4 kV supplying 2.4 kV auxiliary switchgear buses 2A and 2B, and UAT 3 is rated 15,100/20,100/25,200 kVA 24 kV-4.25 kV supplying 4.16 kV auxiliary switchgear buses 3A and 3B. Reserve power to Unit 1 and 2 auxiliary switchgear buses is provided from the 138 kV Substation (South) through a two-winding Reserve Auxiliary Transformer (RAT) rated 10,000/12,500 kVA, 138 kV-2.4 kV. Reserve power to Unit 3 auxiliary switchgear buses is provided from the West Cliff Substation 138/69/13.2 kV transformer through a two-winding RAT rated 31,360 kVA FOA, 13.2 kV-4.25/2.45 kV.

Unit 1, 2, and 3 13.2 kV FGD switchgear buses 0AP01E-A and 0AP01E-B are fed from the two-winding UAT-3C that is powered from Unit 3 generator leads. UAT-3C is rated 33,600/44,800/56,000 kVA, 25 kV-13.2 kV. Reserve power to Unit 1, 2, and 3 13.2 kV FGD switchgear buses is provided from the Unit 1 13.2 kV Generator leads through a Clip PME Triggered Current Limiter connected between the Unit 1 Generator Breaker and the Unit 1 Main Transformer 1 low voltage terminals, via 15 kV cable bus consisting of 4-1/C 500KCMIL/PH conductors. Each 13.2 kV FGD switchgear bus feeds a 13.2 kV–4.16 kV step down transformer rated 13,400/17,900/22,400 kVA, that provides power to the 4.16 kV FGD switchgear buses 0AP02E-A and 0AP02E-B.

2.2 New AQC Auxiliary Electrical System

The addition of SCR, PJFF, and fly ash (FA) handling equipment on Unit 1 will require the addition of a 1,000 HP FD Fan motor. The existing Unit 2 ID fan motor will be used and relocated to the Unit 1 FD fan. The existing Unit 1 2400V switchgear will power and feed the Unit 1 FD fan using an existing breaker. The addition of SCR, PJFF, and FA Handling equipment on Unit 2 will require the addition of one 1,500 HP FD Fan motor, and will require one new 7,900 HP ID fan motor. The existing Unit 2 ID fan motor will be used and relocated to the Unit 2 FD fan. The existing Unit 2 2400V switchgear will power and feed the Unit 2 FD fan using an existing breaker. The addition of a PJFF and FA Handling equipment on Unit 3 will not require the addition of any new significant loads The new total Units 1, 2, and 3 connected electrical load for the new

SCR/PJFF/FA equipment including new fan loads was estimated to be approximately 20,000 kVA. The existing unit auxiliary transformers, reserve auxiliary transformers or existing FGD 13.2 kV switchgear buses were determined to have insufficient spare capacity, spare circuit breakers, single-speed motor starting and voltage limitations, and short circuit ratings to power the total load of the PJFF, SCR and FA additions. Also, existing units 2.4 kV and 4.16 kV auxiliary switchgear buses are older vintage equipment where new additions and spare parts may be an issue.

Unit 1 and 2 will require new 13.2 kV AQC switchgear buses A and B that will be fed respectively from one new two-winding UAT-3D that is powered from Unit 3 generator leads. The new UAT-3D will be rated approximately 15,000/20,000/25,000 kVA, 25 kV-13.2 kV. Reserve power to the new Unit 1 and Unit 2 13.2 kV AQC switchgear buses will be provided existing FGD 13.2 kV switchgear supply, via a new 15 kV cable bus consisting of one (1), 500KCMILconductor per phase. Each new Units 1 and 2 13.2 kV AQC switchgear bus will feed a 13.2 kV–4.16 kV step down auxiliary transformer rated approximately 1,000 kVA, that will provide power to the 4.16 kV AQC switchgear buses A and B. The new 13.2 kV AQC switchgear buses A and B will also supply power to each of the new AQC unit secondary substation (USS) transformers that will power the 480V USS for Units 1 and 2 SCR, PJFF, and FA additions.

The existing 13.2 kV FGD switchgear buses will supply power to each of the new Unit 3 AQC USS transformers, and most likely power the Unit 3 SCR being installed under a separate contract. Any Unit 3 AQC medium voltage motor loads will be powered from a new Unit 3, 4.16 kV AQC switchgear buses A and B. The new Unit 3, 4.16 kV switchgear bus A and B will be fed from new Unit 3, AQC 4.16 kV Switchgear Transformers A & B. The transformers will be fed from the existing 13.2 kV FGD switchgear.

3.0 Summary

The recommended location of the new Units 1 and 2 AQC 13.2 kV reserve power supply that will be connected to the new Unit 1 and 2 13.2 kV AQC switchgear will be at the existing FGD 13.2 kV supply connections . The recommended location of the new AQC UAT-3D will be in proximity to the existing UAT-3C. Cable bus will be routed during detailed design from the secondary windings of the UAT-3D to the new Unit 1 and 2 AQC electrical building close to the new Unit 1 and 2 AQC major loads. The new Unit 3 AQC electrical equipment will be located in the new Unit 3 AQC electrical building. The new AQC electrical buildings will be located in the vicinity of the PJFF and SCR equipment for each unit as shown in the conceptual sketches referenced in Appendix A. 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 Unit 1 and 2 AQC electrical building to provide control power to the switchgear and DCS system. Existing DC and UPS power from the existing Unit 3 FGD electrical building will be used for the new Unit 3 AQC Electrical Equipment Building needs. 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.

The proposed new AQC auxiliary electrical system is shown on one-line drawings 168908-B1DE-E1001, 168908-B2DE-E1002, 168908-B3DE-E1003, and 168908-BCDE-E1004, 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-BCDS-1001, and 168908-BCDS-1002 referenced in Appendix A. Further electrical studies (short circuit, motor starting, etc.) will be performed during detailed design to determine the final transformer impedance and MVA ratings.

Final cable and cable bus routing will be determined during detailed design. The new electrical AQC buildings will be located as shown in the site arrangement drawings in Appendix A. 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

168908-BCDS-1001	Site Arrangement Unit 1 and Unit 2
168908-BCDS-1002	Site Arrangement Unit 3

Equipment and Load Lists

Unit 1 Load List
Unit 2 Load List
Unit 1 and 2 Common Load List
Unit 3 Load List

One-Line Diagrams

168908-B1DE-E1001	One-Line Diagram, Conceptual Overall – Unit 1 AQCS
168908-B2DE-E1002	One-Line Diagram, Conceptual Overall – Unit 2 AQCS
168908-B3DE-E1003	One-Line Diagram, Conceptual Overall – Unit 3 AQCS
168908-BCDE-E1004	One-Line Diagram, Conceptual Overall – Unit 1 / 2 Common AQCS