LG&E/KU – E.W. Brown Station

Phase II Air Quality Control Study

Fly Ash Handling

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1.0 Introduction

The particulate matter collected from the exhaust gas from all three units at the E.W. Brown Station will be collected by one new pulse jet fabric filter (PJFF) per unit rather than the existing electrostatic precipitators according to the additions and modifications proposed by the Phase II Air Quality Control (AQC) Study. This AQC modification requires a new fly ash handling system to collect and transport fly ash from the new fabric filters. The purpose of this report is to describe the new fly ash handling system and associated AQC system modifications proposed, and confirm acceptability of the fly ash handling system design.

At time of this report, installation is underway under separate contract of an onsite dry landfill for fly ash intended to serve all three units at Brown. It is assumed for purposes of this report that the new ash landfill will be completed and that some type of pneumatic transfer and landfilling of fly ash is in operation at the time AQC modifications are completed. Since no design information regarding the assumed pneumatic transfer system is available, it is further assumed for purposes of this report that the ash transfer system described herein is new and totally separate from any pneumatic system currently under consideration.

2.0 System Description and Evaluation

All three units at the Brown Station currently include an electrostatic precipitator (ESP) for collection of particulate matter from the unit exhaust gas stream. As part of the AQC modifications proposed by Phase II, the existing ESPs on each unit will be replaced by a new pulse jet fabric filter (PJFF) to collect fly ash prior to the exhaust gas reaching the wet scrubbers. In addition, Phase II proposes the injection of sorbent for SO_3 control and powdered activated carbon (PAC) for mercury control (the sorbent injection system at Unit 3 will already be in service at the time of Phase II modifications). The injected particulate must also be removed from the exhaust stream by the PJFF.

For purposes of this study all particulate removed from the exhaust gas will be covered under the term "fly ash." Considering the improved efficiency of the proposed PJFF over the ESP plus the new injected particulate material that must be removed from the gas stream, the amount of total fly ash that must be handled will be higher at each unit than that currently processed through the system.

The existing fly ash system is based on sluiced transport of ash, which is not compatible with the proposed dry ash landfill under construction. Accordingly, the existing fly ash system is assumed as inappropriate for the operation of equipment installed as part of Phase II. A new pneumatic transport-based system will be required and its design will be based on the increased ash loading resulting from the PJFFs and injected particulate systems.

2.1 Description of Existing AQC and Fly Ash Systems

The existing AQC system has unit-specific electrostatic precipitators (ESPs) and a common wet flue gas desulfurization (WFGD) for all three generating units. The existing ESPs will no longer be used to collect fly ash and will be either retired in place or demolished to make room for the new fabric filters. The current fly ash handling system will be completely replaced by the new system and the existing system will have no impact on the new one.

At time of this report, a dry landfill for onsite ash storage is under construction at the Brown Station. It is intended that ash from the three units at Brown will be transported dry to this landfill via a new pneumatic ash system to be installed as part of the Phase II AQC modifications.

2.2 New AQC and Fly Ash Systems

A new PJFF system, including PAC and sorbent injection, will be installed on each unit as part of the Phase II construction. The new AQC system includes the addition of Selective Catalytic Reduction (SCR) systems at Units 1 and 2 (the SCR at Unit 3 will be complete and in operation at the time of Phase II modifications). The new fly ash system will also collect ash from the ductwork hoppers beneath the SCRs. The ash collected from each PJFF and any other new ash pick up points will be transferred via a separate new vacuum/pressure pneumatic ash conveying system. The new system will consist of blowers and supporting equipment located in new fly ash handling buildings with an ash conveying pipeline from each PJFF to the new ash storage silo area. One common Fly Ash Handling Building will house the equipment for forwarding fly ash from Units 1 and 2 while a separate Fly Ash Handling Building will house the equipment for Unit 3. Two new common silos will be located adjacent to the landfill serving all three units. Ash conveyed to the storage silos will be conditioned and placed in trucks for transport to the working face of the landfill for deposition and compaction.

Each fabric filter will require its own fly ash handling system. In addition to ash, the new fabric filters will collect powdered activated carbon (PAC) and un-reacted sorbent, and other byproducts from the SO_3 removal system. The new fabric filter and fly ash system for each unit will be sized for the total amount of fly ash, PAC and sorbent generated by each unit.

In general, each unit fly ash system will include the following major components: ash intake and hopper outlet gate valves, two filter separators with pulse jet cleaning systems, two vacuum exhausters with silencers, a new transfer tank, two pressure “pots” (air lock feeders), two pressure transfer blowers, and pneumatic transfer piping system and valves to transfer fly ash to the common ash silos.

Single pressure conveying lines will be provided for each new fly ash system from the fabric filter hopper area to the transfer tank and from the transfer tank to the common ash silos. The Unit 1 and Unit 2 conveying lines downstream of the transfer tank will share a single piperack from the units to the area just south of the Unit 3 PJFF. Similarly, a short length of piperack will support the conveying pipe from the transfer tank at Unit 3 to this same location. All three conveying lines will share a single piperack crossing the main access road and coal delivery rail spur to the area near the fly ash storage silos.

Table 2-1
Fly Ash and Particulate Removal Rate

Total fly ash loading, lb/hr	8,744	14,566	36,037	
Ash removed by ESP, lb/hr	0	0	0	
Ash removed by PJFF, lb/hr	8,744	14,566	36,037	
PAC, lb/hr	278	394	1,003	See Note (1)
Byproducts, lb/hr	1,238	2,061	5,099	See Note (2)
Total byproducts, lb/hr	10,250	17,005	42,098	See Note (2)
Design fly ash removal rate for new fly ash system with fabric filter, lb/hr	21,000	34,000	84,000	Sized for total byproduct rate x 2

Notes: (1) PAC is injected upstream of fabric filter

(2) Represents worst case byproducts required for fabric filter solids removal with lime used as a sorbent and includes both byproduct ($CaSO_4$) and un-reacted sorbent (CaO).

2.2.1 Capacity of New Systems

Conceptually, the capacity of each of the three fly ash transfer systems will be based on the design fly ash removal rate for each unit summarized in the Table 2-1. As noted in the table, the transfer capacity will be based on twice the average daily ash generation rate. This will allow the ash systems to be operated only 12 hours per day, allowing time for normal and emergency maintenance plus recovery time. Actual ash transfer capacity will be confirmed during detailed design.

2.2.2 Silo Capacity Design Basis

Two redundant, 50% capacity fly ash storage silos are assumed to be required to store fly ash generated by all three units. The two common ash silos are tentatively sized for a combined total amount of storage for 96 hours of operation at the maximum fly ash production rate (including byproducts). This will allow fly ash generated during a three-day weekend to be accumulated plus a single eight-hour shift to begin to haul off the accumulated ash. Each silo would be sized for a nominal storage weight of 3,300 tons of fly ash. This value will be confirmed during detailed design. Silos will be located and piped to allow either silo to be filled or unloaded with the other out of service.

3.0 Unit Fly Ash System Descriptions

Each of the unit fly ash systems will be functionally identical but sized for the expected required collection and transfer rate of the respective unit. Moreover, each of the three systems will connect together at a common ash storage point. To avoid repetition, the following Fly Ash System Description can be considered as applicable to the systems at all three units, unless noted otherwise.

The Fly Ash System for each unit will pneumatically remove fly ash from the pulse jet fabric filter (PJFF) hoppers and SCR hoppers and transfer the collected fly ash to two new dry ash storage silos with loadout facilities located in the general area of the landfill southwest of Unit 3. In addition, each of the three ash handling systems will transfer powdered activated carbon (PAC) and sorbent which is injected upstream of the PJFF and collected in the PJFF hoppers. The collected fly ash byproducts will be conveyed to the fly ash silos for temporary storage. The stored ash will subsequently be conditioned and loaded into trucks for deposition in the landfill. The flow diagrams which show the new ash hoppers and fly ash handling system equipment per unit and per the station are referenced in Appendix A.

The Fly Ash System will be an entirely new dry system from the ash hopper pickup points for each of the Unit 1, 2 and 3 AQC systems up to the new common storage silos. Each ash collection point in a unit's fly ash system will be pneumatically conveyed via a vacuum system to a separate transfer tank. This tank will be used to convey ash to both common fly ash silos via a positive pressure conveying system, including filter separators, a collection and transfer tank, pressure pots, and 2 by 50% pressure transfer blowers, all located adjacent to the PJFF. The new transfer system will be sized to transfer all collected fly ash from the 100% capacity PJFF and any additional pickup points required within the ductwork upstream of the PJFFs. Actual system capacity and operating margin will be determined during detailed design.

Each PJFF hopper or ductwork pickup point will be equipped with a manual hopper isolation valve and new automatic feed valves. The automatic feed valves will isolate the hopper being emptied and provide a controlled flow of fly ash to the conveying line. The conveying system will sequentially remove ash from the collection hoppers and transfer it to the filter separators and transfer tank. The transfer blowers will then convey the ash to the common storage silos located at the landfill. Blowers and ancillary equipment for the Unit 1 and Unit 2 Fly Ash Systems will be housed in the Unit 1/Unit 2 Common Fly Ash Handling Building and in the Unit 3 Fly Ash Handling Building for the Unit 3 Fly Ash Handling System.

3.1 Interface and Terminal Points

The system proposed as part of the Phase II modifications is intended to be completely independent of and have no interface with the existing fly ash handling system. One possible exception could be any dust collection hoppers being installed with the Unit 3 SCR currently in design. If such hoppers exist, the Unit 3 fly ash collection system would be extended to pick up the fly ash collected in the hoppers and transfer it to the Unit 3 transfer system for transfer to the storage silos.

Each unit's fly ash system will have a terminal point where the pneumatic piping lines running from the PJFF will connect to the common fly ash storage silos at a target box atop each silo.

Appendix A
Reference Drawings

168908-BCASB-M2022	Common Process Flow Diagram - Fly Ash Handling
168908-B1ASB-M2022	Unit 1 Process Flow Diagram - Fly Ash Handling
168908-B2ASB-M2022	Unit 2 Process Flow Diagram - Fly Ash Handling
168908-B3ASB-M2022	Unit 3 Process Flow Diagram - Fly Ash Handling