LG&E/KU – Ghent Station

Phase II Air Quality Control Study

Comparison of Sorbent Receiving and Distribution Systems

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1.0 Introduction

At three of the four units (Units 1, 3, and 4) at Ghent Station a sorbent, either trona or lime, is currently injected into the exhaust gas system to remove SO_3 from the exhaust gases prior to desulfurization. Ghent Unit 2 currently has a temporary sorbent injection system. Proposed future modifications include the addition of a permanent sorbent injection system for Unit 2. In addition, injection of powdered activated carbon (PAC) upstream of new pulse jet fabric filters (PJFFs) at each unit is planned to remove mercury from the exhaust gas. Both of these systems require receiving, storage, and distribution of relatively large amounts of dry powdered bulk material to the separate units. The most efficient means of handling dry bulk materials on a station-wide basis must be determined to minimize capital costs, reduce maintenance, increase system reliability, and avoid impact to other operations on site.

The intent of this high level comparison is to evaluate whether a centralized station-wide or a decentralized unit-specific dry bulk material receiving and distribution system is most appropriate for Ghent Station.

2.0 Sorbent System Requirements

The arrangements studied and proposed in this report are based on an estimated sorbent consumption rate of 6,300 lbs per hour for each of the four units at Ghent. Assumed PAC consumption is estimated at approximately 1,300 lb per hour per unit for purposes of sizing silos and facilities.

Sizing of receiving silos is normally based on storing seven days worth of consumption. Individual unit day bins are sized based on 24 hours consumption per unit. Both the sorbent and the PAC will be injected upstream of the PJFF and optimum silo location is as near to that location as practical.

Three sorbent and PAC injection system arrangements are considered:

- Install a stand alone receiving and forwarding system at each unit (total of four).
- Install a single storage and delivery system that supplies all four units (single central receiving and forwarding system with day bins at each unit).
- Install a dual storage and delivery system where each sorbent and PAC unit stores and delivers product to two units (two dual receiving and forwarding systems with day bins as appropriate at each unit).

Conceptual silo locations and truck delivery traffic patterns for each of the three arrangements are illustrated on the sketch included in Appendix A to this document.

2.1 Individual Unit Storage/Distribution System

A stand alone system with seven days capacity supplying sorbent to a single unit will require two 14 foot diameter by 90 foot tall silos to be placed close to each dedicated PJFF. The sorbent is assumed to be supplied via truck and is blown from a dry bulk delivery tank into each silo. To serve four units, four separate receiving and forwarding stations will be required. For Units 1, 3, and 4, these stations already exist. Unit 1 is served by two silos located directly east of the Unit 1 powerblock, Unit 3 by two silos located in the courtyard immediately east of the Unit 3 powerblock, and Unit 4 by two silos west of the Unit 4 ESP. The tentative location of the station serving Unit 2 would be north of the abandoned Unit 2 chimney. The main truck delivery route to each of these stations would be via the main gate. Alternately, the west construction gate could be designated as the primary delivery gate for sorbent delivery to minimize truck traffic through the main gate. It is assumed that the fill line for each silo will be routed so that it can be accessed directly from the access road, with the truck parked at the edge of the road during unloading.

A similar system will be required for PAC receiving and distribution at each unit, with delivery to the silos also by truck. A stand alone system with seven days capacity of PAC for a single unit will require two 14 foot diameter by 90 foot tall silos to be placed close to each dedicated PJFF.

Each unit will require approximately eight trucks per day to deliver the required quantity of product, four for sorbent and four for PAC. Assuming each truck will take approximately 45 minutes to complete a delivery "gate to gate", this would place two trucks carrying each material (total of four) onsite on a plant access road at any given time during a standard 8-hour day. Since unloading could be done at any of the four stations, simultaneous unloading of four trucks should not be a significant problem, especially if more than one unloading station is provided at a particular set of silos at a unit.

The maximum piping run between any one silo and its corresponding injection point for this configuration is estimated to be approximately 200 ft.

This arrangement produces the simplest configuration from an operational and system maintenance perspective. In addition, the silos and forwarding equipment for sorbent to three of the four units already exist in place (size of existing silos to be confirmed or days of storage adjusted accordingly). However, this arrangement will result in considerable truck traffic and congestion on the main plant loop roads around the units.

2.2 Central Storage/Distribution System

A central sorbent receiving and distribution system will require four 28 foot diameter by 90 foot tall silos, two for sorbent and two for PAC, with associated blowers and piping, optimally located in an area central to all four units. In addition, to ensure continuous operation, each unit will require a single 10 foot diameter by 60 foot tall day bin for each material in the immediate area of the unit. The existing sorbent silos located at Units 1, 3, and 4 could be utilized as day bins in this proposed configuration.

The optimum location for a central sorbent receiving and forwarding station is in the area south of Unit 2 in the existing parking area south of the Administration Building. This area is also adjacent to the main plant entry gate and along the southern east/west access road.

Approximately 32 trucks per day would be required to deliver the necessary volume of product, sorbent and PAC, for all four units. Assuming each truck will take approximately 40 minutes to complete a delivery "gate to gate", this would place four trucks at the central silos at any given time during a standard 8-hour day. Accordingly, the central station should be provided with four unloading stations to allow simultaneous

unloading of four trucks. To minimize congestion at the main gate, a dedicated roadway isolated from the normal plant access gate should be considered to serve this volume of truck traffic.

The maximum piping run between the central silos and the day tanks at the injection point for this configuration is estimated to be approximately 1,600 feet to Unit 4. A secondary booster blower may be required to ensure proper transport of product along this run. Long piping runs also present significant risk of plugging and breakage.

Alternately, the potential of a central receiving and forwarding system supplied using rail delivery can be considered. Approximately four train cars per day would be required to supply the necessary product to the plant for continuous operation. To avoid daily trains deliveries, a facility capable of receiving, unloading, and releasing a minimum of twenty cars per delivery would be preferred. A dedicated, relatively large, and potentially enclosed unloading facility would be required if this option were used. The locations available for locating a 20-car rail spur and unloading facilities must balance the shortest practical distance to the injection points at the units against the additional congestion resulting from train car handling. The closest central location for silos serviceable by train cars is the same as that proposed for truck delivery. However, this rail access runs directly through the plant main access area. Regularly scheduled rail deliveries run the risk of blocking plant access while deliveries are made and cars are unloaded.

The central storage/distribution arrangement presents major obstacles to efficient handling of dry bulk material. The best available central location is located adjacent to the main gate entry and access point. The central facility requires a dedicated truck route for efficient delivery, but the available footprint limits the size and configuration of delivery routes. In addition, the central location results in extremely long supply runs to each unit. This will increase the cost of constructing the system and create the potential for major maintenance concerns due to plugging.

2.3 Dual Supply Storage/Distribution System

A dual storage and supply system could be considered a compromise between the single central station and the four individual stations. One receiving and forwarding facility for each bulk material would be sized and located to serve Units 1 and 2 with a similar facility located for Units 3 and 4. Each dual facility would include four 28 foot diameter by 70 foot tall storage silos, two for sorbent, two for PAC, plus two truck unloading stations. One set of silos would be located at the west end of the plant, adjacent to the proposed Unit 4 PJFF. The second pair of silos would be located on the east end of the plant, along the east wall of Unit 1 boiler building. A smaller day bin

would be located at Unit 2 and Unit 3 PJFFs; the close proximity of the main silos to Unit 1 and Unit 4 PJFFs makes day bin for those two units unnecessary. The existing silos could be used as day bins at Unit 3.

Approximately 16 trucks per day per facility would be required to deliver the necessary volume of product to the dual facilities. Assuming each truck will take approximately 45 minutes to complete a delivery "gate to gate", this would allow sufficient trucks to be processed at each unloading station during a standard day to exceed consumption rate. The trucks supplying product to the west silo could be routed through the west construction entry gate and then along the east side of the construction parking lot to the Unit 4 PJFF. The route could then circle around the fabric filter using existing roadways and depart using the same gate. The trucks supplying product to the east silo could be routed through the east gate located at the east end of the plant operations parking lot. A new entry point and security post would be required to allow the truck to enter the plant and drive due north to the silo. The route would then circle on the east side using existing plant roadways and depart using the same gate.

The maximum piping run between any one dual silo and an injection point for this configuration is estimated to be approximately 400 feet.

This arrangement appears to be the most efficient if the Owner desires to limit the number of product fill points around the plant site and limit truck traffic on the main riverside road. It allows the truck volume resulting from the sorbent traffic to be divided and routed around the perimeter access roads at the ends of the main plant operations area. This would result in minimal disruption of normal plant operations, while limiting the system piping runs and enhancing system maintenance.

3.0 Summary of Investigation

A single plant-wide central sorbent and PAC receiving and distribution system, although at first appearance the most efficient method of receiving and distributing sorbent and PAC to the units, is likely too centralized to be easily workable. A single unloading area concentrates all delivery activity in one location onsite, greatly increasing congestion in an already high-traffic area. Moreover, the distribution system from the central location would be much longer than optimum, resulting in high capital expense as well as the potential of frequent pluggage and increased maintenance. Significant new facilities would be required for this arrangement, including four silos, four unloading stations, and a very large distribution system, making initial capital cost of this arrangement high.

A dual storage and supply system would reduce the concentration of delivery activity into two widely separated areas, both somewhat out of the main operations areas of the units. The necessary distribution system from storage to units is a distinct improvement over that of a single central system, but still longer than optimum, with the resulting potential operating and maintenance concerns. Since eight new large silos and four new unloading stations would be required, plus the distribution system to the silos, the capital cost of this arrangement would be comparable to that of the single centralized system.

The stand alone unit-specific sorbent system at each unit is essentially mostly in place now. New silos and individual distribution system will be required for Unit 2; silos, blowers, and piping already exist at Units 1, 3, and 4. New silos and individual distribution system will be required for all four units for PAC receiving and distribution. This arrangement appears to be lowest capital cost option of the three considered. Assuming that the existing silos at Units 1, 3, and 4 are sized to provide an acceptable number of days operating capacity for sorbent, the unit specific arrangement appears to be the least complicated and lowest cost option, unless the Owner cannot accept the increased truck traffic throughout the main plant loop and the main gate.

If minimizing onsite traffic and the resulting potential of interference between deliveries and onsite operations is the Owner's primary consideration, a dual system with facilities located out of the main trafficways and served by new dedicated separate gates for bulk truck deliveries is likely the next least expensive system.

The stand alone unit-specific sorbent receiving and distribution system is in the basis for the cost estimate.

Appendix A
Conceptual Sketch
Sorbent/PAC Storage Silo Locations and Delivery Routes

ATTACHMENT

CONCEPTUAL SKETCH
SORBENT/PAC STORAGE SILO LOCATIONS
AND DELIVERY ROUTES

LEGEND

INDIVIDUAL UNIT STORAGE/DISTRIBUTION SYSTEM

- 4 - 14'x90' SILOS PER UNIT - 2 SORBENT, 2 PAC
- TRUCK PARKING WHILE UNLOADING
- ONSITE DELIVERY ROUTE

CENTRAL STORAGE/DISTRIBUTION SYSTEM

- 4 - 28'x90' SILOS - SINGLE STATION - 2 SORBENT, 2 PAC
- TRUCK PARKING WHILE UNLOADING
- ONSITE DELIVERY ROUTE

DUAL SUPPLY STORAGE/DISTRIBUTION SYSTEM

- 4 - 28'x70' SILOS PER STATION - 2 SORBENT, 2 PAC
- TRUCK PARKING WHILE UNLOADING
- ONSITE DELIVERY ROUTE