LG&E/KU – Ghent Station

Phase II Air Quality Control Study

Fly Ash Handling

March 18, 2011
Revision B – Issued For Client Review

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1.0 Introduction

The amount of particulate matter collected from the exhaust gas from all four units at Ghent will be increased by the additions and modifications proposed by the Air Quality Control (AQC) Study Phase II. At the time of this report, design modifications are underway to convert the existing fly ash handling system at Ghent Station from a sluice system to a dry conveying system. For purposes of this report, the modifications to the ash handling system(s) that collect and transport particulate to the ash handling facility will be assumed as in place and operational. It is the modified system that will be investigated to confirm acceptability under the new operating conditions identified in the AQC Phase II Study. The purpose of this report is to describe the modified fly ash handling system and its operating capacity, quantify the impacts to the system due to the AQC modifications proposed, and confirm its acceptability or identify any modifications required to allow proper operation.

2.0 System Description and Evaluation

All four units at Ghent 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 will be supplemented or replaced at all four units by pulse jet fabric filters (PJFFs) to collect fly ash prior to the exhaust gas reaching the wet scrubbers. Sorbent is currently being injected into the AQCS systems at Units 1, 3, and 4 for SO_3 control. Phase II proposes the injection of sorbent, either lime or trona, to Unit 2 as well, and powdered activated carbon (PAC) for mercury control at all four units. In addition to the ash, the injected adsorbent particulate must also be removed from the exhaust streams by the PJFFs.

For purposes of this study all particulate removed from the exhaust gas will be covered under the term "fly ash." The amount of total fly ash that must be handled after the system improvements will be higher at each unit than that currently processed through the system for the following reasons.

- Improved efficiency of the proposed PJFF over the ESP
- New injected particulate material that must be removed from the gas stream.

This increased load on the existing fly ash handling system must be evaluated and any recommended modifications or operating conditions identified.

2.1 Description and Capacity of In-Place Systems

The existing fly ash system conveys fly ash from the ESPs at all four units and air heater ash from Unit 1 by a wet sluice (Hydroveyor) system to nearby ash ponds. The economizer ash for Units 1 and 2 is also sluiced with the fly ash by the Hydroveyor system.. Unit 3 and 4 economizer ash is collected in wet tanks and sluiced with bottom ash and pyrites to the ash ponds. The design conveying rates are indicated below in Table 2-1.

The Ghent Station is currently injecting lime and trona into the exhaust stream of three of the four units. Product is injected both upstream and downstream of the ESPs, but for the purposes of the study, it is conservatively being considered as conveyed by the existing fly ash handling systems. The current values are also indicated in Table 2-1.

Table 2-1
Existing Fly Ash and Sorbent Flow Rates

Parameters	Unit 1	Unit 2	Unit 3	Unit 4	Total
Fly Ash and hopper ash design rates, tons/hour	27	28	30	30	
Lime tons/hour	1.5	1	0	0	
Trona, tons/hour	1.75	0	2	3	
Total	**30.25**	**29**	**32**	**33**	**124.25**

Subsequent to the wet to dry system upgrades at Ghent, fly ash from the ESPs will be collected and transferred as dry material. This dry ash system is expected to be in-place and operational at the beginning of the Phase II work. Fly ash collected by the fields in the ESPs will fall to collection hoppers at the bottom of the ESP. Duct hopper ash from air heaters and economizers collects in hoppers associated with these collection points. Mechanical exhausters will create a vacuum in piping connected to the hopper bottoms. Collected ash will be transferred under vacuum from the hoppers to a filter/separator where the collected ash will be subsequently transferred by a pressurized pneumatic blower system to the ash storage and loadout silos at the coal combustion residue (CCR) facility south of Highway 42. At the CCR facility ash will be either unloaded from the silos to trucks for transfer to beneficial reuse or deposited on conveyors for landfilling operations.

Each unit will be provided with its own vacuum piping and mechanical exhauster system that transfers ash from the collection hoppers to the appropriate filter/separator. The Unit 1 and Unit 2 filter separators and associated pressure blowers will be housed in a common fly ash equipment building located on the north side of Unit 2. The Unit 3 and Unit 4 fly ash equipment building will be located to the north and west of Unit 4.

The general location of the dry fly ash system equipment buildings are shown on Sketch A in Appendix A.

2.2 New Fly Ash Loading

The new equipment proposed in the Stage II study will introduce three additional sources of particulate to be added to the load currently being processed by the existing systems: additional fly ash, lime or trona and PAC.

New PJFFs will be installed downstream of the existing ESPs at Units 1, 2, 3, and 4 and the ESPs may remain in operation depending on the AQCS technologies used. The new PJFFs will be designed based on a theoretical PM limit of 0.01 lb/MBtu, a somewhat greater efficiency than the existing ESPs, resulting in the PJFFs collecting additional fly

ash beyond that collected by the ESP. For the purposes of this evaluation, all the ash generated in the boiler will be considered as fly ash.

To provide additional SO_3 control, sorbent (trona) injection systems have already been installed at Units 1, 3, and 4 as indicated above in Table 2-1. A new trona or lime injection system will be installed at for all units as part of the Phase II modifications proposed. The addition of sorbent injection will result in additional particulate being captured by the new PJFFs. The additional reacted and un-reacted lime or trona must be considered as a new PM load to be processed with the fly ash.

For mercury control, PAC will be injected into the exhaust stream upstream of each PJFF (all four units). Similar to the sorbent, the PAC is then collected in the PJFF for processing as additional ash load at each unit.

The total particulate to be captured by the PJFF for each unit is summarized in Table 2-2.

Table 2-2
Particulate to be Collected at PJFFs

Parameters	Unit 1	Unit 2	Unit 3	Unit 4	Total
Fly Ash, tons/hour	25.5	28.5	28.6	30.1	
PAC, tons/hour	0.6	0.6	0.7	0.6	
Trona, tons/hour	1.6	2.5	2.5	2.5	
lime, tons/hour	2.1	3.3	3.3	3.3	
Total (using the worst case lime or Trona rate.)	**28.2**	**32.4**	**32.6**	**34.0**	

Because these planned adsorbent flow rates represent a relatively small increase in design flow rates, they have been used in as the design flow rates for the dry ash conversion system design. Thus, the in-place systems will be capable of handling the expected adsorbents loading if the system and piping can be configured to include the new PJFFs.

The vacuum piping system at each unit could be extended to the new pickup points at the bottom of new PJFF hoppers, using the existing mechanical exhausters to maintain the vacuum. The particulate collected in the hoppers will be forwarded to the silos. The feasibility of this approach is dependent on whether the vacuum systems are capable of conveying the required distances. The proposed fabric filter arrangements are indicated in Site Arrangement Drawings 168908-GCDS-1001 and 1002 referenced in Appendix B. The location of the Units 1 and 2 PJFFs are adjacent to the Unit 1 and 2 ash handling equipment buildings shown in Drawing 172150-CASB-G1001 in Appendix A. Accordingly, the system will be able to convey from either the ESP or the PJFFs.

Similarly, the planned location for the Unit 4 PJFFs is shown near the location of the Units 3 and 4 ash handling building as shown in Drawing 172150-CASB-G1002 in Appendix A. The Unit 3 PJFF is located significantly farther from the Units 3 and 4 ash handling building than the Unit 3 ESP. Consequently, the vacuum system designed for conveying from the ESP is not expected to be able to convey the ash the increased distance. A new ash conveying system will need to be installed to convey the ash and sorbent from the Unit 3 PJFF to the storage silos. For the purposes of the study, a dilute-phase pressure conveying system will be used. The PJFF hoppers will require about 15 feet clearance for the pressure feeder vessels. The new dilute-phase transfer system will be sized to transfer all collected fly ash from the 100% capacity PJFF should the existing Unit 3 ESPs ultimately be removed from service. The new equipment will be located beneath the Unit 3 PJFF and is shown on Drawing 168908-GCDS-1001 as Item 8. Costs for this system are included in the overall cost estimate for Ghent Unit 3. The cost of extending the existing system to the hopper area of the new PJFFs at Units 1, 2, and 4 are included in those cost estimates, respectively.

3.0 Summary

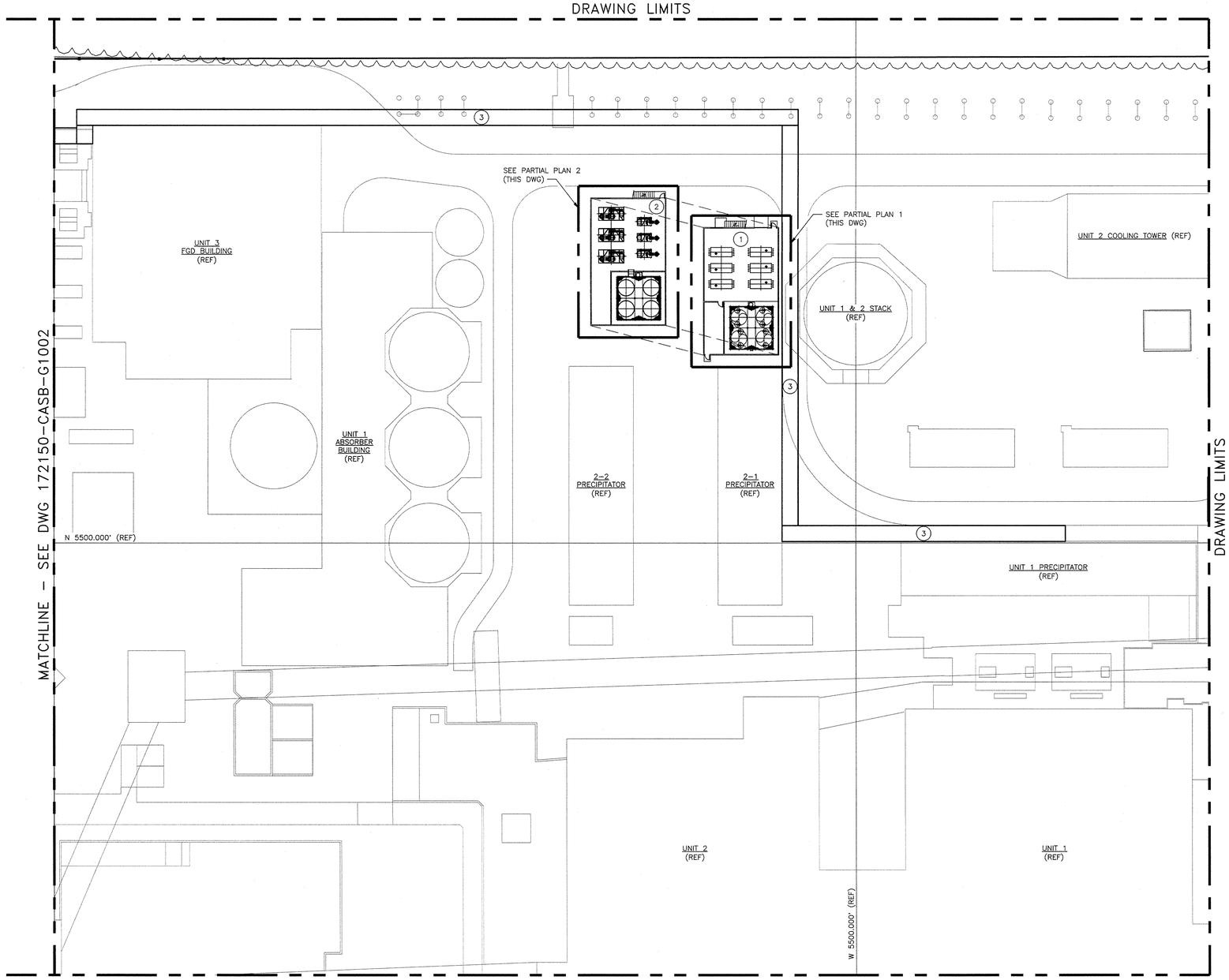
Based on the evaluations presented in Section 2, the following recommendations are made with regard to fly ash handling systems for the four units at Ghent Station. For purposes of this report, the modifications to the ash handling system(s) currently underway at all four Ghent units are assumed as in place and operational. The recommendations below are subject to confirmation during detailed design.

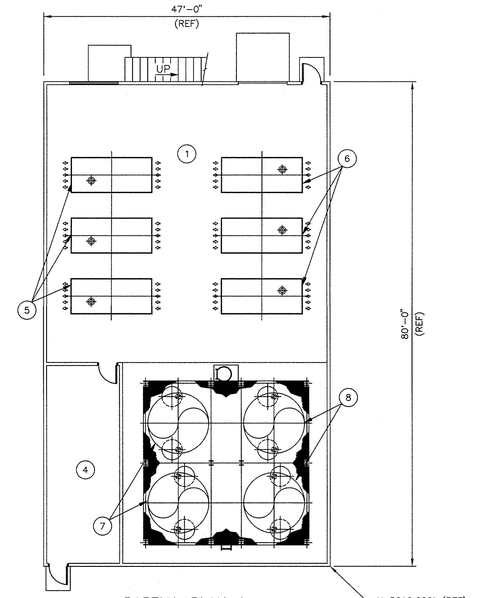
- Unit 1 – rework the existing Unit 1 vacuum exhauster system to extend the piping to the hoppers at the new Unit 1 PJFF. The piping will be sized and arranged to allow the use of the PJFF to collect all particulate should the ESPs be taken out of service at some future time. The vacuum system will convey the ash to the in-use filter/separators. The ash will be pressure conveyed to the in-use silos located in the CCR facility south of Highway 42.
- Unit 2 – rework the existing Unit 2 vacuum exhauster system to extend the piping to the hoppers at the new Unit 2 PJFF. The piping will be sized and arranged to allow the use of the PJFF to collect all particulate should the ESPs be taken out of service at some future time. The vacuum system will convey the ash to the in-use filter/separators. The ash will be pressure conveyed to the in-use silos located in the CCR facility south of Highway 42.
- Unit 3 –add a new pressure conveying ash handling system to forward all collected fly ash from the Unit 3 PJFF to the in-use silos located in the CCR facility south of Highway 42. The system will require feeder vessels under each hopper, pressure blowers, and two abrasion resistant alloy pipe lines routed on the in-use pipe rack across Highway 42. The new system will be sized to allow the use of the PJFF to collect all particulate should the ESPs be taken out of service at some future time.
- Unit 4 – rework the existing Unit 4 vacuum exhauster system to extend the piping to the hoppers at the new Unit 4 PJFF. The piping will be sized and arranged to allow the use of the PJFF to collect all particulate should the ESPs be taken out of service at some future time. The vacuum system will convey the ash to the in-use filter/separators. The ash will be pressure conveyed to the in-use silos located in the CCR facility south of Highway 42.

Appendix A
In service Dry Ash Handling
Arrangement Drawings

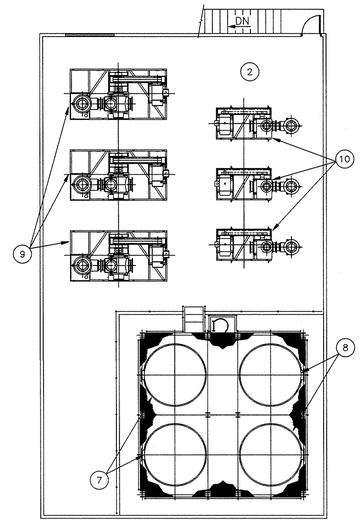
Ghent CCR Transport Site Arrangement
Existing Plant – East End
Drawing No. 172150-CASB-G1001

EQUIPMENT LIST			
ITEM NO.	EQUIP. NO.	DESCRIPTION	TIE DOWN EL
1	–	UNIT 1 & 2 FLY ASH BUILDING – LOWER LEVEL (LOWER LEVEL ESTABLISHES BUILDING LOCATION)	–
2	–	UNIT 1 & 2 FLY ASH BUILDING – UPPER LEVEL	–
3	–	PIPE RACK	–
4	–	ELECTRICAL ROOM	–
5	–	UNIT 1 MECHANICAL BLOWERS (3 X 50%)	–
6	–	UNIT 2 MECHANICAL BLOWERS (3 X 50%)	–
7	–	UNIT 1 FLY ASH FILTER/SEPARATORS	–
8	–	UNIT 2 FLY ASH FILTER/SEPARATORS	–
9	–	UNIT 1 MECHANICAL EXHAUSTERS (3 X 50%)	–
10	–	UNIT 2 MECHANICAL EXHAUSTERS (3 X 50%)	–





PARTIAL PLAN 1
UNIT 1 & 2 FLY ASH BUILDING
(GROUND FLOOR)
SCALE: 1" = 10'-0"



PARTIAL PLAN 2
UNIT 1 & 2 FLY ASH BUILDING
(UPPER FLOOR)
SCALE: 1" = 10'-0"

NOT TO BE USED FOR CONSTRUCTION

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10' 0 10' 20'
SCALE: 1"=10'

DRAWING RELEASE RECORD															
REV.	DATE	PREPARED	APPROVED	PURPOSE	DES	CHK	PDE	REV.	DATE	PREPARED	APPROVED	PURPOSE	DES	CHK	PDE
A	23FEB11	BSS		ISSUED FOR OWNER REVIEW	BDS		AJM								

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SIGNED _____

DATE _____ REG NO. _____

ENGINEER	AJM	DRAWN	BDS
CHECKED		DATE	

PROJECT 172150-CASB-G1001

DRAWING NUMBER

PLANT NORTH — TRUE NORTH

30' 20' 10' 0 30' 60'
SCALE: 1"=30'

SCALE: AS NOTED

PROJECT NUMBER: 172150

Title
GHENT CCR TRANSPORT
SITE ARRANGEMENT
EXISTING PLANT – EAST END

Location and Unit:
GHENT GENERATING STATION, COMMON

Kentucky Utilities Company
an E·ON company

Drawing No: | Rev.: A

DMS Version 2.0

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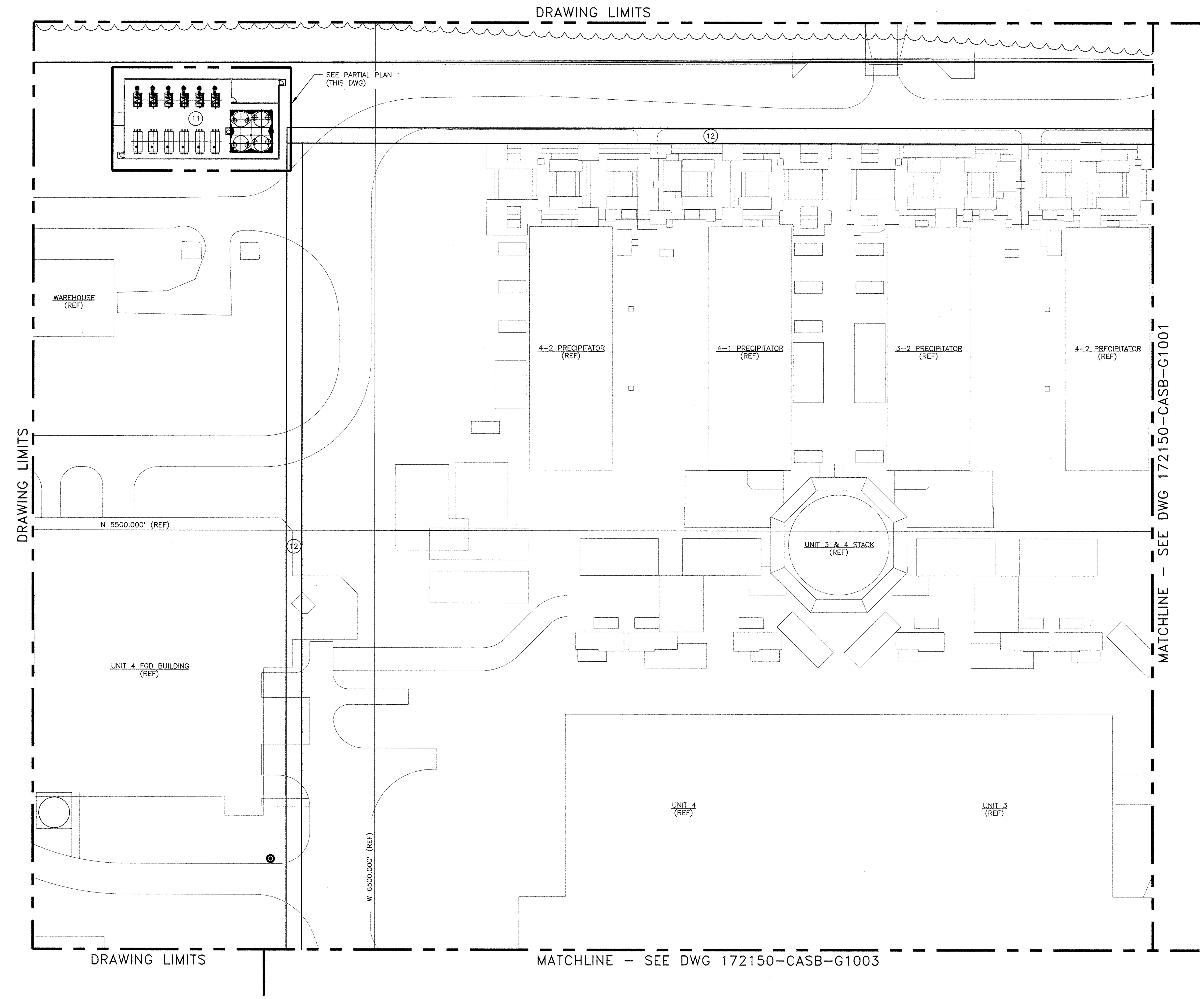
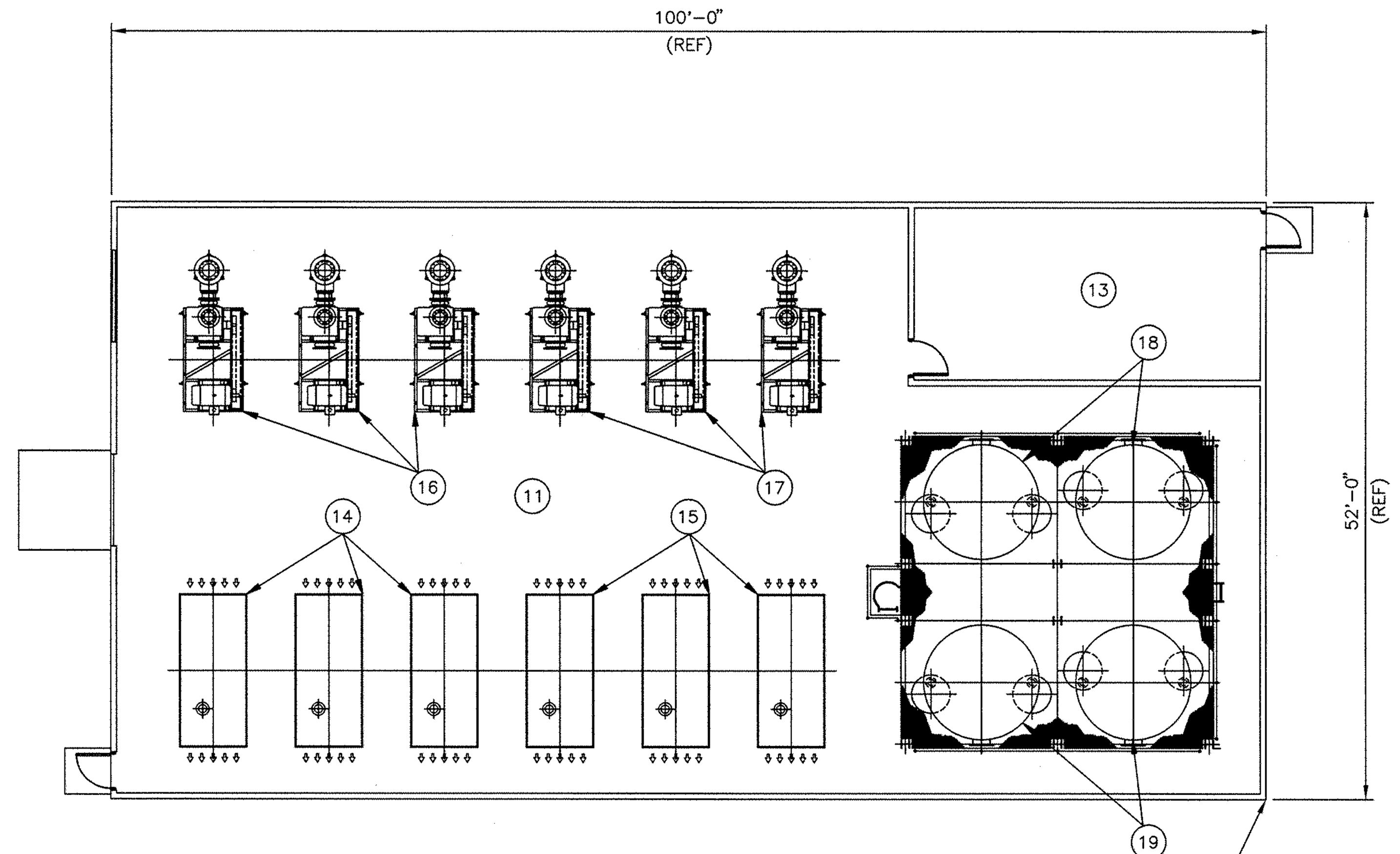
Ghent CCR Transport Site Arrangement
Existing Plant – West End
Drawing No. 172150-CASB-1002





PARTIAL PLAN 1
UNIT 3 & 4 FLY ASH BUILDING
SCALE: 1" = 10'–0"

N 5740.000' (REF)
W 6562.000' (REF)

EQUIPMENT LIST			
ITEM NO.	EQUIP. NO.	DESCRIPTION	TIE DOWN EL
11	–	UNIT 3 & 4 FLY ASH BUILDING	–
12	–	PIPE RACK	–
13	–	ELECTRICAL ROOM	–
14	–	UNIT 3 MECHANICAL BLOWERS (3 X 50%)	–
15	–	UNIT 4 MECHANICAL BLOWERS (3 X 50%)	–
16	–	UNIT 3 MECHANICAL EXHAUSTERS (3 X 50%)	–
17	–	UNIT 4 MECHANICAL EXHAUSTERS (3 X 50%)	–
18	–	UNIT 3 FLY ASH FILTER/SEPARATORS	–
19	–	UNIT 4 FLY ASH FILTER SEPARATORS	–

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REV.	DATE	PREPARED	APPROVED	PURPOSE	DES	CHK	PDE
A	23FEB11	BDS		ISSUED FOR OWNER REVIEW	BDS		AJM

DRAWING RELEASE RECORD

REV.	DATE	PREPARED	APPROVED	PURPOSE	DES	CHK	PDE

SCALE: 1"=10'

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I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF KENTUCKY.

SIGNED
DATE REG NO.
ENGINEER AJM DRAWN BDS
CHECKED DATE

PROJECT DRAWING NUMBER
172150–CASB–G1002

PLANT NORTH TRUE NORTH N

SCALE: 1"=30'

SCALE: AS NOTED
PROJECT NUMBER: 172150

Title
GHENT CCR TRANSPORT
SITE ARRANGEMENT
EXISTING PLANT – WEST END

Location and Unit:
GHENT GENERATING STATION, COMMON

Kentucky Utilities Company
an e·on company

Drawing No:
Rev. A

SAV01382
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02/23/11 14:01:13
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DMS Version 2.0

Appendix B
Reference Drawings

168908-GCDS-1001	Site Arrangement Unit 1 and Unit 2
168908-GCDS-1002	Site Arrangement Unit 3 and Unit 4