LG&E/KU – Mill Creek Station

Phase II Air Quality Control Study

WFGD and Landfill Waste Disposal

February 10, 2011
Revision B – Issued for Client Review

B&V File Number 41.0814.4

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1.0 Introduction

The Mill Creek Station is located in southwestern Jefferson County, approximately 10.5 miles southwest of the city of Louisville, Kentucky, on a 509 acre site. Mill Creek Station includes four coal fired electric generating units with a gross total generating capacity of 1,608 MW. All four boilers fire high sulfur bituminous coal (i.e., high sulfur western Kentucky bituminous coal from Illinois Basin, natural gas for startup). Each Mill Creek Station unit includes one GE reheat tandem compound, double-flow turbine with a condenser and hydrogen-cooled generator. Units 1 and 2 each consist of one Combustion Engineering subcritical, balanced draft boiler and have a gross capacity of 330 MW each. Units 1 and 2 are equipped with LNBs and OFA for NO_x control, a CS-ESP for PM control, and a WFGD for SO_2 and HCl (hydrogen chloride) control. Units 3 and 4 each consist of one Babcock & Wilcox (B&W) balanced draft, Carolina type radiant boiler and have a gross capacity of 423 MW and 525 MW, respectively. Each is equipped with LNBs and SCR for NO_x control; a CS-ESP for PM control and a WFGD for SO_2 and HCl control.

The following Air Quality Control (AQC) technologies were evaluated to ensure that there is compliance with the emissions reductions that are required to meet future regulations:

- Pulse Jet Fabric Filter (PJFF) with sorbent (trona/lime) injection on Units 1-4.
- Selective Catalytic Reduction (SCR) on Units 1 and 2.
- Refurbishing or replacing wet scrubbers on Units 1, 2 and 4, including using Unit 4's scrubber for Unit 3.
- New Wet Flue Gas Desulfurization (WFGD) on Unit 4.
- Powdered activated carbon (PAC) injection on Units 1-4.

Based on the previously listed AQC technologies, the purpose of this study is to evaluate the physical and chemical composition of the fly ash material removed by the new PJFF on Units 1-4 as well as the gypsum byproduct material that is produced by the new Unit 4 WFGD scrubber. This study will not discuss any potential impact of disposal of fly ash and scrubber byproducts on existing landfill. The potential impact analysis on the existing landfill is by others.

2.0 Composition of Fly Ash

Fly ash is one of the solid waste items produced directly from the combustion of coal. The burning of harder, older anthracite and bituminous coals produces fly ash which is pozzolanic in nature, and usually contains less than 10 percent lime (CaO). Fly ash with pozzolanic properties means that it reacts with calcium hydroxide in the presence of water to form compounds possessing cementitious properties at room temperature. Most of the fly ash produced from coal-fired power stations is captured in particulate removal equipment like PJFFs or ESPs and safely disposed off in landfills. This section describes the production and composition of the fly ash removed by PJFFs from Units 1-4.

Additionally, Units 1-4 would utilize a PAC injection system for control of mercury and sorbent injection system (lime or trona) for control of sulfuric acid mist upstream of the PJFF. The byproducts from the PAC and sorbent injection system would be collected in the PJFF and would be removed with the fly ash for disposal in a landfill.

2.1 Units 1 and 2 Fly Ash

Currently Units 1 and 2 have existing cold side electrostatic precipitator (CS-ESP). The existing CS-ESP for each unit would be demolished and an SCR would be installed in the same physical location as the existing CS-ESP of the respective units. The fly ash and byproducts from PAC and sorbent injection would be collected in a new PJFF, one each for Units 1 and 2. Additionally, lime or trona, which is used as sorbents for removal of sulfuric acid, would be collected as well.

Due to the differing amounts of sorbent usage rates between lime and trona, tables have been created to show the differences. Tables 2-1 and 2-2 provide the estimated quantity and composition of fly ash and byproducts removed from the PJFFs for Unit 1 and Unit 2 respectively when trona is used as a sorbent in addition to PAC injection. Tables 2-3 and 2-4 provide the estimated quantity and composition of fly ash and byproducts removed from the PJFFs for Unit 1 and Unit 2 when lime is used as a sorbent in addition to PAC injection.

Table 2-1

Unit 1 PJFF - Composition of Fly Ash and Byproduct for Trona Sorbent

Byproduct Composition	lb/hr	Percentage
Fly ash from coal combustion	28,165	88.03%
Unreacted Trona ($Na_2CO_3.NaHCO_3.2H_2O$)	1,759	5.50%
Na_2SO_4	1,287	4.02%
Powdered Activated Carbon	783	2.45%
Total	**31,994**	**100.00%**

Table 2-2

Unit 2 PJFF - Composition of Fly Ash and Byproduct for Trona Sorbent

Byproduct Composition	lb/hr	Percentage
Fly ash from coal combustion	28,925	87.99%
Unreacted Trona ($Na_2CO_3.NaHCO_3.2H_2O$)	1,807	5.50%
Na_2SO_4	1,322	4.02%
Powdered Activated Carbon	818	2.49%
Total	**32,871**	**100.00%**

Table 2-3

Unit 1 PJFF - Composition of Fly Ash and Byproduct for Lime Sorbent

Byproduct Composition	lb/hr	Percentage
Fly ash from coal combustion	28,165	85.51%
Unreacted Lime (CaO)	2,756	8.37%
$CaSO_4$	1,233	3.74%
Powdered Activated Carbon	783	2.38%
Total	**32,938**	**100.00%**

Table 2-4

Unit 2 PJFF - Composition of Fly Ash and Byproduct for Lime Sorbent

Byproduct Composition	lb/hr	Percentage
Fly ash from coal combustion	28,925	85.47%
Unreacted Lime (CaO)	2,831	8.36%
$CaSO_4$	1,267	3.74%
Powdered Activated Carbon	818	2.42%
Total	**33,840**	**100.00%**

2.2 Units 3 and 4 Fly Ash

Currently Units 3 and 4 have existing CS-ESPs and the majority of the fly ash is removed by the existing CS-ESPs. The byproducts from PAC and sorbent (lime or trona) injection as well as finer combustion particulate not collected in the CS-ESP would be collected in new PJFFs for Units 3 and 4. Due to significantly lower amounts of fly ash in the flue gas stream entering the new PJFFs on Units 3 and 4, sorbent and PAC may blind the bags of new PJFFs which may cause increase in operational issues. Additionally, a high rate of pre-filtration would reduce the amount of nonflammable fly ash available to be mixed with the PAC injected upstream of and collected by the PJFF. The higher ratio of flammable PAC to nonflammable fly ash collected in the PJFF could present a potential fire hazard.

Due to the differing amounts of sorbent usage rates between lime and trona, tables have been created to show the differences. Furthermore, the fly ash quantities in these tables represent the fly ash that would be captured in the new PJFFs assuming greater than 99% particulate capture efficiency in the CS-ESPs. Tables 2-5 and 2-6 provide the estimated quantity and composition of fly ash and byproducts removed from the PJFFs for Unit 3 and Unit 4 respectively when trona is used as a sorbent in addition to PAC injection. Tables 2-7 and 2-8 provide the estimated quantity and composition of fly ash and byproducts removed from the PJFFs for Unit 3 and Unit 4 when lime is used as a sorbent in addition to PAC injection.

Table 2-5

Unit 3 PJFF - Composition of Fly Ash and Byproduct for Trona Sorbent

Byproduct Composition	lb/hr	Percentage
Fly ash from coal combustion	176	3.42%
Unreacted Trona ($Na_2CO_3.NaHCO_3.2H_2O$)	2,297	44.73%
Na_2SO_4	1,680	32.72%
Powdered Activated Carbon	982	19.13%
Total	**5,135**	**100.00%**

Table 2-6

Unit 4 PJFF - Composition of Fly Ash and Byproduct for Trona Sorbent

Byproduct Composition	lb/hr	Percentage
Fly ash from coal combustion	130	2.11%
Unreacted Trona ($Na_2CO_3.NaHCO_3.2H_2O$)	2,795	45.33%
Na_2SO_4	2,045	33.16%
Powdered Activated Carbon	1,196	19.40%
Total	**6,166**	**100.00%**

Table 2-7

Unit 3 PJFF - Composition of Fly Ash and Byproduct for Lime Sorbent

Byproduct Composition	lb/hr	Percentage
Fly ash from coal combustion	176	2.76%
Unreacted Lime (CaO)	3,598	56.52%
$CaSO_4$	1,610	25.30%
Powdered Activated Carbon	982	15.43%
Total	**6,366**	**100.00%**

Table 2-8

Unit 4 PJFF - Composition of Fly Ash and Byproduct for Lime Sorbent

Byproduct Composition	lb/hr	Percentage
Fly ash from coal combustion	130	1.70%
Unreacted Lime (CaO)	4,379	57.13%
$CaSO_4$	1,960	25.57%
Powdered Activated Carbon	1,196	15.60%
Total	**7,665**	**100.00%**

One way to reduce the fire hazard concern and also reduce the potential of blinding PJFF bags is to de-energize some of the existing fields of Mill Creek Units 3 and 4 CS-ESPs to the point where some fly ash would be carried to the new PJFF to mix with the injected PAC. Hence it is recommended that some of the existing fields of the CS-ESPs be de-energized to the point where approximately 75% of the fly ash would be removed by the existing CS-ESPs. The remaining fly ash would be collected in the new PJFFs along with byproducts from PAC and sorbent injection. The fly ash would provide a more useful coating of particulate on the bags for filtration. However, the drawback to this philosophy would be that the existing ID fans would experience increased particulate loading which would likely decrease the expected operating life of the rotors and other ID fan related equipment. To alleviate this risk, the existing ID fans needs to be bypassed and all draft fans would need to be placed downstream of the new PJFFs.

If the existing CS-ESPs on Units 3 and 4 are bypassed completely all the fly ash and byproduct which includes lime/trona and PAC would be captured in the new PJFFs for Units 3 and 4. However, as previously discussed, the drawback to this philosophy would be that the existing ID fans would experience increased particulate loading. In this case, the existing ID fans would experience 100% of the particulate posing a significant risk to their longevity. To alleviate this risk, the existing ID fans needs to be bypassed and all draft fans would need to be placed downstream of the new PJFFs. However, the basis of the cost estimate will be to keep Units 3 and 4 ESPs fully operational and in-service.

3.0 Characterization of Gypsum Byproduct

WFGD byproduct is produced from the capture or scrubbing of SO_2 emissions using limestone. WFGD technologies were developed and refined to aid coal fired power plants in achieving the emission reductions of SO_2 mandated by various environmental regulations.

WFGD byproduct is the material from WFGD processes or systems. It is composed primarily of water, $CaSO_4$, $CaSO_3$, and small quantities of fly ash. The WFGD byproduct could contain some particulate bound mercury and other hazardous air pollutants (HAPs). It has the consistency of sludge when allowed to settle in a pond. When the water is removed by filtering equipment, such as vacuum filters, byproduct moisture content in the scrubber varies from 5 to 20 percent. Forced oxidized WFGD byproduct is often called gypsum.

The gypsum by-product produced by WFGD scrubbers can be classified as either disposal-grade or commercial-grade. In general, there are three commercial grades: wallboard, cement, and agricultural. The chemical and physical requirements of the three commercial grades and the disposable grade differ significantly as shown in Table 3-1. The principal differences between these three commercial grades are the maximum or minimum levels of calcium sulfate, moisture, silicon dioxide (SiO_2), and soluble salts (soluble chlorides in particular). The maximum amount of chlorides is limited to 100 ppm for wallboard quality gypsum.

Table 3-1

Disposal-Grade Gypsum Characteristics and Example

Commercial-Grade Gypsum Specification Limits

End Use	Disposal*	Wallboard	Cement	Agriculture
Moisture, % max	<20	<10	<14	<20
$CaSO_4 \bullet 2H_2O$, % min	80 to 95+	>95	85-88	>80
$CaSO_3 \bullet \frac{1}{2}H_2O$, % max	<1 to 2+	0.5 – 1.0		
SiO_2, % max	<1 to 3+	1.0	2.0	
Fe_2O_3, % max		1.5	1.0	
Al_2O_3, % max			1.0	
Fly ash, % max	<1 to 3+	1.0		
Total insolubles, % max	<5 to 20+	3.5	<15	
Water soluble Cl^-, ppm max	2,000 to 12,000	100 to 120	50,000	
Total dissolved solids, ppm max	5,000 to 150,000	600		
Mean particle size, µm	<20 to 90+	20 - 75		

* Disposal gypsum characteristics are based on a typical industry range of potential limestone supplies.

3.1 Production Rate

It is estimated that Mill Creek Unit 4 would produce approximately 49 tons per hour (tph) of WFGD waste material and approximately 97 gallons per minute (gpm) of blowdown for chloride purge under full load and typical fuel conditions using high sulfur bituminous coal (i.e., high sulfur western Kentucky bituminous coal from Illinois Basin). Additionally, it is expected that the gypsum produced by Mill Creek Unit 4 WFGD system would be disposed of in a landfill or could be recycled off site for beneficial use.

3.2 Physical Characteristics

The target moisture level for disposal-grade gypsum is in the range of 15 to 20 weight percent. Gypsum in this moisture range is easily transported by belt conveyor and compacts well in a landfill. Filter cake moisture levels as low as 13 weight percent can be reliably attained by a rotary drum vacuum filter handling oxidized WFGD byproduct solids. Attaining moisture levels in the 8 to 10 weight percent range typically requires the use of a horizontal belt vacuum filter.

The soluble chloride level in the slurry leaving the WFGD absorber reaction tank may vary from less than 10,000 mg/L to over 50,000 mg/L depending on the WFGD system design and materials of construction. This level may be acceptable for disposal-grade gypsum.

The bulk density of the gypsum is a key parameter for sizing material storage and handling equipment from both a volume and support basis. Early work with WFGD gypsum indicated that the measured bulk density ranged from 78 to 96 lb/cf but that the actual working range of the material was 55 to 65 lb/cf.[1] Black & Veatch's own standards for design with this material are provided below.

Parameters	Volume Design (Lb/cf)	Structural Design (Lb/cf)
Dry compacted landfill (dry density)	75	NA
Hoppers, belts, and supports	50	90

3.3 Chemical Characteristics

The gypsum contains impurities that enter the system from fly ash that passes through upstream ESPs and/or PJFFs and is captured in the WFGD and from the limestone and water in the WFGD absorber. For landfill gypsum this may be an issue if the material leaches out and for saleable gypsum the level of impurities must be limited.

While the specific concentration of these impurities cannot be defined without detailed information on the characteristics of the fly ash, limestone, and water that will be used at Mill Creek Station, research has been completed that provides concentration ranges of the impurities that have been seen from other units. Table 3-2 provides the

[1] P.A Bhat. & K.J. Rogers,, "Geotechnical Engineering Study of FGD Gypsum for Landfill Operation", Presented at 4th International Conference on FGD and Other Synthetic Gypsum, May 16-18, 1995 Toronto, Canada.

ranges of major constituents and Table 3-3 provides ranges of concentrations seen for trace constituents.[2]

Table 3-2
Major & Minor Composition of FGD Gypsum
(all values wt. %)

Constituent	FGD Gypsum (Multiple Source)	FGD Gypsum (Berland et al, 2003)[3]
Aluminum	NR	0.05 - 2.70
Boron	<0.0003 - 0.0042	0.0005 - 0.0029
Calcium	18.5 - 24.3	19.3 - 22.9
Iron	0.026 - 0.3	0.07 - 4.0
Magnesium	0.010 - 0.74	0.60 - 2.95
Potassium	<0.004 - 0.09	0.0 - 0.25
Silicon	0.022 - 69.2	0.05 - 2.95
Sodium	0.023 - 5.8	0.0 - 0.22
Sulfur	14.9 - 20.9	17.6 - 18.4

NR = Not Reported; NA = Not Available

[2] Debra F. Pflughoeft-Hassett, David J. Hassett, & Kurt Eylands "A Comparison of Properties of FGD & Natural Gypsum Products", Energy & Environmental Research Center Presented at Agricultural & Industrial Uses of FGD Gypsum Workshop, October 23, 2007.

[3] Tera D. Berland, Debra F. Pflughoeft-Hassett, Bruce A. Dockter, Kurt E. Eylands, David J. Hassett, & Loreal V. Heebink "Review of Handling and Use of FGD Material - CARRC Topical Report", Prepared by Energy & Environmental Research Center for US Department of Energy Cooperative Agreement No. DE-FC26-98Ft40321, April 2003.

Table 3-3

Trace Element Concentrations in FGD & Natural Gypsum

(all values ppm)

Trace Constituent	FGD Gypsum	
	(Multiple Sources)	(Berland et al, 2003)[4]
Antimony	0.1 - 9.1	NR
Arsenic	0.6 - 4.0	<1 - 2
Barium	33.8 - 77.2	1 - 6400
Cadmium	0.003 - 1.2	<1 - 2
Chromium	0.56 - 42.0	3 - 24
Copper	0.96 - 27.9	<1 - 64
Lead	0.8 - 12.0	1 - 47
Lithium	<9 and 48.8	NR
Manganese	1.37—52.1	3—94
Mercury	0.004 - 1.4	NR
Molybdenum	0.5 - 12.0	<1 - 3
Nickel	0.73 - 20.1	<3 - 19
Selenium	2.0 - 30.0	<1 - 15
Thallium	0.6 - 2.0	NR
Vanadium	<1 - 73.2	8 - 21
Zinc	3.4 - 102	<1 - 20

[4] Tera D. Berland, Debra F. Pflughoeft-Hassett, Bruce A. Dockter, Kurt E. Eylands, David J. Hassett, & Loreal V. Heebink "Review of Handling and Use of FGD Material - CARRC Topical Report", Prepared by Energy & Environmental Research Center for US Department of Energy Cooperative Agreement No. DE-FC26-98Ft40321, April 2003.

Additional research work has been completed for the US EPA with regard to potential landfill properties of the material and the potential for leaching of the trace constituents or discharge from commercially used gypsum, especially with regards to mercury. Results of this work have provided the following findings: [5]

- Total metals concentration in FGD gypsum appears lower than fly ash and scrubber sludge.
- Leachate testing results appear to suggest that Hg leaching is of minimal concern but there may be a concern for leaching of other metals from some facilities (e.g., Cd, Mo, Se, Tl).

With an effective mercury reduction system such as PAC injection and PJFF being proposed for the Mill Creek units, it would be expected that even lower levels of mercury will be present in any gypsum byproducts; therefore, Hg leaching would be reduced even further.

[5] "Evaluating the Fate of Metals from Management of FGD Gypsum from Implementation of Multi-Pollutant" Susan Thorneloe1, Gregory Helms, David Kosson,and Florence Sanchez, Completed for US EPA, Office of Research and Development, October 23, 2007.
http://library.acaa-usa.org/6-EPA_Study_on_Mercury_Leaching_from_FGD_Gypsum.pdf

4.0 Summary

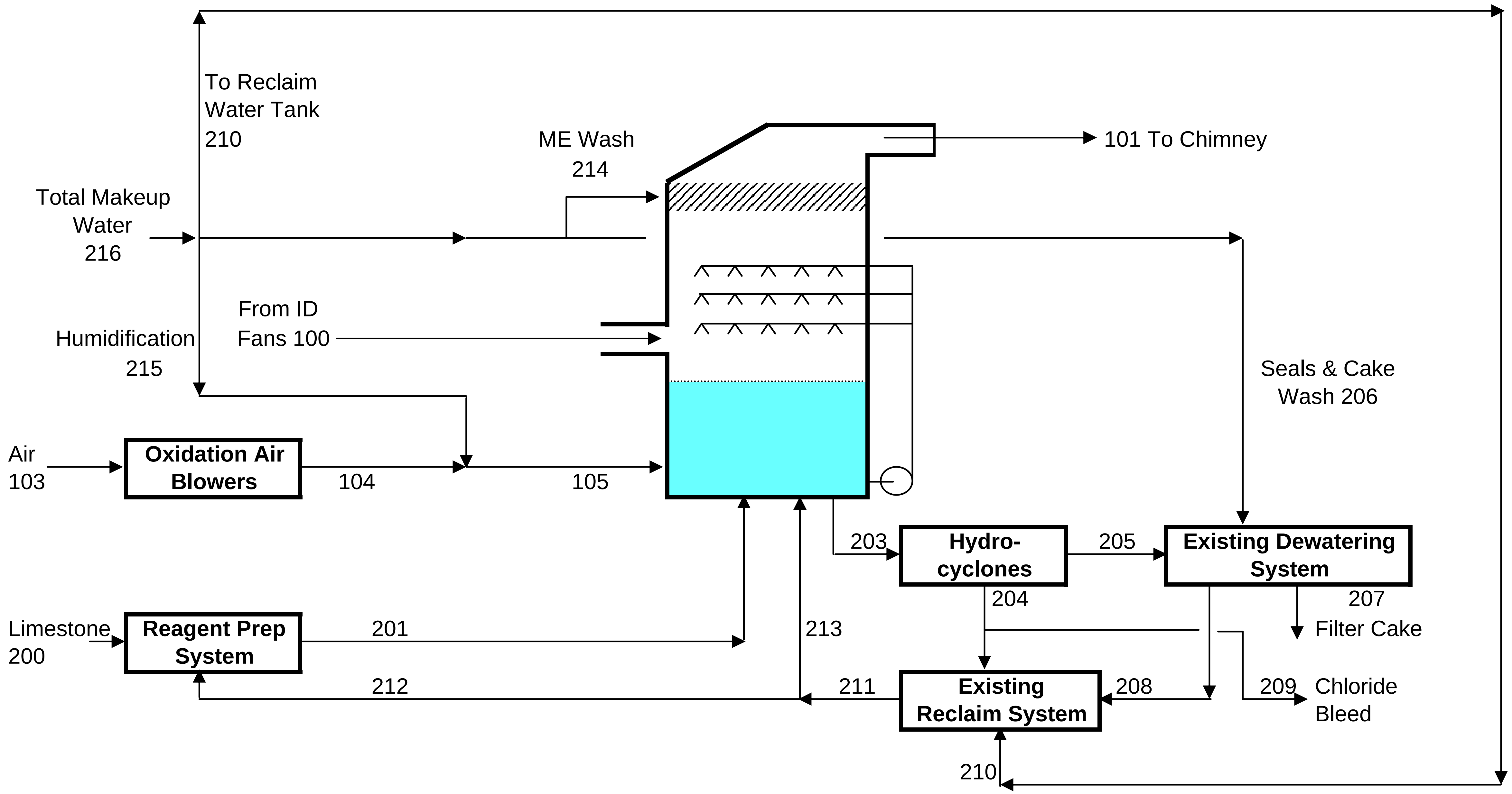
The information provided in this study may be utilized by LG&E/KU in addressing the transport and final disposal of the byproducts. However, this study does not discuss any potential impact of disposal of fly ash and scrubber byproducts on the existing landfill. Additional review regarding expansions of existing landfills may also be required to meet the stricter design requirements.

For fly ash containing activated carbon (used for mercury control at power plants), the physical and engineering performance of the material is expected to be similar to that of fly ash without activated carbon. However, it may have some potential handling issues, such as increased dusting. Therefore, the disposal requirements are expected to be the same as fly ash without activated carbon. In addition, the potential for gypsum sale off site for beneficial reuse may be limited.

The general properties of the gypsum that will be produced have been estimated based on previous research work and experience. The exact properties of the material can not be determined without further detailed design information, and the specific characteristics of fly ash, limestone, and water that will be used at Mill Creek Station. Additional review of the trace element leaching properties of gypsum and fly ash byproducts with regard to the specific landfill limitations may be required. A detailed landfill study and leachate testing may be required to address the potential impact of disposal of fly ash and scrubber byproducts in existing or new landfill.

Appendix A
WFGD System Mass Balance

Process Flow Diagram



No.	Date	DRN	DES	CHK	PDE	APP	REVISIONS & RECORD OF REVIEW	BLACK & VEATCH	LG&E/KU	
									Mill Creek Unit 4	Revision
									Spray Tower Mass Balance	1
1	18-Jan-11	PDM	PDM				Revised Cl in make-up water		5,122 MBtu/hr 6.0 lb/MBtu SO2	
0	5-Jan-11	PDM	PDM				Initial Issue		Calculation No. 168908.52.1403.1201	

DESIGN BASIS SUMMARY	
Mill Creek Unit 4	
Unit Rating, MW (net)	525
Boiler Heat Input, MMBtu/hr	5,122
Fuel Burn Rate, lb/hr	457,321
Altitude, ft. above MSL	393
Ambient Pressure, in H_2O	401
Ambient Temperature, ^{0}F	77
SO_2 Inlet Loading, lb of SO_2/MMBtu	6.00
SO_2 Removal Efficiency, %	98
Excess Air, %	20.0
Air Heater Leakage, %	10.0
Oxygen at FGD Inlet, %	6.4

Gas Streams	100	101	103	104	105
	Total Inlet Flue Gas	Total Outlet Flue Gas	Oxidation Air Inlet	Oxidation Air Outlet	Oxidation Air Humidified
Flow, acfm	2,026,176	1,674,655	15,044	10,794	10,013
Flow, lb/hr	6,104,272	6,511,165	65,783	65,783	66,967
H_2O, lb/hr	293,196	603,179	784	784	1,968
O_2, lb/hr	421,886	479,534	15,043	15,043	15,043
N_2, lb/hr	4,336,165	4,385,258	49,093	49,093	49,093
CO_2, lb/hr	1,021,572	1,042,580	97	97	97
SO_2, lb/hr	30,701	614	0	0	0
HCl, lb/hr	752	0	0	0	0
Fly ash lb/hr	154	77	0	0	0
Temp, F	354	129	77	151	86
Pressure, inwg	11.0	1.0	0.0	235.0	235.0

PERFORMANCE DATA	
SO_2 removed, lb/hr	30,087
HCl removed, lb/hr	752
Fly ash removed, lb/hr	77
Limestone Reagent Stoichiometry Guarantee in Waste Solids	1.03
Limestone consumption, tph	26.6
Makeup water required, gpm	775
Chloride blowdown, gpm	96.7
Gypsum byproduct production (wet basis), tph	49.0

COAL ANALYSIS[1]	
Carbon, %	61.21
Hydrogen, %	4.28
Sulfur, %	3.36
Nitrogen, %	1.27
Oxygen, %	6.88
Moisture, %	11.00
Chlorine, %	0.16
Ash, %	12.00
High Heating Value (HHV), Btu/lb	11,200

Liquid Streams	200	201	203	204	205	206	207	208	209
	Limestone Feed	Reagent Feed	Absorber Bleed	H'cyclone Overflow	H'cyclone Underflow	Vac Filter Seal Water	Vac Filter Cake	Vac Filter Filtrate	Cl Control Blowdown
Flow, gpm	--	252	1,315	1,072	243	70	--	211	97
Flow, lb/hr	53,115	161,672	719,357	549,727	169,630	35,050	98,099	106,581	49,604
Total SS, lb/hr	53,115	56,585	107,904	23,089	84,815	0	83,384	1,431	2,083
Total SS, %	100	35	15	4.2	50	0	85	1.3	4.2
Specific gravity	--	1.28	1.09	1.02	1.39	1.00	--	1.01	1.02
H_2O, lb/hr	0	105,087	611,454	526,639	84,815	35,050	14,715	105,150	47,521
$CaCO_3$, lb/hr	47,803	47,958	2,395	1,078	1,317	0	1,295	22	97
$MgCO_3$, lb/hr	3,187	3,437	3,865	1,739	2,126	0	2,090	36	157
$CaSO_4$-2H_2O, lb/hr	0	2,630	96,031	17,228	78,803	0	77,474	1,329	1,555
$CaSO_3$-1/2H_2O, lb/hr	0	166	1,672	1,170	502	0	493	8	106
Fly ash, lb/hr	0	32	286	229	57	0	56	1	21
Inerts, lb/hr	2,125	2,361	3,655	1,645	2,010	0	1,976	34	148
Cl, lb/hr	0	1,020	7,337	6,320	1,018	1	177	843	570
Cl, mg/L	0	9,708	12,000	12,000	12,000	39	12,000	8,013	12,000

LIMESTONE ANALYSIS	
$CaCO_3$, %	90.0
Total $MgCO_3$, %	6.0
Reactive $MgCO_3$, %	3.0
Inerts, %	4.0
Slurry Solids, %	35.0
Specific gravity	1.3
Bond Work Index (BWI)	12.0
Delivered size	3/4" x 0"

Liquid Streams	210	211	212	213	214	215	216
	Makeup to Reclaim	Reclaim Water	Reclaim to Reagent	Reclaim to Rxn Tank	Makeup ME Wash	Oxid Air Quench	Total Makeup
Flow, gpm	190	1,376	213	1,185	513	2	775
Flow, lb/hr	95,136	701,841	108,557	593,284	256,647	1,184	388,017
Total SS, lb/hr	0	22,436	3,470	18,966	0	0	0
Total SS, %	0	3.2	3.2	3.2	0	0	0
Specific gravity	1.00	1.02	1.02	1.02	1.00	1.00	1.00
H_2O, lb/hr	95,136	679,405	105,087	574,318	256,647	1,184	388,017
$CaCO_3$, lb/hr	0	1,003	155	848	0	0	0
$MgCO_3$, lb/hr	0	1,618	250	1,368	0	0	0
$CaSO_4$-2H_2O, lb/hr	0	17,003	2,630	14,373	0	0	0
$CaSO_3$-1/2H_2O, lb/hr	0	1,073	166	907	0	0	0
Fly ash, lb/hr	0	209	32	177	0	0	0
Inerts, lb/hr	0	1,530	237	1,293	0	0	0
Cl, lb/hr	4	6,596	1,020	5,576	10	0	15
Cl, mg/L	39	9,708	9,708	9,708	39	39	39

GYPSUM QUALITY (Dry Basis)	
$CaSO_4$-2H_2O, %	92.9
$CaSO_3$-1/2 H_2O, %	0.6
$CaCO_3$, %	1.6
$MgCO_3$, %	2.5
Fly Ash, %	0.1
Inerts, %	2.4
Maximum Chloride Content, ppm	2,118
Solids, % min	85
Crystal Size (Stokes Mean Size), microns	30

Note:
1 Coal analysis is the ultimate analysis adjusted for moisture

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