LG&E/KU – E.W. Brown Station

Phase II Air Quality Control Study

Materials of Construction

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1.0 Introduction

The E.W. Brown Station is located on Herrington Lake in Mercer County, Kentucky, between Shakertown and Burgin, off of Hwy 33. The station was constructed on the west side of Herrington Lake, the impoundment behind Dix Dam. The plant began commercial operation in 1957. The station includes three pulverized coal fired electric generating units with a total nameplate capacity of 747 MW gross. The electrical power from the E.W. Brown Station units is used to provide both load and voltage support for the 138 kV transmission systems.

The plant site also includes seven simple cycle combustion turbines located on the northwest side of the site.

All three steam generators (boilers) fire high sulfur bituminous coal. Unit 1 has a gross capacity of 110 MW and is equipped with old generation Low NO_x Burners (LNBs) and Cold-side Dry Electrostatic Precipitator (CS-DESP) for nitrogen oxide (NO_x) and particulate matter (PM) control, respectively. Unit 2 has a gross capacity of 180 MW and is equipped with LNBs, Overfire Air (OFA), and CS-DESP for NO_x and PM control. Unit 3 has a gross capacity of 457 MW and is equipped with LNBs, OFA, and CS-DESP for NO_x and PM control. LG&E/KU is in the process of installing a Selective Catalytic Reduction (SCR) module (in-service date, 2012) on Unit 3 to control NO_x. LG&E/KU recently installed a common Wet Flue Gas Desulfurization (WFGD) for sulfur dioxide (SO_2) control for Units 1, 2, and 3. Unit 2 is also equipped with a WFGD bypass system which directs flue gas to the Unit 3 chimney. Lower sulfur coal will be fired in Unit 2 during bypass operation. LG&E/KU is also in the process of installing sorbent injection on Unit 3.

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) on Units 1-3.
- Selective Catalytic Reduction (SCR) on Units 1 and 2.
- Sorbent (Trona/Lime) injection on Units 1 and 2.
- Powdered activated carbon (PAC) injection on Units 1-3.

This document states the materials of construction for different AQC equipment.

2.0 Materials of Construction

This section describes details of materials of construction for each of the air quality control equipment described in Section 1.0. The equipment stated in this section includes PJFF, SCR, sorbent injection and PAC injection.

2.1 Pulse Jet Fabric Filter (PJFF)

The casing of the PJFF shall be made up of carbon steel. PJFF uses fabric bags as filters to collect particulate.

2.1.1 PJFF Bag Cages

PJFF bag cage material is very important to overall performance and durability of the filter bags. The cages feature evenly spaced rings and wires, with a rounded bottom pan to help ensure proper filter bag fit.

Low carbon steel (bright basic wire), Galvanized low carbon steel, Type 304 stainless steel, Type 316 stainless steel can be used for the construction of fabric filter cages. The cages can also be enamel coated.

2.1.2 PJFF Bag Casings

PJFF bag casings are typically made up of carbon steel. Table 2-1 shows a summary of the materials of construction for different parts of PJFF.

Table 2-1
PJFF Material of Construction

Component	**Material**
Casing plate, stiffeners, and baffles	ASTM A36
Ductwork plates and shapes	ASTM A36
Hoppers	ASTM A36
Structural steel	ASTM A36
Miscellaneous steel	ASTM A36
Steel pipe for interior stiffeners	ASTM A53 Schedule 80 minimum
High strength shop and field bolts, including nuts and washers	ASTM A325
Hot-dip galvanizing	ASTM A123, A153, and A385
Mechanical galvanizing (load indicating washers only)	ASTM B695

Table 2-1 PJFF Material of Construction	
Component	**Material**
Instrument valve manifold bodies and trim	316 stainless steel

2.1.3 PJFF Bags

Table 2-2 specifies the most popular styles of fabric for PJFF bags and the conditions they are most suited to handle.

Table 2-2
PJFF Bags Material

Fabrics	Polypropylene	Acrylic	Polyester	PPS	Aramid	P84	Fiberglass	Teflon
Maximum Continuous Operating Temperature, ºF	170	265	275	375	400	356-500	500	500
Abrasion	Excellent	Good	Excellent	Good	Excellent	Fair	Fair	Good
Energy Absorption	Good	Good	Excellent	Good	Good	Good	Fair	Good
Filtration Properties	Good	Good	Excellent	Excellent	Excellent	Excellent	Fair	Fair
Moist Heat	Excellent	Excellent	Poor	Good	Good	Good	Excellent	Excellent
Alkalines	Excellent	Fair	Fair	Excellent	Good	Fair	Fair	Excellent
Mineral Acids	Excellent	Good	Fair	Excellent	Fair	Good	Poor	Excellent
Oxygen (15%+)	Excellent	Excellent	Excellent	Poor	Excellent	Excellent	Excellent	Excellent

2.1.4 PJFF Air Dryers

Table 2-3 shows the materials of construction for air dryers.

Table 2-3
PJFF Air Dryer Materials

Component	Material
Mineral fiber thermal insulating cement	ASTM C195
Heat reactivated dryer heating elements, alloy cladding	UNS N08810
Heat reactivated dryer insulation for external reactivation heater and purge piping	ASTM C533
Insulation jacketing	ASTM B209 Alclad 3004, or acceptable equal
Inlet and outlet flanges	ASTM A105 or A181

2.1.5 PJFF Air Compressors

Table 2-4 shows the materials of construction for air compressors.

Table 2-4
PJFF Air Compressor Materials

Component	Material
Intercooler and aftercooler	
Tubes	Copper, ASTM B111
Tubesheets	Brass, ASTM B36
Oil cooler	
Tubes	Copper, ASTM B111
Tubesheets	Brass, ASTM B36
Shell and heads	ASME SA285 Grade C
Nozzles	ASME SA106 Grade B
Flanges	ASME SA105

2.2 Selective Catalytic Reduction (SCR)

Selective Catalytic Reduction (SCR) systems are the most widely used post-combustion NO_x control technology for achieving significant reductions in NO_x emissions. In SCR systems, vaporized ammonia (NH_3) injected into the flue gas stream acts as a reducing agent, achieving NO_x emission reductions when passed over an appropriate amount of catalyst. Additionally, there are desired reaction temperature ranges for the entering flue gas and at times methods to maintain these temperatures above a minimum.

2.2.1 SCR Reactor

The SCR reactor is the housing for the catalyst. The reactor is basically a widened section of ductwork modified by the addition of gas flow distribution devices, catalyst, catalyst support structures, access doors, and soot blowers.

Typically, carbon steel shall be used to build SCR reactor. Material which comes in contact with vaporized ammonia which is used as a reagent shall be 304 stainless steel. At temperatures above 825 ^{0}F alloy steel shall be used.

2.2.2 SCR Catalyst

The conventional SCR catalysts are either homogeneous ceramic or metal substrate coated. The catalyst composition is vanadium-based, with titanium included to disperse the vanadium catalyst and tungsten added to minimize adverse SO_2 and SO_3 oxidation reactions.

2.2.3 SCR Ammonia System

The ammonia reagent for the SCR systems will be supplied by anhydrous ammonia.

Table 2-5 shows summary of the materials used for different sections in SCR.

Table 2-5
SCR Material of Construction

Component	**Material**
SCR Reactor	Carbon Steel or Alloy Steel
SCR Catalyst	Vanadium, Titanium, Tungsten
Material in contact with vaporized ammonia	304 stainless steel
Piping in contact with vaporized ammonia	304 stainless steel
Economizer Gas-Side Bypass	Alloy Steel

2.3 PAC and Sorbent Injection

2.3.1 Storage Silo (PAC and Hydrated Lime/ Trona)

Table 2-6 shows the materials of construction for storage silos.

Table 2-6
Sorbent Injection Storage Silo Materials

Component	Material
Silos or Bins, Support Steel, and Accessories	
Plates	ASTM A36/A36M*
Shapes	ASTM A36/A36M* or A992/A992M*
Plates	ASTM A572/A572M Grade 50*
Shapes	ASTM A572/A572M Grade 50* or A529/A529M Grade 50* or A992/A992M*
Temporary Erection Bolts	ASTM A307 bolts with compatible washers and nuts
Structural Bolts	ASTM A325 Type 1 bolts with compatible F436 hardened washers, A563 heavy hex nuts and F959 direct tension indicators
Note: Surfaces which by service will be subject to corrosive attack by stored or processed material shall be protected by a suitable permanent lining or be constructed of material suitably resistant to attack.	

2.3.2 Storage Silo accessories (PAC and Hydrated Lime/ Trona)

Table 2-7 shows the materials of construction for storage silos accessories.

Table 2-7
Sorbent Injection Storage Silo Accessories Materials

Component	Material
Silo housing	ASTM A36 steel
Vent filter bag cages	Options include galvanized, epoxy coated, and stainless steel
Vent filter housing	Mild steel
Vent filter tubesheet	Mild steel
Vent filter pulse air venturi	Aluminum
Vent filter bag material	Polyester, Nomex, Gore Tex 14 or 16 oz

2.3.3 Pneumatic Conveying System (PAC and Hydrated Lime/ Trona)

Table 2-8 shows the materials of construction for pneumatic conveying system.

Table 2-8
Sorbent Injection Pneumatic Conveying System Materials

Component	Material
Pneumatic transporting piping	ASTM A106 Grade B, carbon steel, schedule 40 for large bore, schedule 80 for small bore
In-duct injection lances and supports	304L stainless steel (UNS S30403)
Elbows (in the piping)	Ceramic-lined abrasion and wear resistant material