**BACKGROUND**

To investigate the potential for electrostatic precipitator (ESP) upgrades, we asked Babcock & Wilcox (B&W) to support us with their expertise. Our instructions to B&W were that we would meet with a plant representative to discuss the ESP design and upgrades and to walk around the ESPs for expansion potential, and a week later they would provide order of magnitude estimates for ESP expansion or conversion to a Pulse Jet Fabric Filter conversion (FFC). B&W met with the Project Engineering Dept. (PE) and a plant representative at Ghent (Ghent) and Trimble County (TC) Stations on March 9, 2011, Mill Creek Station (MC) on March 10, 2011, and at the E.W. Brown Station (Brown) on March 11, 2011. From PE were Larry VanGansbeke, Lead Engineer, Joe Strickland, Lead Engineer, and Kyle Roshberg, Co-op employee. The plant representatives were, Carla Piening, Ghent Sr. Scientist, Dave Anderson, TC Outage Coordinator, Tiffany Koller, MC Maintenance Supervisor, and Brian Sumner, Brown Manager - Maintenance.

**SUMMARY**

From our investigation, it appears that merely upgrading the ESPs does very little towards the goal of reducing HAPS emissions from the stack discharge. Any improvement in particulate emissions from an ESP upgrade may only serve to reduce the particulate removal in the FGD. The Fabric Filter conversions on certain units may approach or achieve the new PM and HAPS targets. To ascertain the potential removal efficiency and the cost/benefit of the FFC versus a new Pulse Jet Fabric Filter, further study will be necessary.

The limitations of this investigation into the potential for ESP expansion or conversion are:

• The study took place over the course of two weeks.

• The stations do not have ESP inlet or outlet PM data. All emissions data is at the stack.

• ESP modifications can only improve particulate matter (PM) emissions and will provide insignificant removal of HAP emissions.

• Potential ESP improvements may not improve stack emissions as downstream FGD performs significant removal of particulate matter.

• The costs shown are order of magnitude and do not include costs external to the ESP, such as duct modifications, new fans, power distribution, owner costs, contingency, etc.

• Order of magnitude costs for ESP modifications have an accuracy for material of ±20% and installation of ±40%.

• Ghent Units 2, 3, and 4 are hot side ESPs and cannot benefit from FFC due to fabric temperature restrictions.

Benefits and risks of conversion to Fabric Filters:

• Some improvement in HAPS emissions.

• Sub-optimal design due to existing structure. Efficiency may be less than new PJFF.

• Condition of existing ESP structure unknown, up to 40 years in service.

• Any ESP converted to a fabric filter will preclude fly ash sales from that unit.

• An FFC will save site footprint over a new Pulse Jet Fabric Filter.

• The outage time required for a conversion is about 10-12 weeks.

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| LG&E/Kentucky Utilities - Potential ESP Upgrades |
| **Station** | **Unit #** | **Scenario #1** | **Scenario #2** | **Scenario #3** | **Scenario #4** | **Remarks** |
| EW Brown | 1 | Add 9ft outlet field:Materials: $1.2m Installation: $2.1m |   |   |   | DESP mods will improve PM, but will not improve HCl, SO2, Hg, CO or Dioxin emissions. |
| EW Brown | 2 | Add 9ft inlet field:Materials: $1.3m Installation: $2.5m | FF Conversion:Materials: $3.7m Installation: $5.4m |   |   | DESP mods will improve PM, but will not improve HCl, SO2, Hg, CO or Dioxin emissions. FFC will improve PM, HCl, SO2, Hg, CO and Dioxin emissions. |
| EW Brown | 3 OLD | ESP tuning |   |   |   | DESP tuning will improve PM, but will not improve HCl, SO2, Hg, CO or Dioxin emissions. |
| EW Brown | 3 NEW | Sectionalize inlet field:Materials: $350k Installation: $550k | Add 9ft outlet field:Materials: $2.6m Installation: $5m | Add 6ft height:Materials: $4.6m Installation: $8m | FF Conversion:Materials: $10.8m Installation: $18m | DESP mods will improve PM, but will not improve HCl, SO2, Hg, CO or Dioxin emissions. FFC will improve PM, HCl, SO2, Hg, CO and Dioxin emissions. |
| Ghent | 1 | New AVC's:Materials: $100k Installation: $150k | Convert to SMPS:Materials: $1.1m Installation: $600k | Add 12ft outlet field:Materials: $4m Installation: $7m |   | DESP mods will improve PM, but will not improve HCl, SO2, Hg, CO or Dioxin emissions.  |
| Ghent | 2 | New AVC's:Materials: $130k Installation: $150k | Convert to SMPS:Materials: $1.8m Installation: $1m | Add 6ft height:Materials: $8.5m Installation: $13m |   | DESP mods will improve PM, but will not improve HCl, SO2, Hg, CO or Dioxin emissions. |
| Ghent | 3 | New AVC's:Materials: $210k Installation: $280k | Convert to SMPS:Materials: $3.4m Installation: $2.5m | Add 6ft height:Materials: $12.4m Installation: $20m |   | DESP mods will improve PM, but will not improve HCl, SO2, Hg, CO or Dioxin emissions. |
| Ghent | 4 | New AVC's:Materials: $210k Installation: $280k | Convert to SMPS:Materials: $3.4m Installation: $2.5m | Add 6ft height:Materials: $12.4m Installation: $20m |   | DESP mods will improve PM, but will not improve HCl, SO2, Hg, CO or Dioxin emissions. |
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| **Station** | **Unit #** | **Scenario #1** | **Scenario #2** | **Scenario #3** | **Scenario #4** | **Remarks** |
| Mill Creek | 1 | Add 5ft height:Materials: $3.6m Installation: $8m | FF Conversion:Materials: $8m Installation: $12m (feasible?) |   |   | DESP mods will improve PM, but will not improve HCl, SO2, Hg, CO or Dioxin emissions. FFC will improve PM, HCl, SO2, Hg, CO and Dioxin emissions. |
| Mill Creek | 2 | Add 5ft height:Materials: $3.6m Installation: $8m | FF Conversion:Materials: $8m Installation: $12m (feasible?) |   |   | DESP mods will improve PM, but will not improve HCl, SO2, Hg, CO or Dioxin emissions. FFC will improve PM, HCl, SO2, Hg, CO and Dioxin emissions. |
| Mill Creek | 3 | Add 12ft outlet field: Materials: $3.3m Installation: $7m | FF Conversion:Materials: $11m Installation: $13m |   |   | DESP mods will improve PM, but will not improve HCl, SO2, Hg, CO or Dioxin emissions. FFC will improve PM, HCl, SO2, Hg, CO and Dioxin emissions. |
| Mill Creek | 4 | Add 9ft outlet field:Materials: $4.2m Installation: $7m | Add 6ft height: Materials: $8.4m Installation: $14m | FF Conversion: Materials: $13m Installation: $15m |   | DESP mods will improve PM, but will not improve HCl, SO2, Hg, CO or Dioxin emissions. FFC will improve PM, HCl, SO2, Hg, CO and Dioxin emissions. |
| Trimble | 1 | Outlet field top rap conversion + purge air for all fields:Materials: $1.8m Installation: $3m | FF Conversion:Materials: $16m Installation: $19m |   |   | DESP mods will improve PM, but will not improve HCl, SO2, Hg, CO or Dioxin emissions. FFC will improve PM, HCl, SO2, Hg, CO and Dioxin emissions. |

NOTES:

1. Sectionalize - Add conventional T/R sets to increase the number of electrical fields.

2. New AVC's - Replace the existing voltage controls with B&W SQ-300i AVC's. Reuse cabinets.

3. Convert to SMPS - Replace existing conventional T/R sets with high frequency power supplies (one for one swap). New controls and bus/guard.

4. Add Height - Remove existing roof beams and add height to ESP. Rebuild at 400mm spacing with rigid discharge electrodes and new T/R sets.

5. Add Field - Add an additional mechanical field to existing ESP. New field at 400mm spacing with rigid discharge electrodes and new T/R sets.

6. Add Field - Rebuild at 400mm spacing with rigid discharge electrodes and new T/R sets. Convert to roof mounted EGR rappers.

7. FF Conversion - Remove ESP internals and convert to a pulse jet fabric filter. All ESPs will need to increase in height. Only on cold sides.

8. Budget prices (above) are provided as order of magnitude values: Materials +/- 20%, Installation +/- 40%.

9. Budget prices do not include costs external to the DESP, such as ductwork modifications.

10. Budget prices do not include Owner costs.

11. This limited study did not assess power distribution issues.

12. Costs provided by B&W. Remarks are by LGE-KU PE Dept.