LG&E/KU – Mill Creek Station

Phase II Air Quality Control Study

Scrubber Support Structure Steel Refurbishment Cost Estimate

March 11, 2011
Revision B – Issued For Client Review

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1.0 Introduction

Black & Veatch (B&V) was requested to perform a visual inspection of the scrubber steel support structures at the Mill Creek Generating Station, Units 1, 2, and 4, to assess the condition of the structural steel and provide input to the replacement and/or repair of the steel support structures.

The tasks of the scope of work were:

- Observe the condition of the structural steel.
- Provide a construction execution plan.
- Prepare a budgetary cost estimate for steel repair/replacement.

Original design drawings of the steel structure dated 1979 and reports written in 2008 by Mesa Associates concerning an assessment of the FGD System reliability were provided by LG&E/KU and reviewed prior to the site visit. Since the drawings for the steel support structures and scrubber system for Unit 1, 2, and 4 are dated 1979, it is assumed the structures were constructed in 1979 or 1980 and have been in service for the past 30 plus years.

B&V has performed a visual inspection of the condition of the scrubber steel support structure at Units 1, 2, and 4 with specific attention to what needs to be replaced and what could be repaired. During the week of February 28 through March 4, 2011, Joe Collins, Robert Gillespie, and Richard Yutz of Overland Contracting Inc. (OCI) and Greg Kaufman and Lyle Morgan of B&V were at the Mill Creek Station to perform a visual inspection of the scrubber steel support structure—no forensic inspections or analyses were performed. The structural steel visual inspections were accompanied by Kenny Craigmyle and Bill Strange of LG&E/KU.

On Units 1, 2, and 4 there is limited access to the upper levels of the steel structure due to the ductwork leaking flue gas and due to the condition of the steel grating platforms. On Units 1 and 2, the steel support structure straddles a reaction tank and supports the equipment and ductwork above the tank. The structural loading from the scrubber system is transferred to grade though the braced columns on each side of the tank.

The steel structures were visually inspected several times during the week. On Tuesday March 1, Unit 2 was offline providing for a closer look at some of the upper level steel. The visual inspection accomplished during this site visit was only to evaluate the structural steel. The ductwork and internal scrubber equipment have been evaluated by others. However, it should be noted that the structural steel replacement/repair should be completed in conjunction with other scrubber related construction tasks.

B&V observed the basic structural condition of the scrubber support structures and, in general, has determined the steel structure at Units 1 and 2 to be deteriorated to the point of needing replacement, and that the steel structure at Unit 4 is in good condition, but in need of some repairs.

2.0 Field Observations

During the site visit, the B&V/OCI personnel observed the steel support structures from the ground and then observed what was safely accessible at higher elevations. The following observations and photographs are typical of multiple locations in the structure.

Unit 1

1. The protective coating on the structural steel is corroded away in large areas. Some of the corroded areas have significant loss of steel cross section.

2. The columns have lost steel section from the steel delaminating and falling off. In most cases, the brace connections are also damaged leaving a thinner gusset plate and deteriorated connection angles, bolts, and nuts. In some locations the bolts and nuts are corroded to the point of rounding the hexagon surface and having no thread. This is typical for the main support columns and bracing.

Unit 1 Column Line D-6

3. Some of the columns at column lines A through C could be cleaned, repaired, and coated, but the columns at column lines D through H will need to be replaced.

Unit 1 Column Line A-0.1 and A-0.2

4. The columns are corroded and have lost section in the webs, flanges, and connections.

Unit 1 Column Line E-5

5. Steel is delaminating from the flanges and web as shown in the following picture.

Unit 1 Column Line E-5

6. Steel is delaminating from the bracing flanges.

Unit 1 Main Bracing between Column Line H-3 and H-7

7. Base plates and anchor bolt chairs are typically corroded.

Unit 1 Column Line H-2

8. The duct support hanger is attached to a beam that has been corroded away. The loading is no longer supporting by the beam and has transferred elsewhere in the structure. This is in danger of collapse.

The conditions of the structural steel at Unit 2 are similar to Unit one. The following observations and photographs are typical of multiple locations in the structure.

Unit 2

1. The protective coating on the structural steel is corroded away in large areas. Some of the corroded areas have significant loss of steel cross section.

2. The bottom of the column has lost steel section from the steel delaminating and falling off. In most cases the brace connection is also damaged leaving a thinner gusset plate and deteriorated connection angles, bolts, and nuts. In some locations the bolts and nuts are corroded to the point of rounding the hexagon surface and having no thread. This is typical for the main support columns and bracing.

Unit 2 Column Line Ec-19

3. Some of the columns at column lines A through Cd could be cleaned, repaired, and coated, but the columns at column lines Ec through Gc will need to be replaced.

4. The columns are corroded and have lost section in the webs, flanges, and connections.

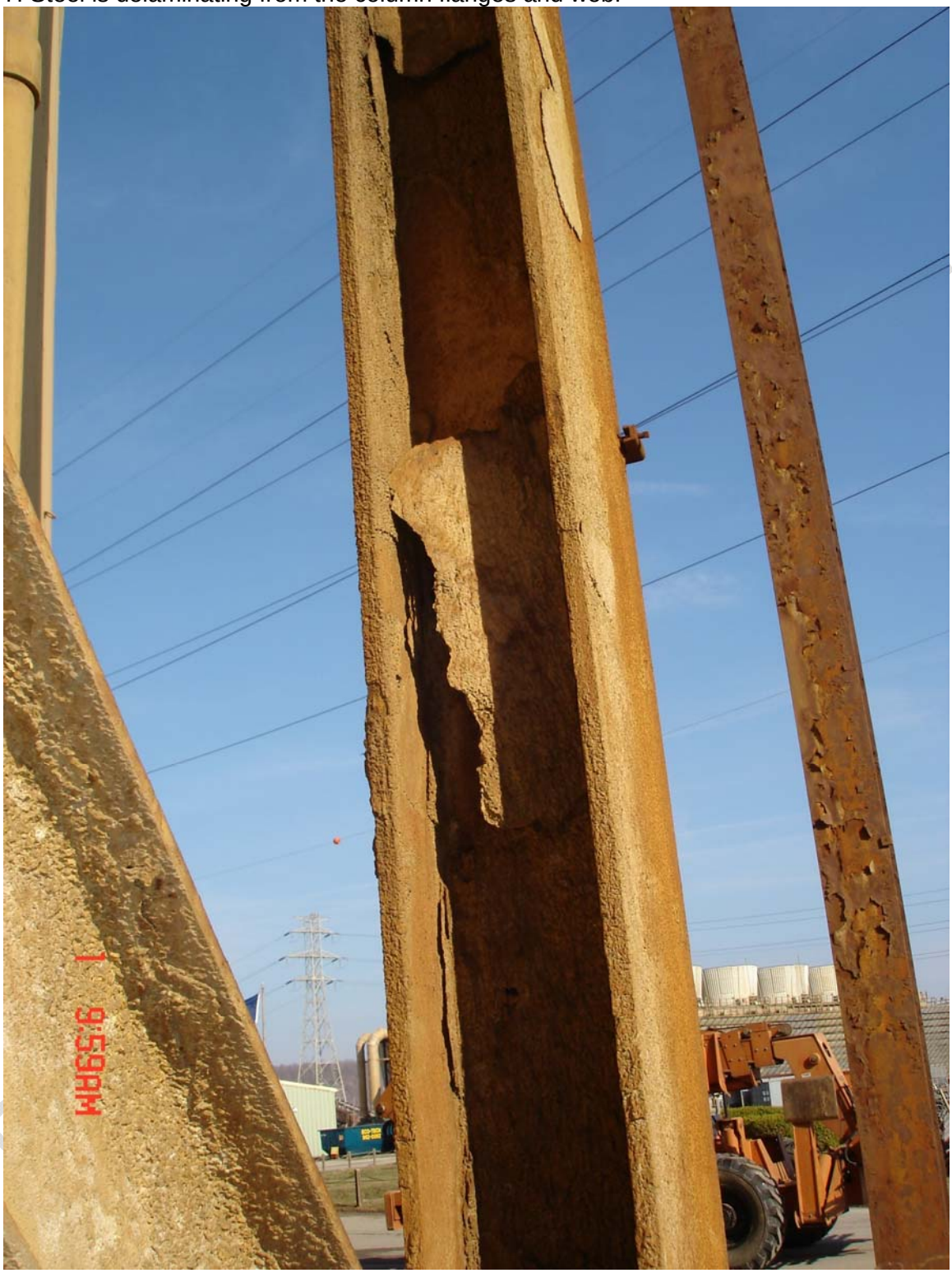
5. The horizontal bracing is damaged. The beam in the foreground has lost the web and the bottom flange. Some of the angle bracing has been completely corroded away.

Unit 2 About Elevation 500

6. Steel is delaminating from the column splice plates and the shim/filler plates have been corroded as shown in the following picture.

Unit 2 About Elevation 515

7. Steel is delaminating from the column flanges and web.



Unit 2 Column Line Gc-24

8. Base plates and anchor bolt chairs are typically corroded.

Unit 2 Column Line Gc-25

9. Some base plates, connection plates/angles, and connection bolts and nuts, are corroded and have lost significant section.

Unit 2 Column Line Gc-24

10. There are several beams and posts at the upper elevations that have been corroded through the webs and/or flanges.

Unit 2 About Elevation 500

The condition of the structural steel at Unit 4 is generally in much better shape than at Units 1 and 2. The coating on the steel is typically still in place and the structure is in a repairable condition. The following observations and photographs are typical of multiple locations in the structure.

Unit 4

1. Several of the column bases have been damaged and need to have the broken and missing grout repaired. The base plates and bottom of the columns should be cleaned and coated to prevent corrosion damage. Some base plates will need to be repaired.

Unit 4 Typical of column bases at column lines L, M, N, and P

2. The ductwork at Unit 4 is leaking flue gas and the acidic condensate is dripping on the structure. The base plate and column at column line N-6B has been damaged and will need to be repaired.

Unit 4 Column Line N-6B

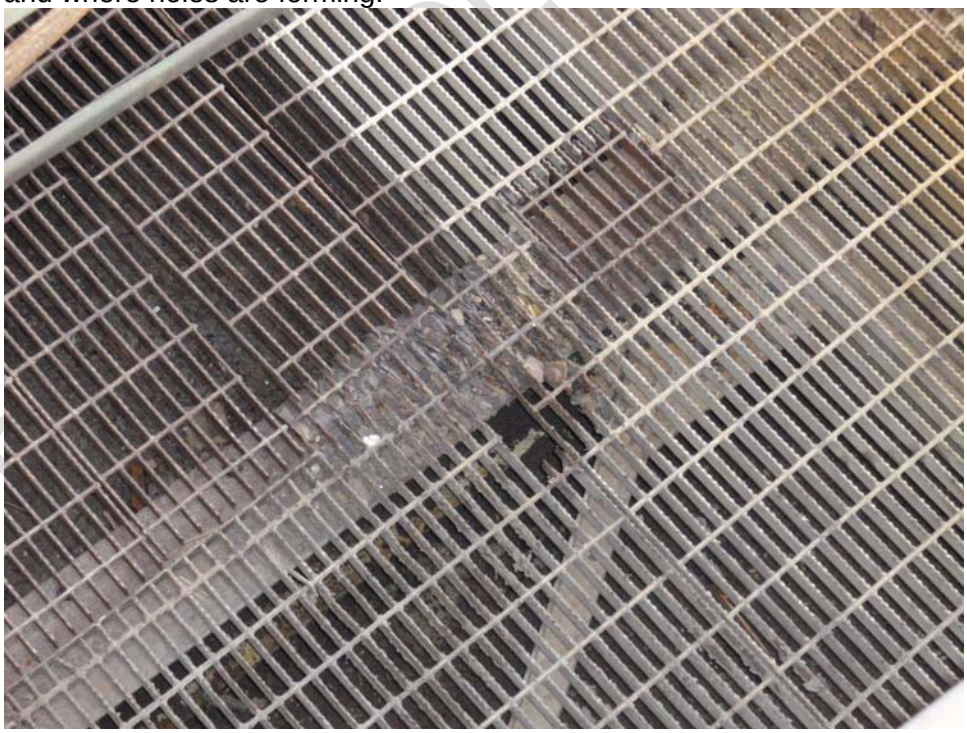
3. Beam on Column Line N between Column 4A and 6B at about elevation 500 where the acidic condensate is dripping. All levels of steel under this drip need to be repaired.

Unit 4 Column Line N about elevation 500

4. The structural steel will need to be cleaned, repaired, and coated in locations where the flue gas is leaking from the duct and acidic condensate is dripping on the steel.

Unit 4

5. The grating above the tank is corroding and will need to be replaced where it is thin and where holes are forming.



Unit 4 Grating platform

6. Grating in the upper level platforms can be seen to have holes corroded through.

Unit 4 Upper level grating platform.

7. The ductwork is leaking inside the Unit 4 building at the corners. The steel should be cleaned, repaired, and coated.

Unit 4 Inside Building are leaking duct.

3.0 Recommendations and Conclusions

Summarizing the field observations from Unit 1 and 2:
1. The structural steel coating is missing in many areas of the structure leaving the steel unprotected from the elements.
2. The structural steel has corroded and is currently delaminating in many areas causing flanges and webs to be much thinner than the original condition.
3. The structural steel along Column Lines A through C appears to be in good enough condition to use. The structural steel in this area may be cleaned, repaired and coated instead of replacing.
4. Steel above elevation 500 ft has corroded and delaminated reducing structural cross-section causing thin webs and flanges. Some steel sections have holes through the webs and flanges.
5. Connections have deteriorated connection plates and eroded nuts and bolt heads.
6. The existing structural steel demolition and new structural steel erection should be scheduled to be completed in conjunction with other construction work planned for each Generation Unit.
7. The ductwork should be repaired so the flue gas and acidic condensate cannot continue to erode the steel.

Summarizing the field observations from Unit 4:
1. The structural steel is in relative good shape with a few exceptions.
2. The steel generally has paint coating.
3. The cause of steel deterioration is the leaking ductwork, both flue gas and dripping acidic condensate.
4. West side where drip is on beam has corroded the flange which will need to be repaired.
5. Some grating is eroded and needs to be replaced.
6. Some small horizontal bracing has been deteriorated and needs to be replaced,
7. The ductwork should be repaired so the flue gas and acidic condensate cannot continue to erode the steel.

Based on our field observations, B&V/OCI believes the structural integrity of the Unit 1 and 2 FGD steel support structure is hazardous and needs to be replaced. Unit 4 steel is in good condition, but needs to be repaired where the steel has been damaged.

B&V/OCI recommends the following:

Unit 1
Take down the existing structure and replace it with new structure between Column Lines D through H and Column Lines 1 through 10. The existing duct support structure at Column Lines A through C can be cleaned, repaired, and coated.

Unit 2
Take down the existing structure and replace it with new structure between Column Lines Ec through Gc and Column Lines 18 to 25. The existing duct support structure at Column Lines A through Cd can be cleaned, repaired, and coated.

Unit 4
Repair the existing deteriorated steel.

4.0 Constructability Assessment

Constructability:

A visual inspection of the FGD steel support structures for Units 1, 2, and 4 was conducted during the week of February 28 through March 4, 2011. The Overland Construction Inc. (OCI) inspection team consisted of Joe Collins, Richard Yutz, and Robert Gillespie. The initial intent of the inspection was to determine how to replace, repair, or modify the support steel while keeping the plant in operation. After the first day of inspection, it became clear that an extensive percentage of the steel structure for Units 1 and 2 needs to be replaced and can not be repaired without taking an outage. The main structural steel support has deteriorated to the point that it is not feasible to temporarily support, weld, or attach any additional members to it. The structure was also evaluated from a safety standpoint and the team determined that any disturbance to the structure may cause it to collapse. The structural steel support at Unit 4 is in much better shape and can be repaired. Many of the repairs at Unit 4 can be made without taking an outage.

The corrective action for Unit 1 is to remove and replace the entire steel structure between Column Lines D through H and Column Lines 1 through 10. The corrective action for Unit 2 is to remove and replace the entire steel structure between Column Lines Ec through Gc and Column Lines 18 through 25. The steel structure along Column Lines A through C can be cleaned, repaired, and painted. From a cost and safety standpoint, this is the only alternative.

The existing structure described in the preceding paragraph should be disassembled from the top down. The material would be immediately taken off site and disposed. Any foundation modifications and/or repairs would be made immediately following the steel structure removal. To reduce the length of the outage, the new steel should be fabricated, painted, and preassembled in as large of sections as feasible prior to the outage. The new steel support structure would then be erected.

The corrective action for Unit 4 is to do a major clean up of the entire structure and repair the damaged steel sections. Some of the clean up will require an outage, but can be worked around scheduled plant outages. The duct leakage needs to be repaired or the collection of debris and corroding of the steel will continue. There are a few steel sections that need to be replaced during a scheduled outage or possibly with Unit 4 on line.

Common Area around Units 1 and 2 - The pump area and electrical switchgear room above it are in good shape and would only require some clean up and minor repairs. The structural steel that supports the inlet and outlet duct between columns A through C could be cleaned, repaired, and repainted. There may be a few members that need to be replaced.

The electrical cable tray and conduit systems supported by the FGD steel support structures of Units 1, 2, and 4 were also visually inspected. The cable tray and conduit at Units 1 and 2 are deteriorated so that cable trays and conduit are overloaded and unsupported. New supports will be required for the cable tray and conduit systems. Much of the cable tray and conduit are corroded with wire exposed. Due to changes

over the years, there are some abandoned cables in the trays that could be removed. It is recommended to remove and replace the electrical systems for Units 1 and 2. This can be coordinated with the removal and replacement of the structural steel. Tracing and tagging the circuits can be completed prior to an outage.

The cable tray and conduit at Unit 4 can be salvaged by cleaning the tray system and replacing a few trays that have been badly damaged. The use of fiberglass tray and unistrut with stainless steel rod and hardware can be considered for future installations.

Demolition/Construction Plan:

Unit 2 has the most real estate available to set up a crane and lay down structural steel. A large crane could be set up on the north side of the unit and be utilized for both demolition and erection. The parking lot and the area next to the cooling towers could be used to dispose of the old steel as well as the preassembly of the new steel. There is a 345 kV transmission line on the north side of Unit 2. It appears there is enough space to set up the crane, but access would be easier if the transmission line were relocated.

Unit 1 is a little more congested than Unit 2. A smaller crane and/or a tower crane would have to be utilized. A large crane may be placed north of Unit 2 and could reach over Unit 2 and assist the construction on Unit 1. The same lay down areas will be utilized for the disposal and preassembly of the steel.

The foundation repairs for both Units 1 and 2 will be to demolish the piers and drill and epoxy new anchor bolts into the existing footing foundations. New concrete piers will be placed around the anchors. It is not determined at this time how many foundations will need to be repaired.

Unit 4 will require a dedicated clean up crew that will utilize a vacuum truck and pressure washers. Scaffold will also be erected to access areas for clean up as well as steel repair.

Schedule:

Unit 1 is the most difficult and will require the most time to disassemble and reassemble due to the congested area within the plant. It is estimated that at a minimum a 14 week outage should be scheduled for this unit.

Unit 2 has much better access and lay down for disassembly and assembly. It is estimated that at a minimum a 12 week outage should be scheduled for this unit.

Although the visual inspection focused only on the replacement of the structures for Units 1 and 2, the duct work, as well as any scrubber modifications, will need to be completed in conjunction with the steel replacement. This may add to the total duration of the outage.

Unit 4 clean up will not require a continuous outage; however, there may be some areas that need to be shut down for a short period of time due to electrical hazard. Much of the clean up is associated with the cable trays and electrical systems. It does not appear that the structural repairs will require an outage. The time frame required to do the clean up will be 4 weeks.

5.0 Cost Estimate

Costs:

The costs listed below include engineering, supervision, labor, materials, and equipment to:

1. Remove and replace the entire steel structure between Column Lines D through H and Column Lines 1 through 10 for Unit 1.

2. Remove and replace the entire steel structure between Column Lines Ec through Gc and Column Lines 18 through 25 for Unit 2.

3. Clean, repair, and paint the structural steel that supports the ductwork between Columns A through C for Units 1 and 2 and the foundation repairs for both Units 1 and 2.

4. Major clean up of the Unit 4 structure, repair the damaged steel sections, and paint the structural steel with missing and damaged coating.

Electrical, ductwork/ductwork support steel, and mechanical piping costs were not included in the pricing.

Budgetary Cost Estimate

Unit 1:

Procurement:	$1,899,582
Construction:	$2,634,019
Construction Management:	$1,613,122
Engineering:	$ 614,672
Total:	$6,761,395

Unit 2:

Procurement:	$1,899,582
Construction:	$2,634,019
Construction Management:	$1,613,122
Engineering:	$ 614,672
Total:	$6,761,395

Unit 4:

Procurement:	$183,830
Construction:	$415,126
Construction Management:	$205,349
Engineering	$ 80,431
Total:	$884,736