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Dated: 7/31/2019
File: CB-45418-C

Attention: Chuck Lauricella
Engineering Manager
Erie Coke Corporation
925 East Bay Drive
Erie, PA 16507

Subject: **Erie Coke Corporation**
Coke-Side Shed Engineering Evaluation for Capture Improvement

International Chimney completed an engineering evaluation of the existing dust collection – pushing emissions control – shed located on Battery #1 (A) and #2 (B) at Erie Coke Corporation. The purpose of this evaluation is to recommend engineering solutions to increase dust capture and collection from the coke pushing process occurring under the sheds and, by doing so, to decrease the amount of visible opacity observed from the sheds during oven pushing.

Proposed Engineering Solutions

ICC engineering proposes the following six solutions to be completed in order to help facilitate a lower visible opacity during oven pushing:

1. Extend both the North and the South sheds an additional five feet on each end and enclose the area with additional metal siding.
2. Add metal siding to the exterior portion of the structural bents on the west shed wall that will extend from the roof down approximately 25' and be at a lower elevation than the existing west wall.
3. Install sized industrial air curtains (air doors) at each of the four ends of the dust collection sheds and in the corners closest to the coke battery (between the ends of the collecting-mains and the ends of the shed) where leakage has been observed.
4. Extend the deflectors down on all four of the new extended shed ends.
5. Install a local suction magnification system consisting of automatic suction duct dampers to isolate suction to one shed or the other during coke pushes depending upon which battery is pushing.
6. Install flashing or roof panel closure strips to seal the eaves of the sheds above the west shed walls.

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Extending the Four Shed Ends & Adding Lower Siding to Exterior Bents

By extending the four North and South shed ends by five feet each and providing lower siding to the exterior of structural bents (instead of the higher siding currently on the interior structural bents), there will be an increased collection volume under the structural roof decking and siding. By increasing the volume of the shed, more dust will be able to be contained within the shed during a push so that the air hood vents can remove the particulate. The current volume entrapment including both sheds is approximately 131,000 cubic feet. The proposed volume entrapment would be approximately 221,000 cubic feet with an added difference of 90,000 cubic feet – a 68% increase in volume from the current sheds.

Air Curtains (Air Doors) at the Four Shed Ends

In addition to the added volume, installing industrial air curtains at the ends of the coke battery sheds and at the corners would help contain the dust particulate at the open ends. Since the quench car and door machine must routinely pass through the sheds, a complete enclosure at the ends is not possible. Strip curtains would impede both cars and would be at a high risk of catching fire or being ripped down when the quench car and door machine pass through the sheds. With the high powered air curtains, the quench and guide cars will be able to pass through the ends easily without impedance, fire hazard or damage. The air curtains will provide extra shielding to help contain stray dust that attempts to escape at the ends of the shed.

Extend the Custom End Deflectors

The custom end deflectors that hang from the shed ceiling should be extended further on both ends of each shed as far as operationally allowable. By extending the deflectors, and with assistance from the air curtains, the overhead hood can collect more dust as the coke is being pushed from the ovens nearer to the ends of the sheds. Because the battery end ovens will be approximately within ten to twenty feet of the shed's ends, dust has a higher probability of escaping when end ovens are pushed. By extending the deflectors, the probability of dust escaping will be lowered and provide added protection along with the help of the air curtains described earlier.

Suction Isolation

The dust collection suction mains located above the shed roof on A-Battery (#1) incorporates two butterfly dampers before the hoods that penetrate the topside of the shed roof – one damper going to each shed. These dampers should be strategically and automatically opened and closed depending on what oven is being pushed. For example, if Oven #50 is being pushed, which is located under the north shed, the damper that leads to the hoods under the south shed should be partly closed. This will allow higher suction and draft for the hoods located in the northern shed. This principle, in reverse, also applies to the southern shed. This method of increasing local shed collection air flow is superior to increasing the total baghouse air flow with larger or faster fans because it does not adversely affect the air-to-cloth ratio of the baghouse bags. In addition, it is more energy efficient than running a high suction on the battery shed that is not presently pushing an oven.

Install Eave Flashing or Roof Panel Closure Strips

Install flashing or roof panel closure strips to seal the eaves of the sheds above the west shed walls. Either custom cut flashing during installation or install custom made roof panel closure strips designed and fabricated for the corrugation pattern of the roof sheeting – depending on which method is determined to be most feasible with the existing roof installation.

Estimated Preliminary Materials List

To perform the work described above, a list of materials was gathered as a preliminary design to extend the sheds and support the air curtains and siding:

- W16 x 26 Beams: Total linear feet = 218', Total Weight = 5,668 lbs.
- C6 x 8.2 Girts: Total linear feet = 751', Total Weight = 6,159 lbs.
- 2 <4" x 4" x ¼" Angle Bracing: Total linear feet = 168', Total Weight = 2,218 lbs.
- Siding and Roofing: 2" deep 20 ga. intermediate ribbed galvanized decking
  Total Area = 9,800 sq. ft.
- Air Curtains: Approximately 96 linear feet (or less) in the 4 north/south spaces between the end of the collecting-mains and the new extended ends of the shed. Approximately 89 linear feet above the four shed east/west end openings. A total of 185 linear feet (or less) in all. Less, because custom sheeting will be required in each of the four locations to accommodate the differing specific geometries of each.
- Enough flashing or fabricated roof panel closure strips to seal approximately 304 linear feet of roof eaves.

Comparison of Shed's Anticipated Roof Design and the Sheds As-Built

The anticipated design of the shed roof at Erie Coke was depicted in Figure 2-2 of the *Plan Approval Application* prepared by All4 (from Kimberton, PA) and submitted to the Pennsylvania Department of Environmental Protection (PADEP) by Erie Coke in October 2010. The depiction in that figure was a modified schematic based on a design used by Bethlehem Steel Corporation in Lackawanna, NY in the 1980's and 1990's. The schematic was not drawn to scale or dimensioned. By using the approximate relative locations of the battery collecting-main, the battery coke-side bench, the battery quench tracks, and the anticipated dust collection plenum from the proposed schematic; it was possible to sketch a dimensioned version overlaid onto the actual as-built cross-section for comparison purposes.

The anticipated design was a peaked roof with a plenum at the peak. The as-built design is a sloped roof from the two battery collecting-mains away from the batteries going west. By using the dimensioned sketch described above, it was possible to conduct a comparative analysis of the dimensions, approximate cross-sectional areas and approximate volumes of the anticipated design verses the as-built shed. The total volume of both sheds produced by the anticipated design would have been, as estimated by this rough method, approximately 189,900 cubic feet. The approximate total volume of the sheds as-built is 131,000 cubic feet. The solutions ICC recommends in this engineering evaluation will increase the total volume of the sheds to approximately 221,000 cubic feet as was described earlier in this report.

The direction of ICC's ultimate recommended solutions regarding shed volume can be explained by the following factors. After further research and interviewing maintenance, operations and engineering personnel at Bethlehem Steel Corporation, Erie Coke's engineering department discovered that Bethlehem Steel's experience with that design was inadequate for several reasons:

1. The roof sloped toward the battery deposited large amounts of water directly to the top of the hot coke oven batteries during heavy precipitation events.
2. This water immediately evaporated into steam clouds that created zero visibility on the battery top where heavy machinery on tracks and operations personnel were working and moving about. This created a severe safety hazard for employees.
3. If the precipitation event persisted, the battery top would often cool enough such that water would begin to infiltrate the brickwork and wash away lidding mud from the oven lids.
4. This water infiltration led to brickwork damage that had an adverse impact on battery stack opacity and on oven refractory life and performance.
5. Due to the washed away lidding mud, ovens lids would leak leading to increased fugitive emissions from the battery topside.
6. Some water would go down flues from the battery top and cool the oven walls and adversely affect battery wall heating leading to higher particulate loads on the whole pushing emissions control system.

Another adverse detail of the Bethlehem Steel design was reported as well. The elevation of the dust collection plenum was too high. Due to the distance from the particulate source, only the lightest particulate dust rose to that elevation to be collected. A large portion of heavier particulate simply accumulated in the shed and settled on the quench tracks under the shed. Through analysis of our dimensioned overlaid sketch it can be seen that with the peaked roof design:

1. The plenum would be approximately 33 feet above the most concentrated particulate source during oven pushing.
2. The plenum would be offset from the centerline of the quench tracks by approximately 5 feet. This means that a large portion of whatever particulate is to be collected would have to travel in an indirect path to be captured – and instead of being directly captured, it would fill up the roof peak volume and accumulate longer.

The Erie Coke shed is designed so that the plenum is approximately 14 feet above the particulate source during a push and it is centered nearly directly over the centerline of the quench tracks. This gives the hot rising particulate a direct and close path directly into the plenum so that much of the pushing emission is captured directly and locally at the oven being pushed. Any particulate not captured directly and locally, can accumulate in the shed volume and be slowly drawn in by the plenum along the whole length of the shed similar to the Bethlehem Steel design. For the reasons specified above, ICC believes that the six solutions recommended in this report are superior to shutting down the whole pushing emissions control system for several months, taking off both of the roofs and all of the suction mains and replacing them with an inferior design.

Analysis on Closing the Roof Gap between the Two Sheds

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Due to the location of the battery coal supply bins there is a gap between Battery A and Battery B of approximately 76 feet. Closing the roof gap between the two sheds would require adding foundations in locations where the underground battery waste heat tunnels and breechings, the quench tracks and the battery chimney make that prohibitive. It would also eliminate a necessary open entry point for cranes and loaders to conduct both track cleaning and battery maintenance operations that are required for safe and effective operations of the facility. In addition, adding shed volume in a location where there is no particulate source would accumulate particulate from both sheds and may require an added and unnecessary dust collection plenum. Each shed will capture more with an isolated automatic suction control system and air curtains than both sheds with a middle passive roof can capture without shed isolation. In addition, with the five foot extensions to each shed end, the gap will be reduced to approximately 66 feet.

Summary

With the combined benefits of the following six recommended solutions, shed capture and collection from the coke pushing process will be improved and, by doing so, there will be a decrease in the amount of visible opacity observed from the sheds during a push and a corresponding decrease in shed pushing emissions.

1. The extra shed volume (approximately 14,500 cubic feet) associated with the extension of each of the four shed ends by five feet, and
2. The extra shed volume (75,500 cubic feet) associated with moving the west shed wall sheeting to the outer bents and down farther, and
3. Installing air curtains and sheeting in the areas most prone to shed leakage, and
4. Extending the deflectors down from the four newly extended shed ends, and
5. Installing a suction main isolation system with automatic operating dampers to magnify the suction to the shed that is presently pushing an oven, and
6. Installing flashing or roof panel closure strips to seal the eaves of the sheds above the west shed walls.

Conclusion

ICC engineering recommends the above six solutions to be implemented and/or installed at Erie Coke to help maximize capture and reduce fugitive dust particulate emissions. Erie Coke will be able to utilize the existing structural steel bents and purlins to make these improvements in a cost effective way without added foundations either between or at the north or south extreme ends of the sheds. ICC believes that these recommendations together represent the most reasonable and effective engineering solution to achieve lower pushing emissions and will be more effective than replacing the roof with a peaked roof design or adding a passive roof between the two sheds.

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
GEORGE REGINALD GARDNER
ENGINEER
No. PE-36156-E

7-31-2019

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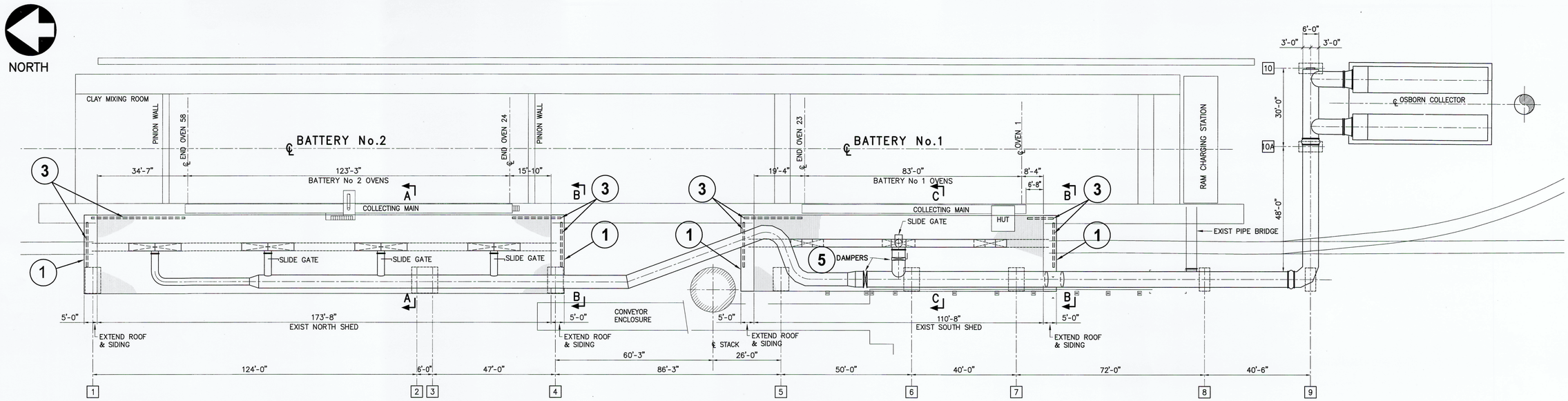
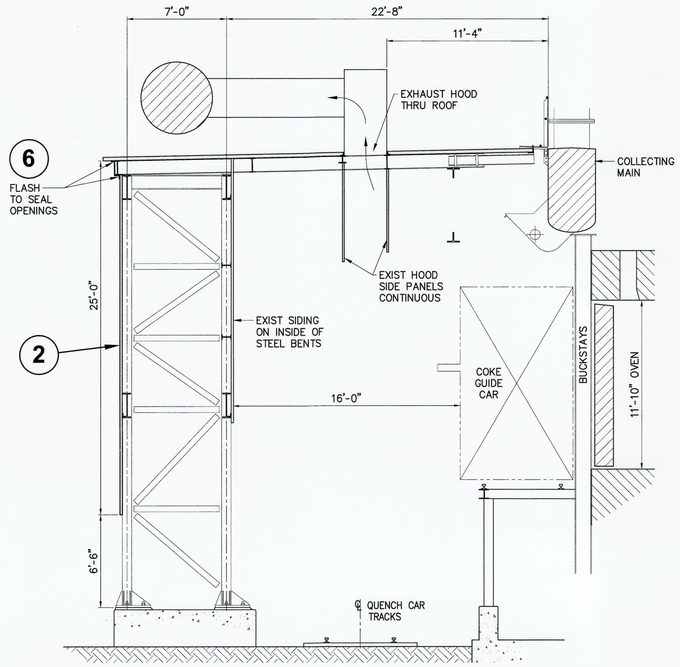


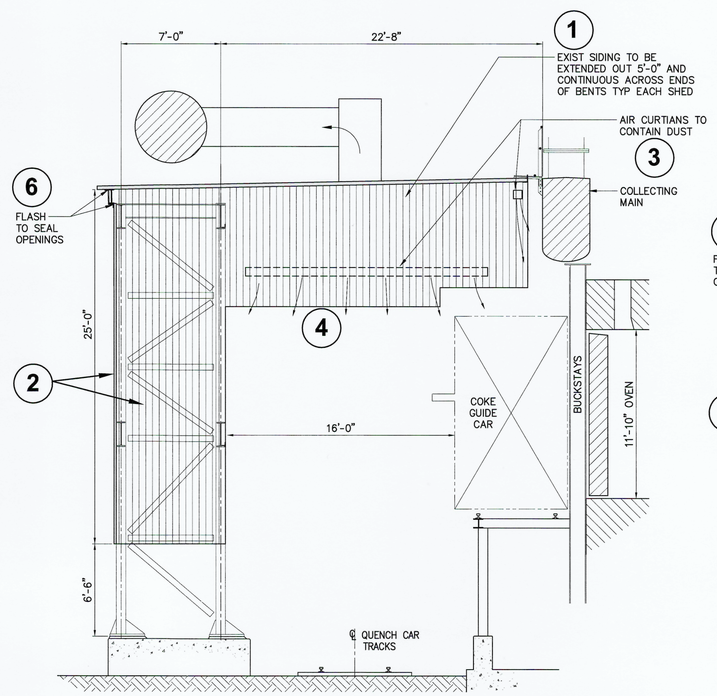
PLAN AT SHEDS

SCALE : 1" = 20'-0"



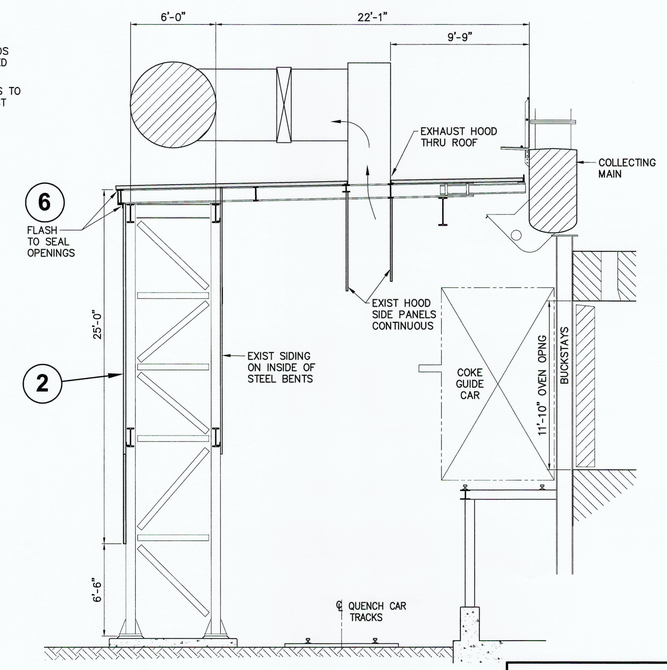
SECTION A–A

SCALE : 3/16" = 1'-0"



SECTION B–B

SCALE : 3/16" = 1'-0"



SECTION C–C

SCALE : 3/16" = 1'-0"

VOLUME OF EXISTING SHEDS = 131,000 CU. FT.
VOLUME OF PROPOSED = 221,000 CU. FT.

PROPOSED SHED MODIFICATIONS

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL ENGINEER
GEORGE REGINALD GARDNER
No. 46-034-E

INTERNATIONAL CHIMNEY CORPORATION
Engineers Contractors
Buffalo, New York

REVISIONS		Date	7–31–19
		Scale	AS NOTED
		Drawn by	RON BOUVY
		Approved by	
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		DRAWING NO. 45418	SHEET A / REV. A

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