

From Worst ESP to Best

Santee Cooper Winyah Station
Unit # 3 ESP Upgrade 2011

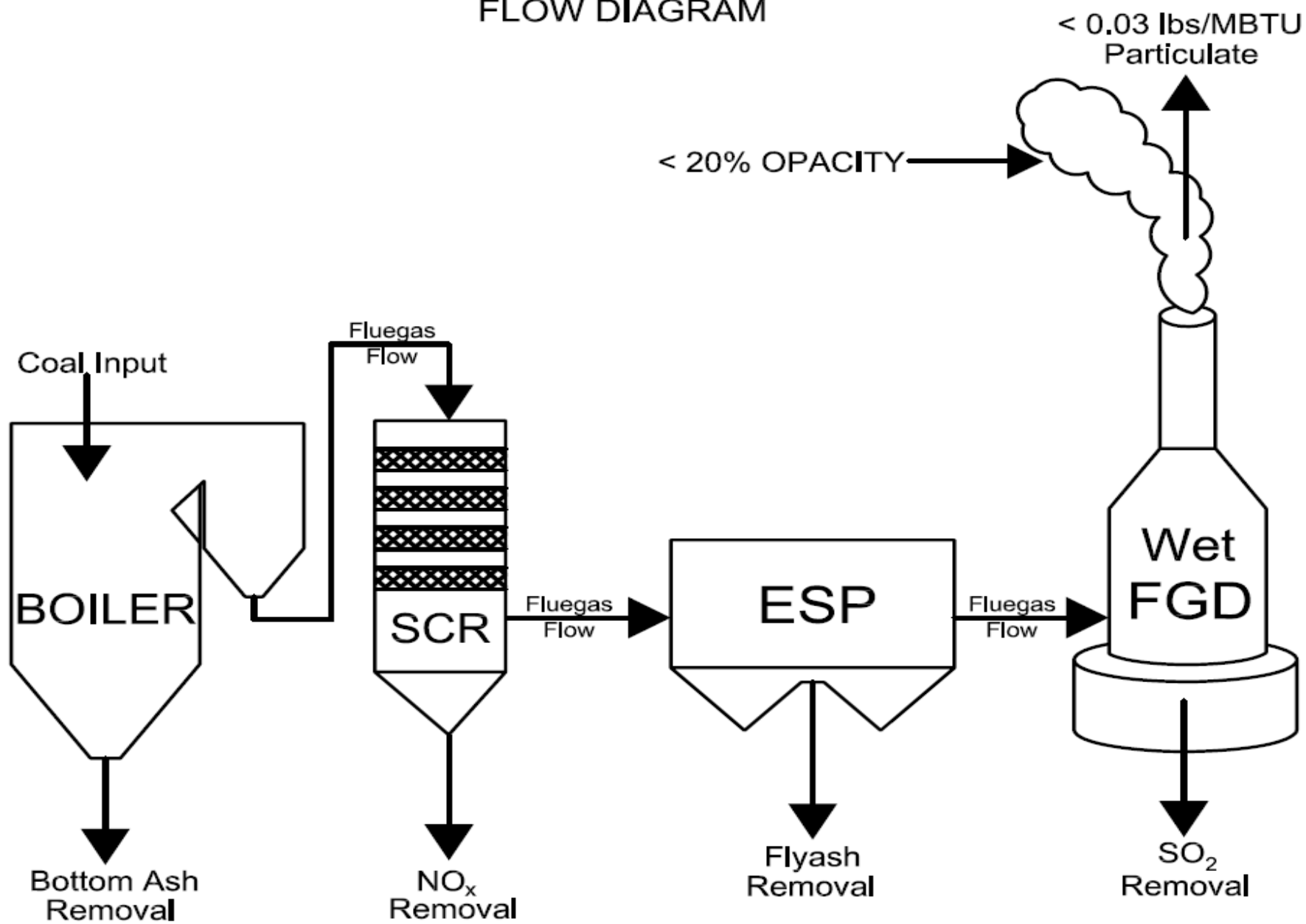
Presented by Dennis Shanahan
Director of Business development
Clyde Bergemann Power Group



Santee Cooper Winyah Unit 3 Precipitator From “Worst to Best”

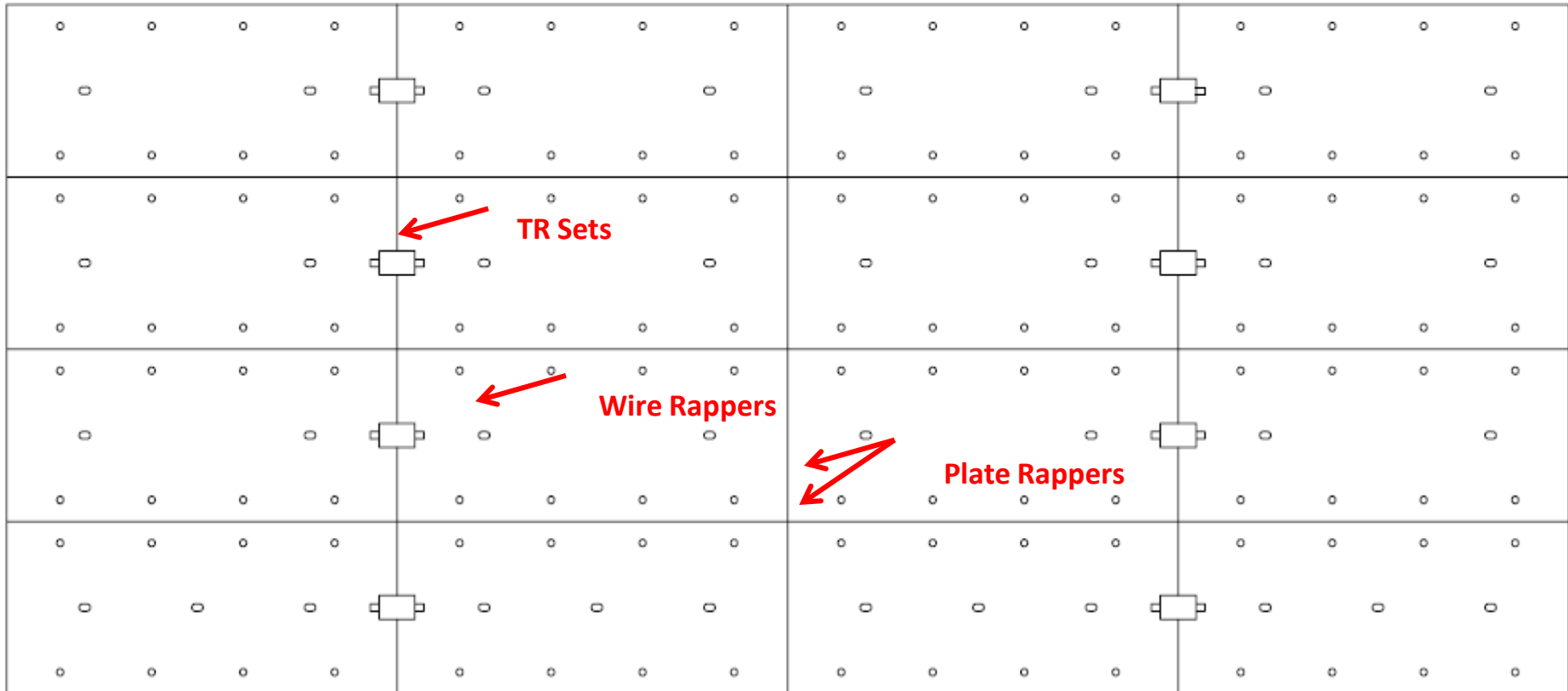
April 12, 2012

WINYAH UNIT 3 POLLUTION CONTROL EQUIPMENT FLOW DIAGRAM



WINYAH 3 PRECIPITATOR, EXISTING CONFIGURATION

03 MAR 2008

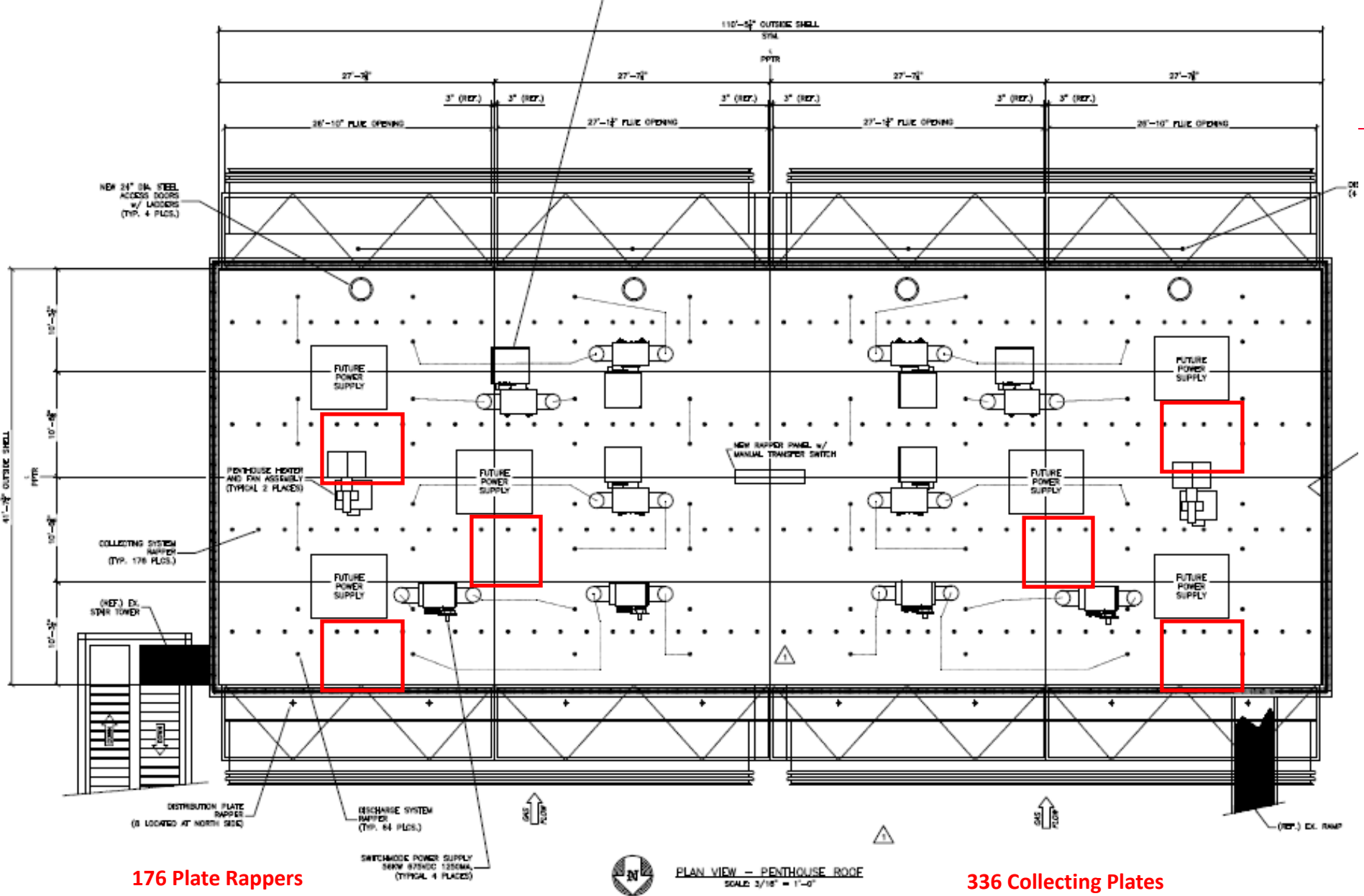


NOTES:

1. NO. OF PLATES = 576
2. SIZE OF PLATES = 30 FT x 9 FT.
3. SPACING OF PLATES = 9 IN.
4. TYPE OF DISCHARGE ELECTRODES: WIRES
5. NO. OF DE'S = 6720
6. VOLTAGE OF DE'S = 45 KV

↑
GAS FLOW

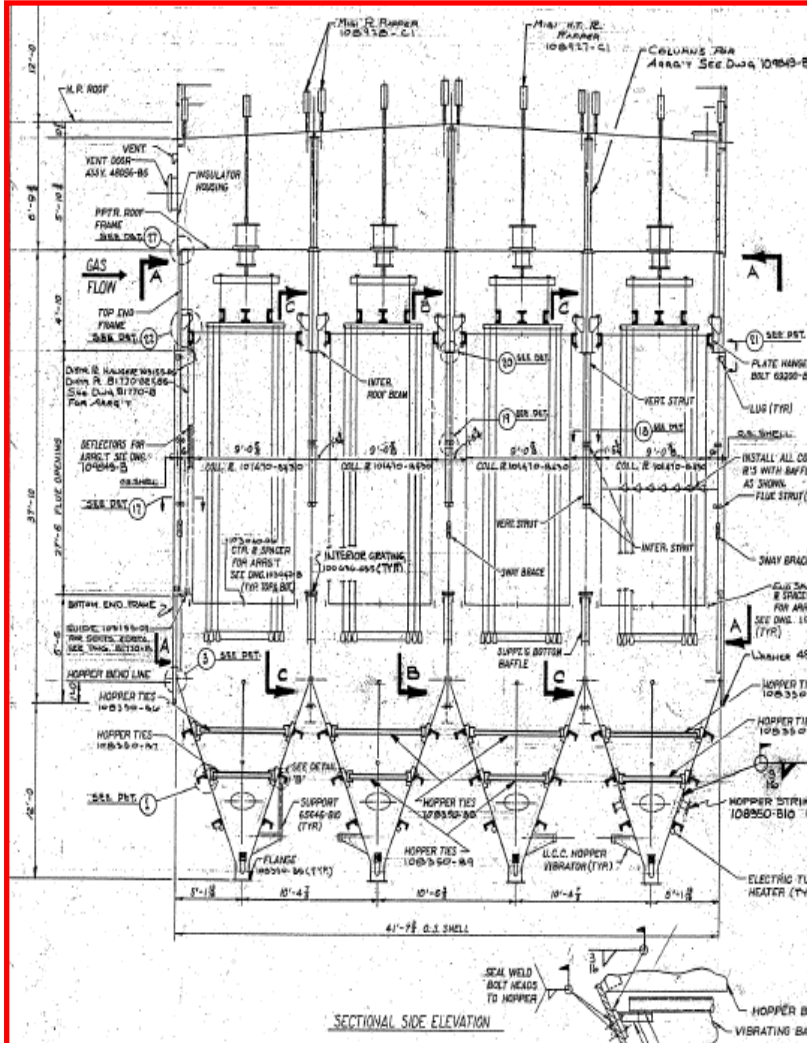
7. NO. OF T/R SETS = 8
8. MECHANICAL SECTIONS = 16 (4 WIDE x 4 DEEP)
9. ELECTRICAL SECTIONS = 8 (2 WIDE x 4 DEEP)
10. NO. OF PLATE RAPPERS = 128
11. NO. OF DE RAPPERS = 36
12. NO. OF PERF PLATE RAPPERS = 8



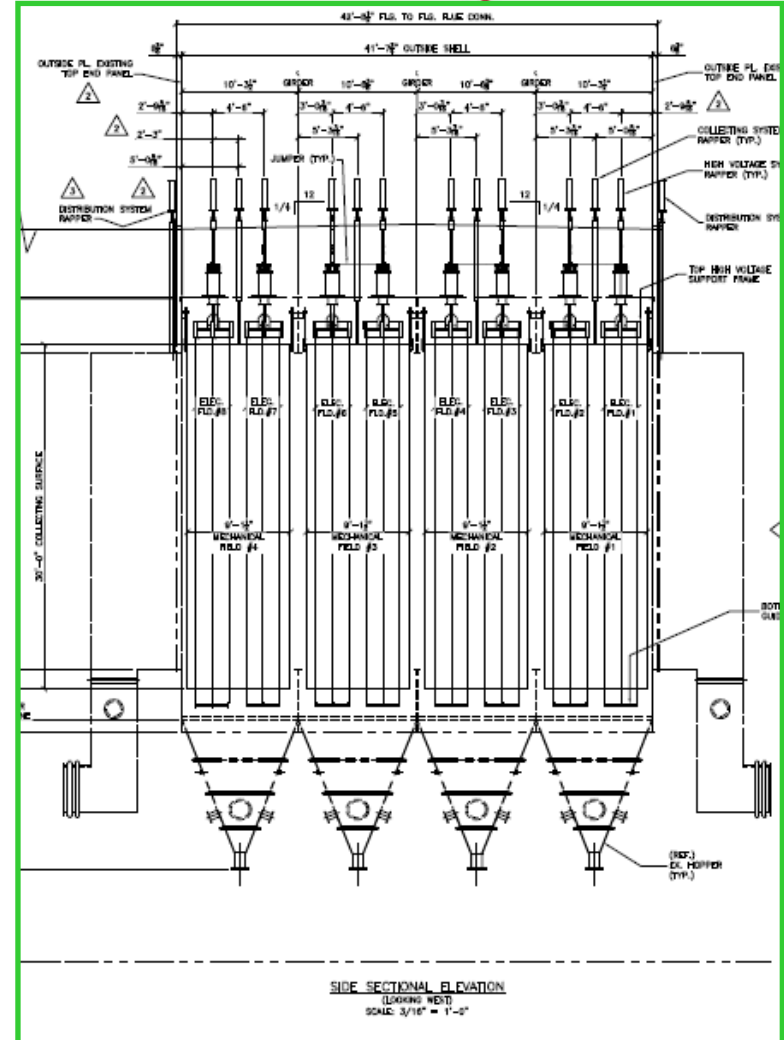
176 Plate Rappers
48 DE Rappers
83 kV DE Voltage

336 Collecting Plates
1920 RDE
15.75" Plate Spacing

Design Comparison



Original Internal Design

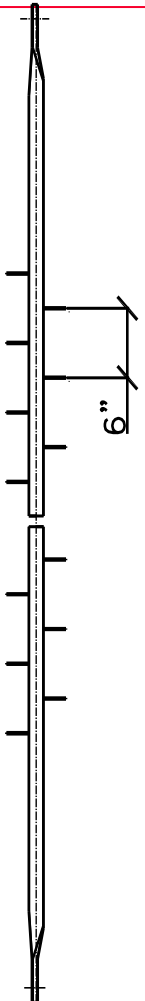


New Upgraded Internal Design

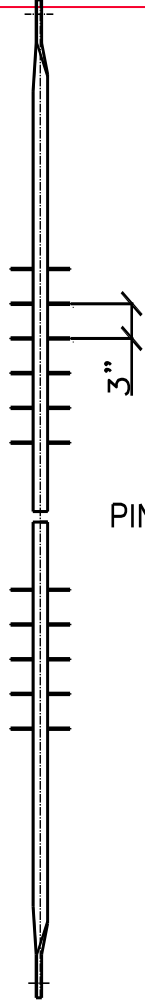
16 inch plate spacing and direct rapped collecting plates



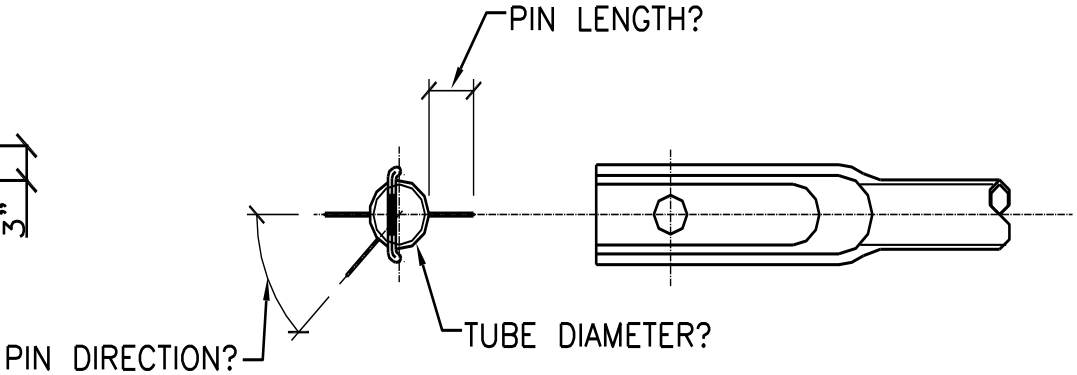
Customized Rigitrodes



STAGGERED PIN ARRANGEMENT



OPPOSED PIN ARRANGEMENT



- VARY:
- PIN LENGTH
 - DIRECTION
 - TUBE DIAMETER

Direct Rapped Collecting Plates



- Electric Single Impulse (ESI) Rapper
 - Gravity Impact Type
 - One Piece Construction
 - Stainless inserts
 - Fully Adjustable
 - Intensity
 - Cycle time
 - Up to 20 ft. lbs.
 - Multiple Rap

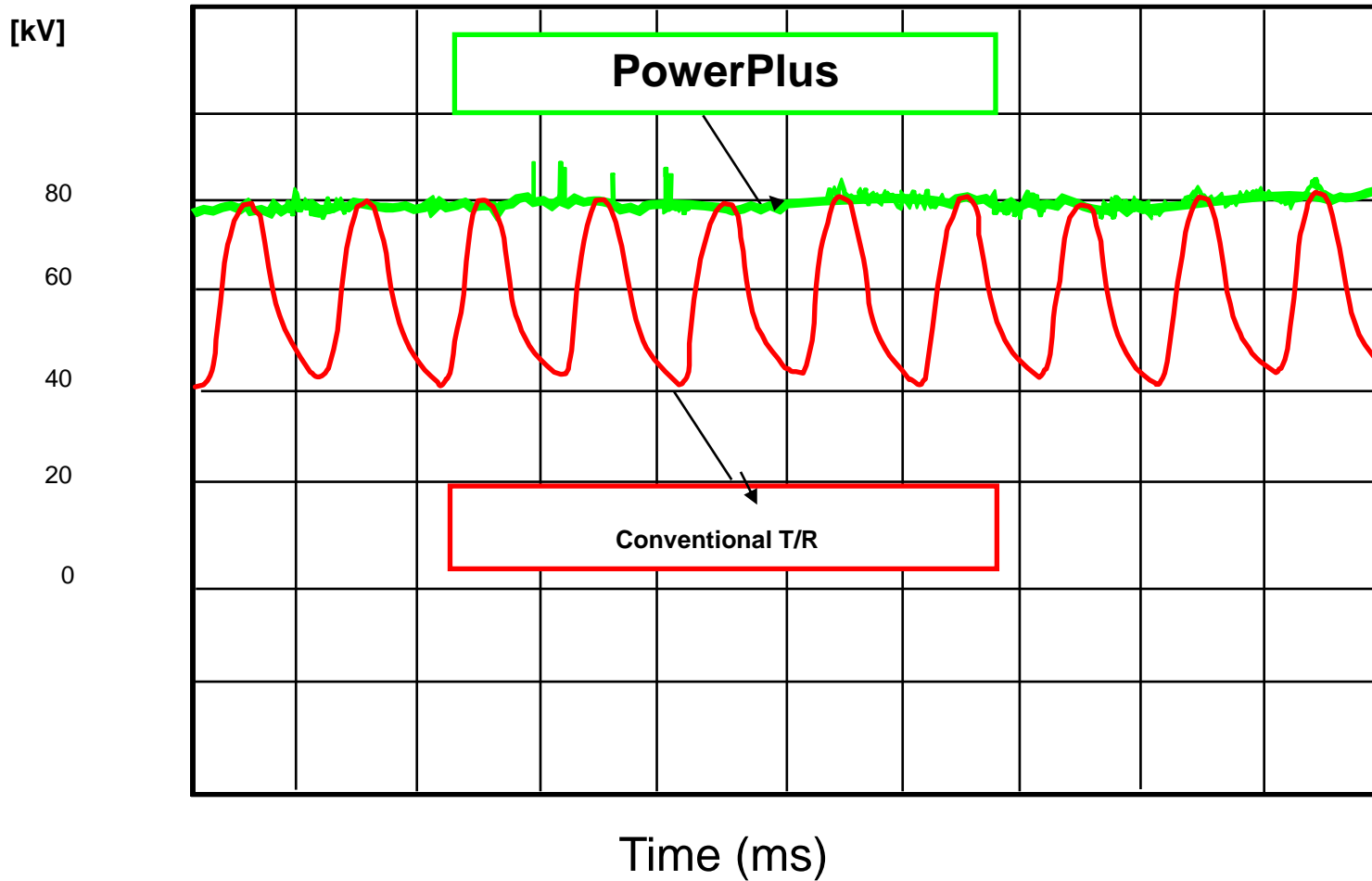


NWL Rapper Panel



NWL Power Plus High Frequency Switch Mode Power Supplies





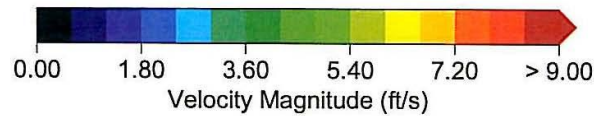
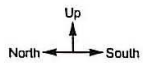
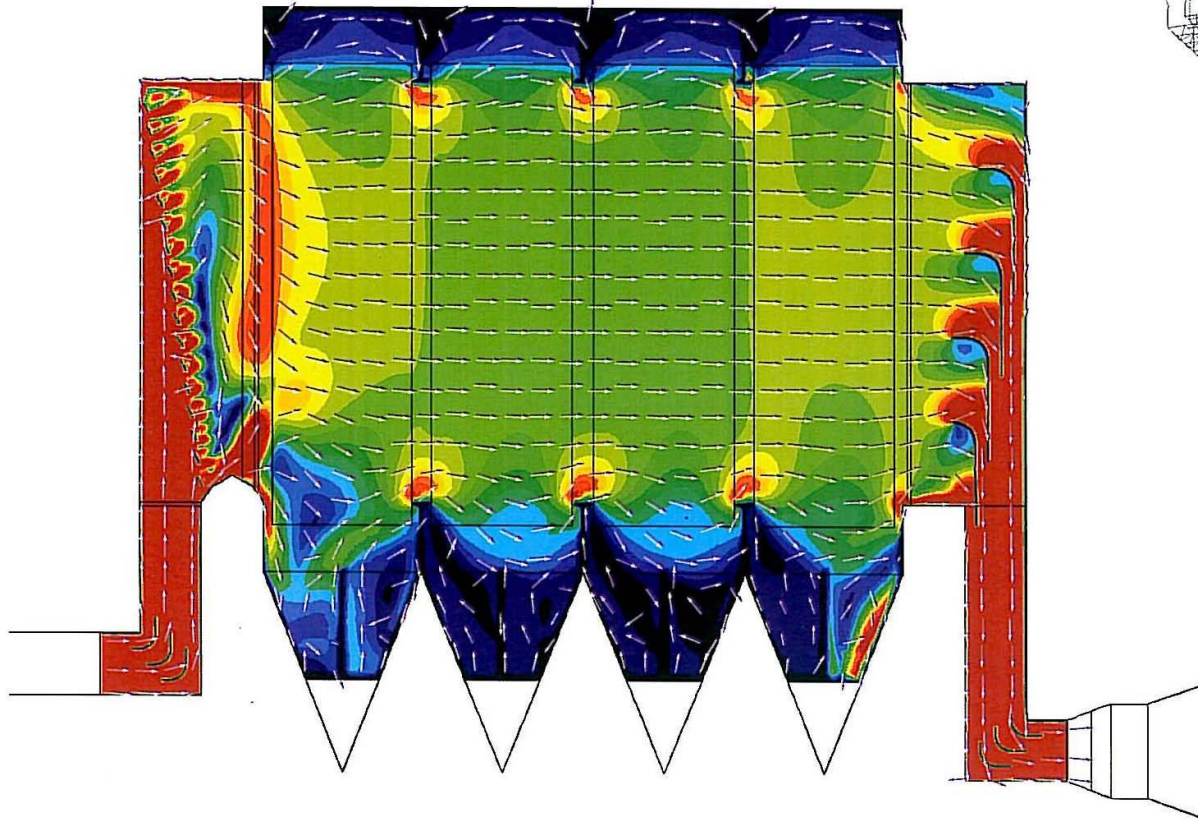
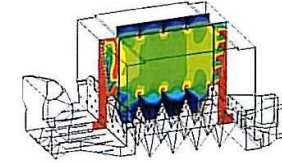
NWL PCAMS remote work station



1980 Original Air Flow Design

Baseline Results

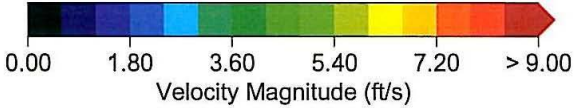
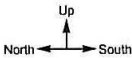
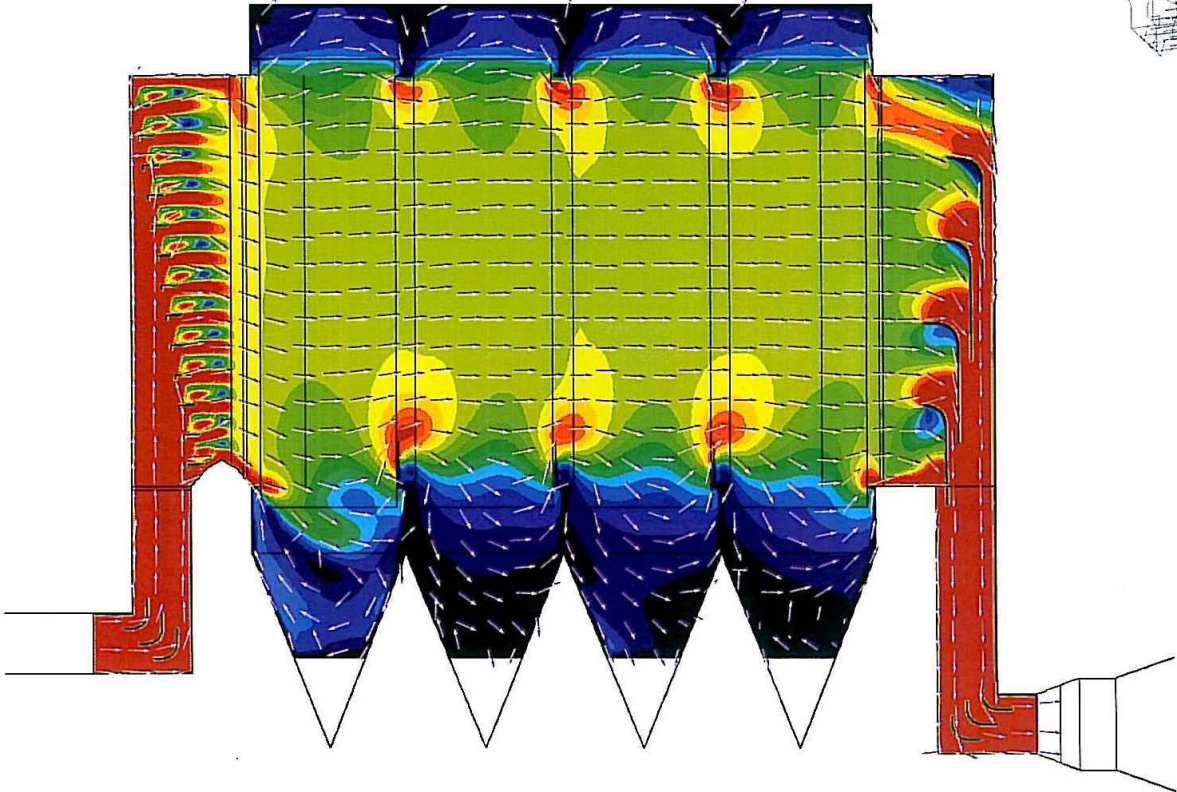
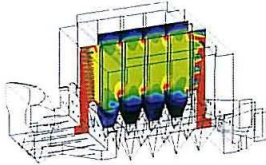
Side View: TP21



2010 Air Flow Design

Final Design Results

Side View: TP21

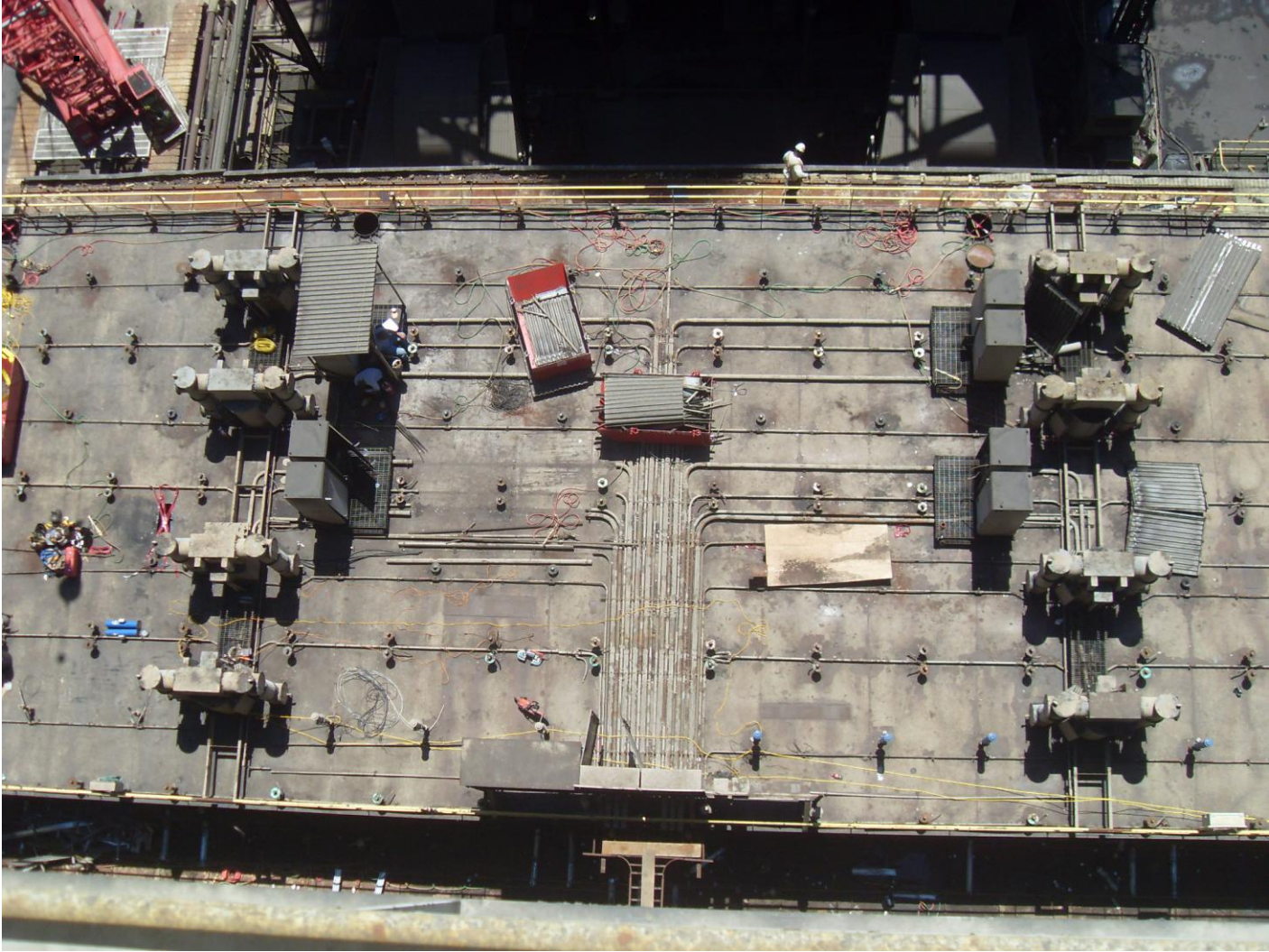


Pre Assembled Penthouse





First Day of the Outage



Demolition of Penthouse



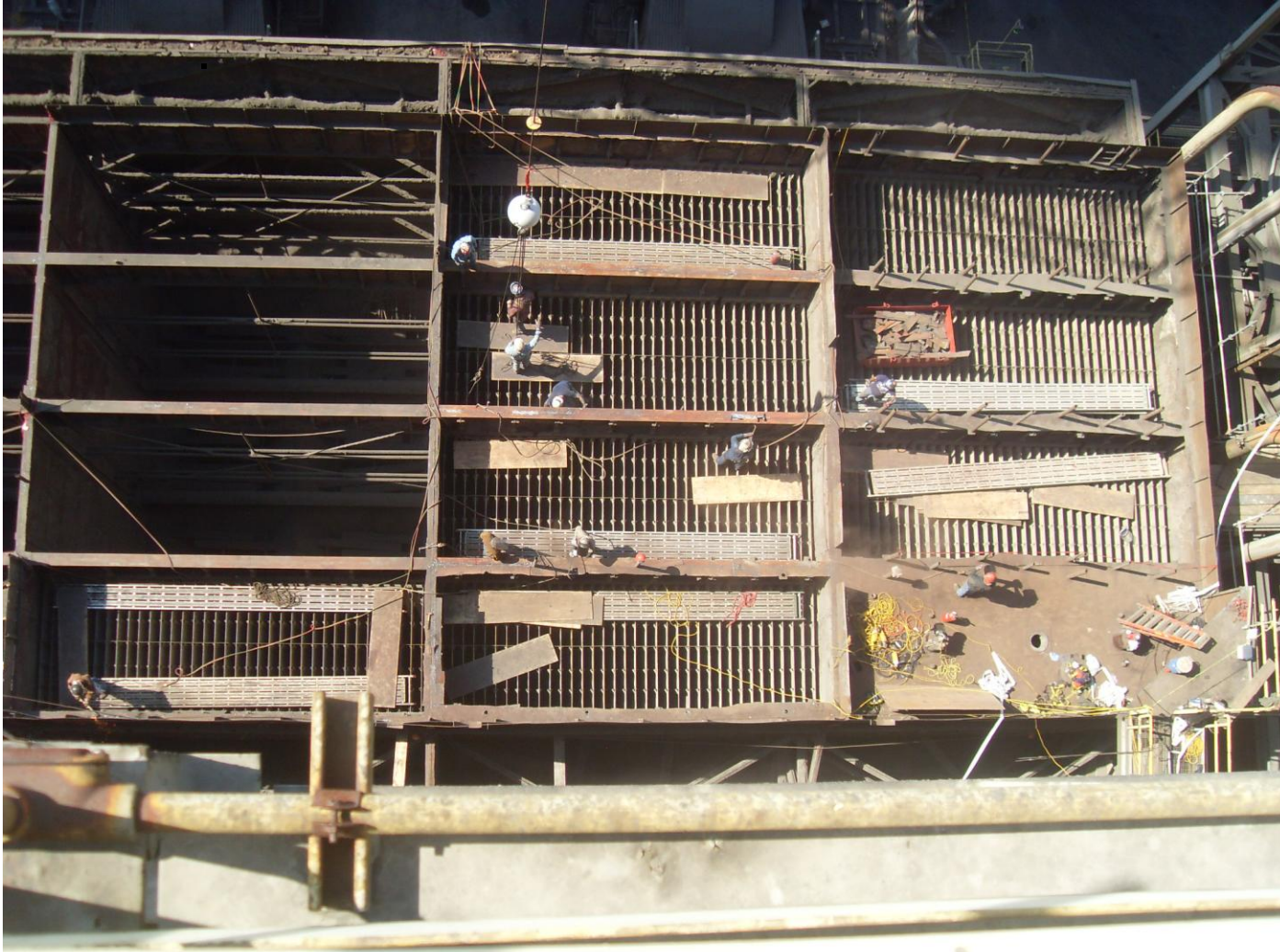
Demolition Continues



Demolition of hot roof



Demolition Nearly Complete



Day 8 Water Wash Casing Start Modifications for New Internals



April 24, 2011 – Day 8

3 Support Girders were found to be corroded and were replaced



New collecting and discharge electrode and one of three new girders



One of Three New Girder Beams Installed

Modifications completed new collecting plates being installed



Discharge electrodes being installed and final Quality Inspections of the pins



New collecting plates nearly complete and hot roof on one chamber



Model study results being installed



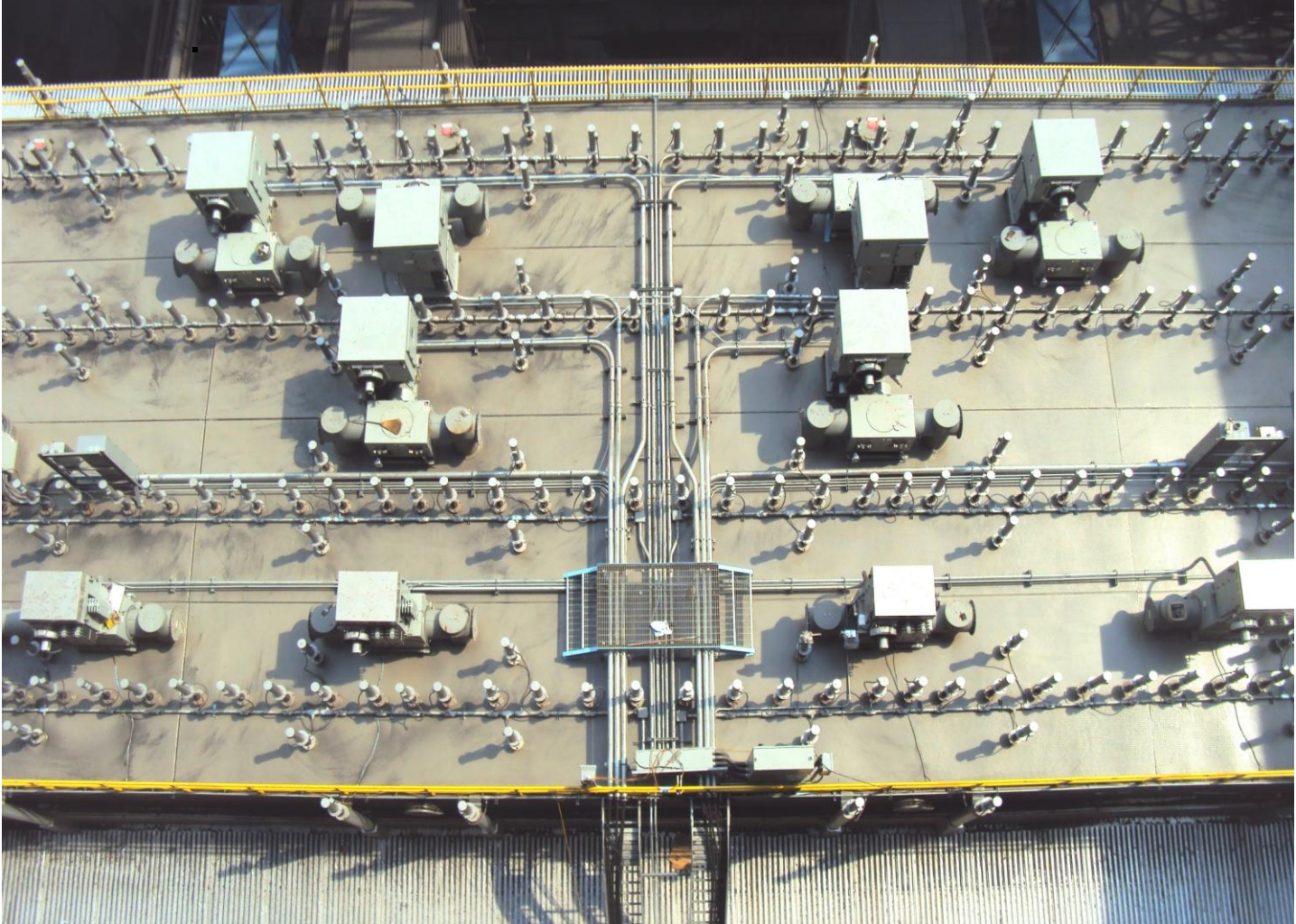
Penthouse section being lifted into place



Penthouse Completed



Completed rebuild 5 days ahead of schedule



Precipitator Test Results



| YEAR TESTED | PARTICULATE RESULTS (Lbs/MBTU) |
|-------------------------|--------------------------------|
| 2006 | 0.045* |
| 2007 | 0.058* |
| 2008 | 0.012* |
| 2009 | 0.025* |
| Post Outage Performance | 0.023** |

Permit Limit = 0.100 Lbs/MBTU
2013 CD Limit = 0.030 Lbs/MBTU

* - Indicates test samples taken from Stack CEMS level which receives additional PM removal by Wet FGD.
 ** - Indicates test samples taken from outlet of ESP.

Conclusions



- Performance guarantee for particulate was achieved
- Installation was completed 5 days ahead of schedule
- Total Organic Compounds (TOC) levels for gypsum quality are the lowest of all the units on the site. Previously to the rebuild at times it was not in acceptable ranges which is above 1250 ppm. The new TOC levels since the rebuild average 300 ppm. This indicates that a very high percentage of carbon is being removed as well as other particulate.



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