Heat Recovery Steam Generator (HRSG) Modification to increase back pressure capability and MW output

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Challenge

- Lakeland Electric (LE) McIntosh Power Plant (MPP) Unit 5 is a Siemens 501G 1x1 Combined Cycle power plant.
- The original design had a maximum allowable duct pressure for the HRSG of 28” WC. Commissioned in 2001.
- Unit 5 experienced fouling due to ammonia salts and rust accumulation in the HRSG low pressure section, that resulted in the unit not being able to achieve full load due to back pressure on the combustion turbine.
- Fouling led to a derate of 15 MWs. The plant was cycling often.

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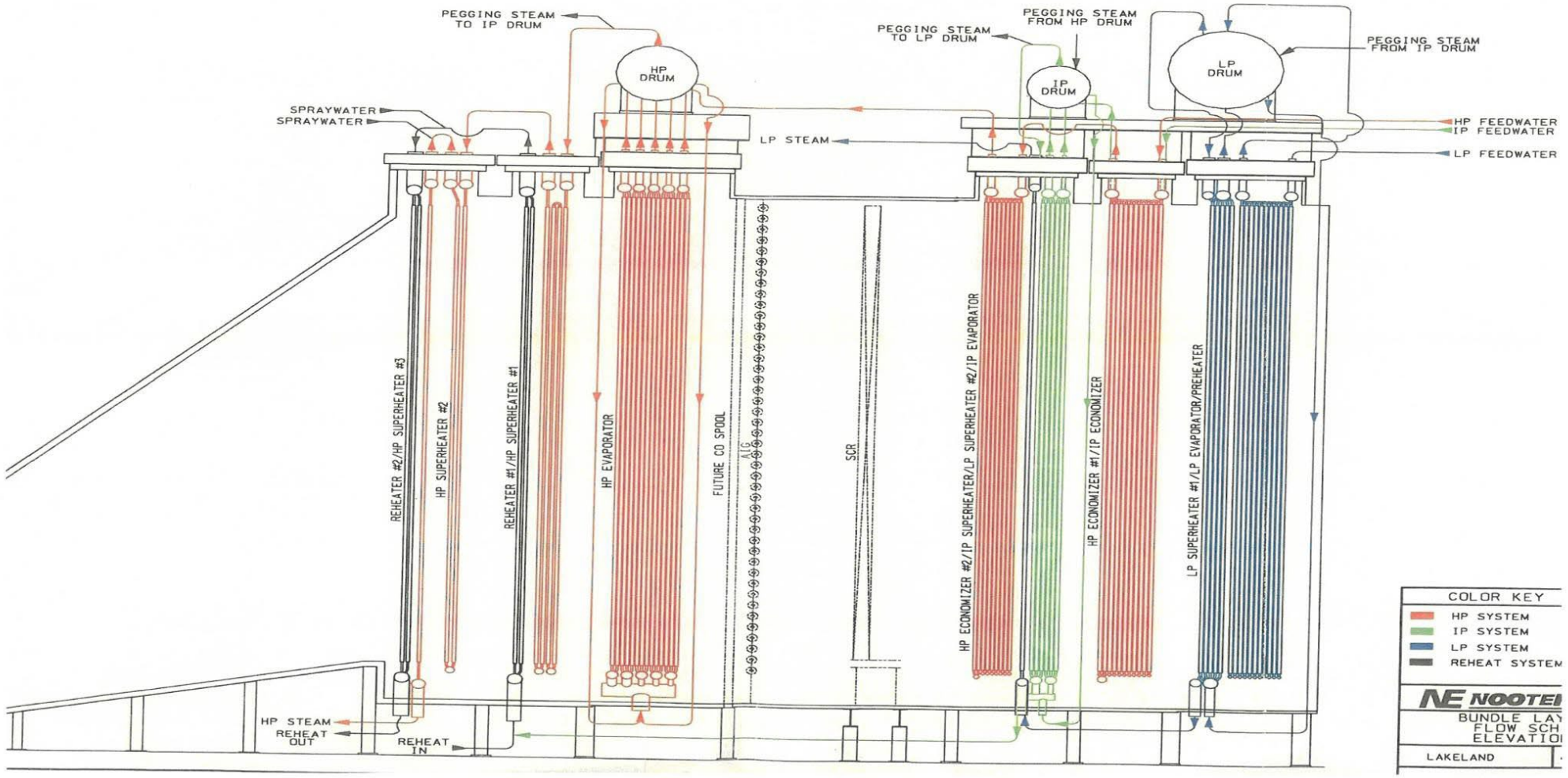
Unit 5 HRSG – Pressure Sections



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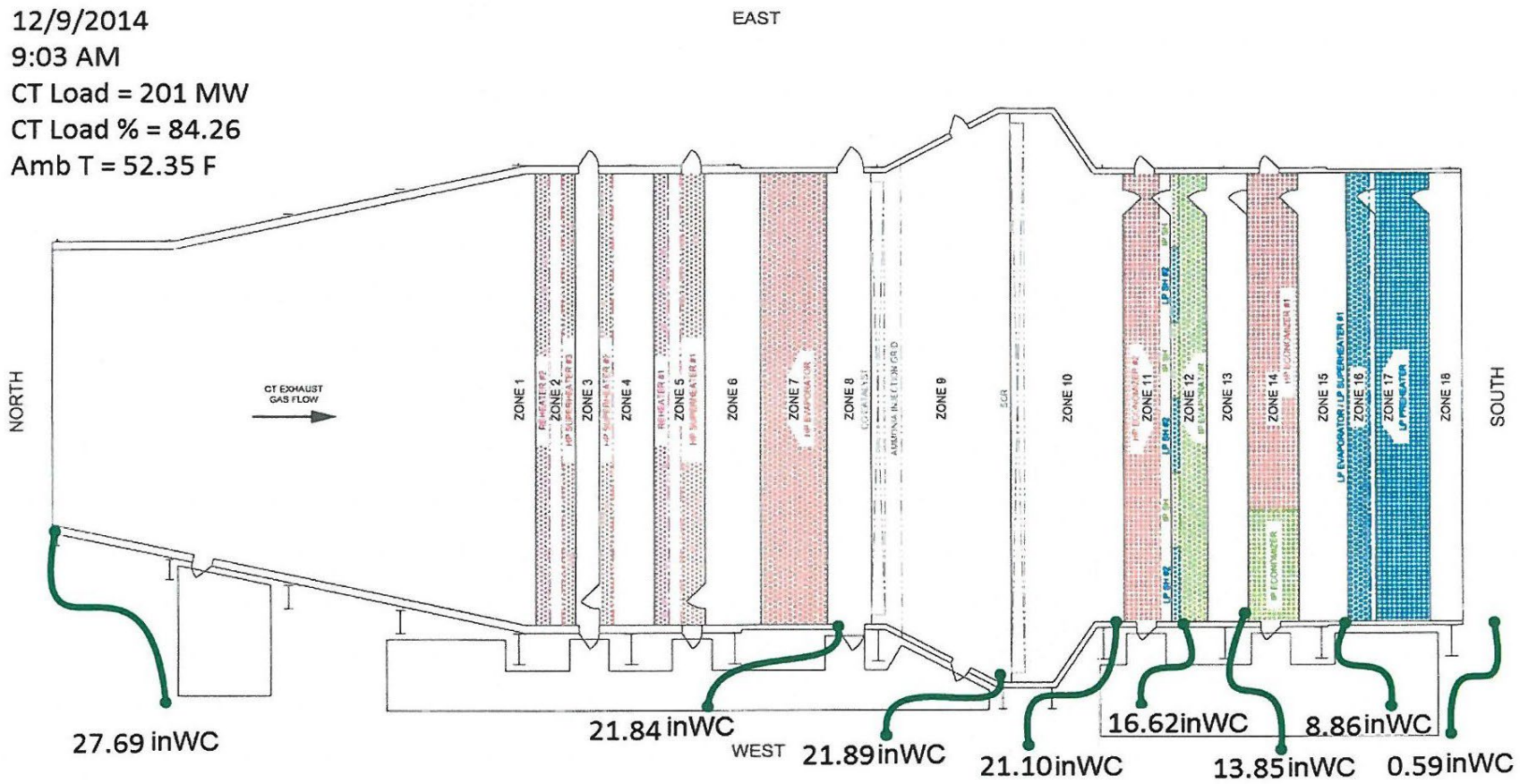
Unit 5 HRSG – Backpressure Measurements

12/9/2014
9:03 AM
CT Load = 201 MW
CT Load % = 84.26
Amb T = 52.35 F



11/16/15
27.08

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Mitigation Steps

- We performed various cleaning methods.
  - Dry Ice, CO_2
  - High Pressure, High Volume Air
  - Tube Spreading
  - Pressure wave cleaning, GE/Alstrom
- Installed Sonic Horns
- Tried vibrators on the lower headers
- Installed dehumidifiers on the CT inlet and low-pressure section of the HRSG.

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Mitigation Steps

- In 2008 we completed modifications adding 30 stiffeners to two top sections (between columns) and two bottom sections to allow duct pressure to be raised from 28” to 30” WC.
- Alarm point reset from 26” to 28” WC.
- The runback SP for the CT was changed from 28” to 30” WC
- Running at the new alarm point of 28” WC, Unit 5 had a load output increase of 15 MW’s, temporarily eliminating the derate.

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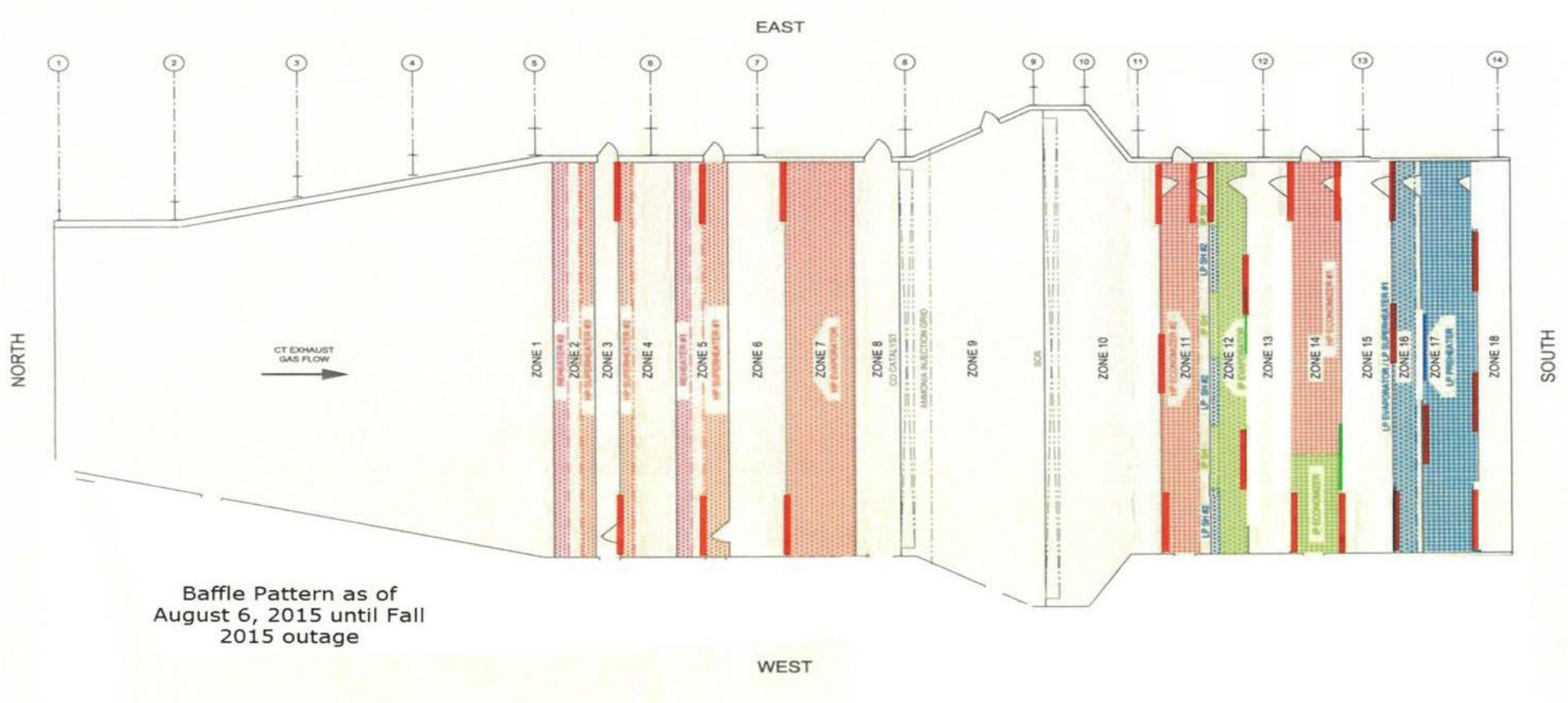
Mitigation Steps

- Due to continued increases in back pressure, we started removing lower baffle plates in the LP & IP sections.
- Adjusted parameters for ammonia control and distribution.
- Raised the temperature control on the economizer recirc. pump to keep the temperature above the acid dew point.

Baffle Removal Map



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Mitigation Steps

- By 2016, the backpressure had continued to rise due to fouling.
- In 2016 we commissioned Nooter Eriksen with the goal of increasing the duct pressure rating from 30” to 45”.
- 2017 outage modifications added 607 stiffener plates to 7 sections of each side, 11 sections of the roof and 12 sections of the floor.
- This was done to prevent the duct pressure from being a limiting. factor. We also upgraded expansion joints to 45”.
- We had field assistance from Nooter Eriksen. Contact: Paul Gremaud: pgremaud@ne.com, 636-651-1400.

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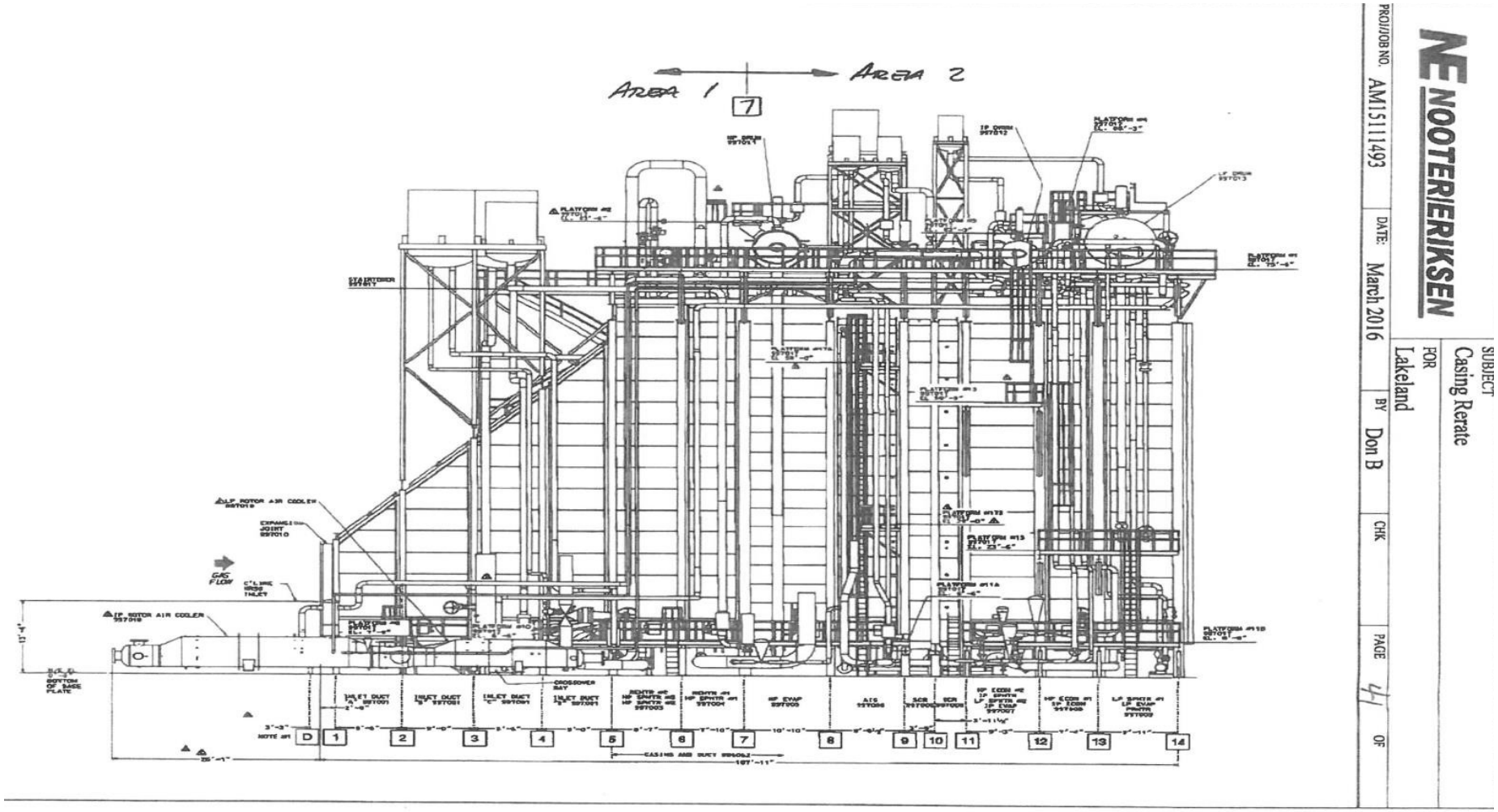
NE Casing Study Divided HRSG Into Area 1/HP, Area 2/IP&LP



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NE Casing Study – Roof Casing Stiffeners

NE NOOTER/ERIKSEN

SUBJECT: Casing Rerate

FOR: Lakeland

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AM15111493	March 2016	Don B			

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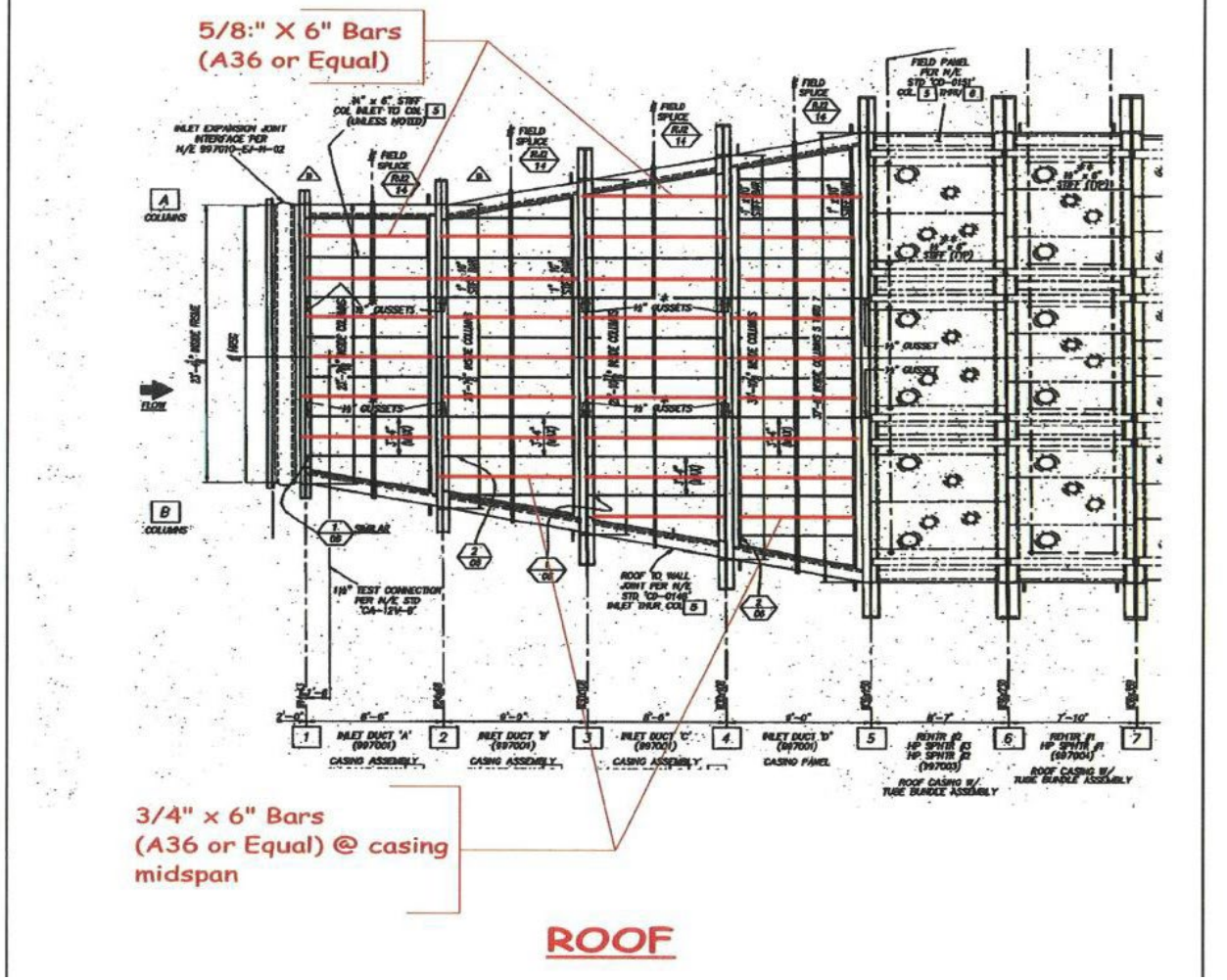

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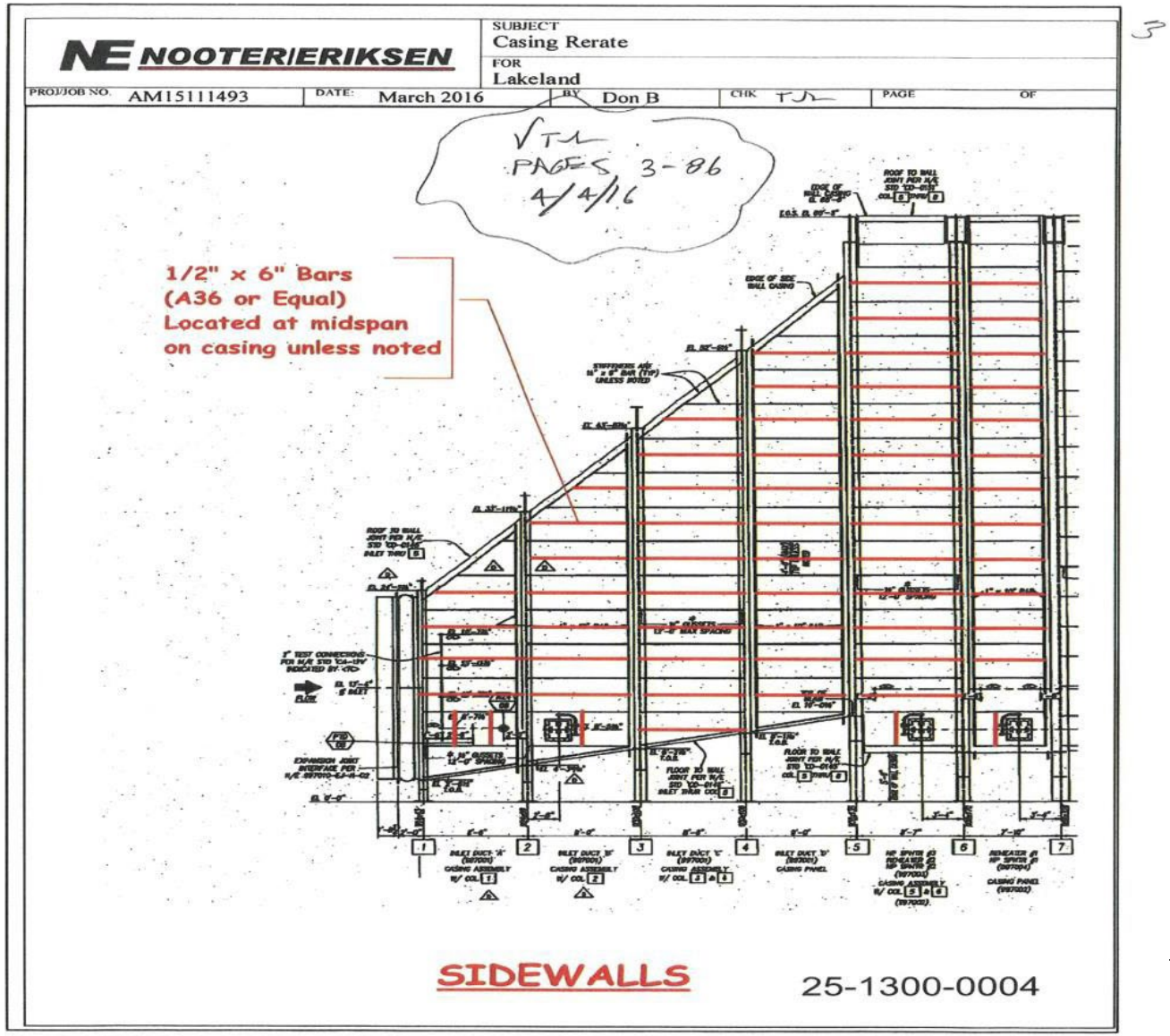
NE Casing Study – Sidewall Casing Stiffeners



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NE Casing Study – Floor Casing Stiffeners

NOOTER/ERIKSEN

SUBJECT: Casing Rerate

FOR: Lakeland

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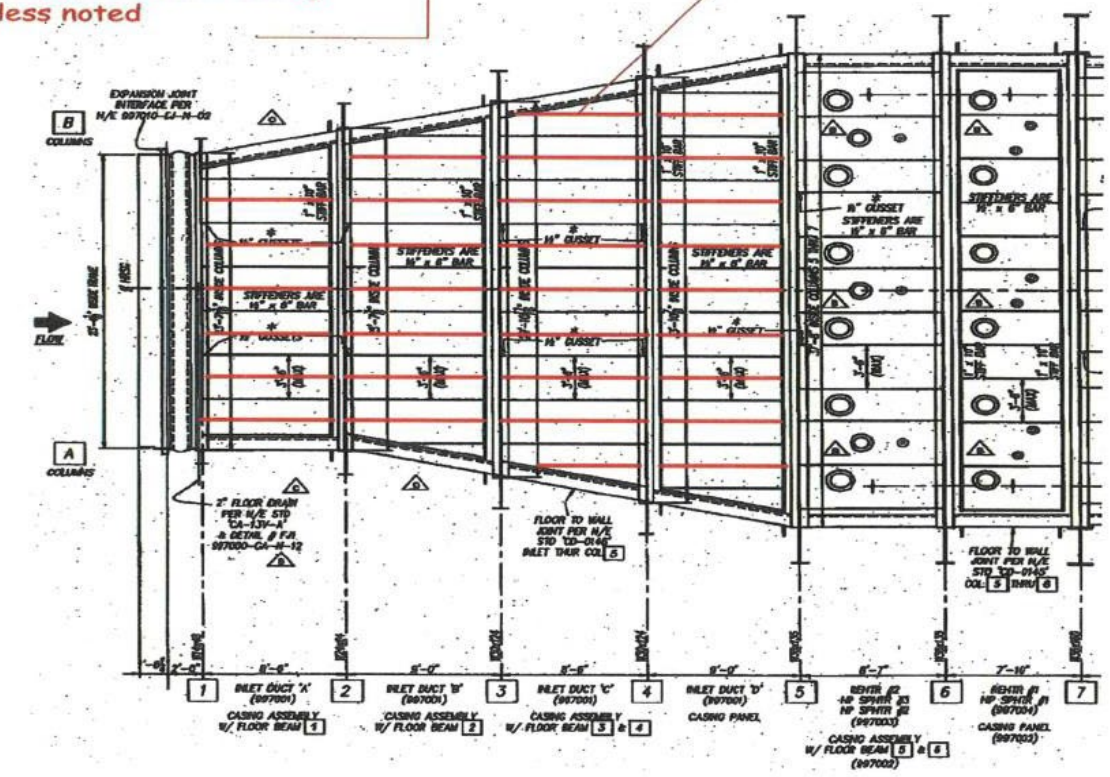
1/2" x 6" Bars (A36 or Equal)
At midspan on the casing
unless noted



FLOOR

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Last Major Steps

- In 2020, we replaced the LP economizer (pre-heater) along with the LP superheater #1 and the LP evaporator bundles. In addition to the back pressure issues, we also had tube leaks. The LP Economizer went from 11 tube rows to 15 smaller diameter tube rows. This gave us a 20” cleaning lane between the LP economizer and the LP Evaporator/SH1.

- Replaced the SCR catalyst.

- Re-installed all baffle plates as original design.

- Performed pressure wave cleaning on the IP sections (Area 2).

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Unit 5 HRSG

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Unit 5 HRSG – Casing Stiffeners

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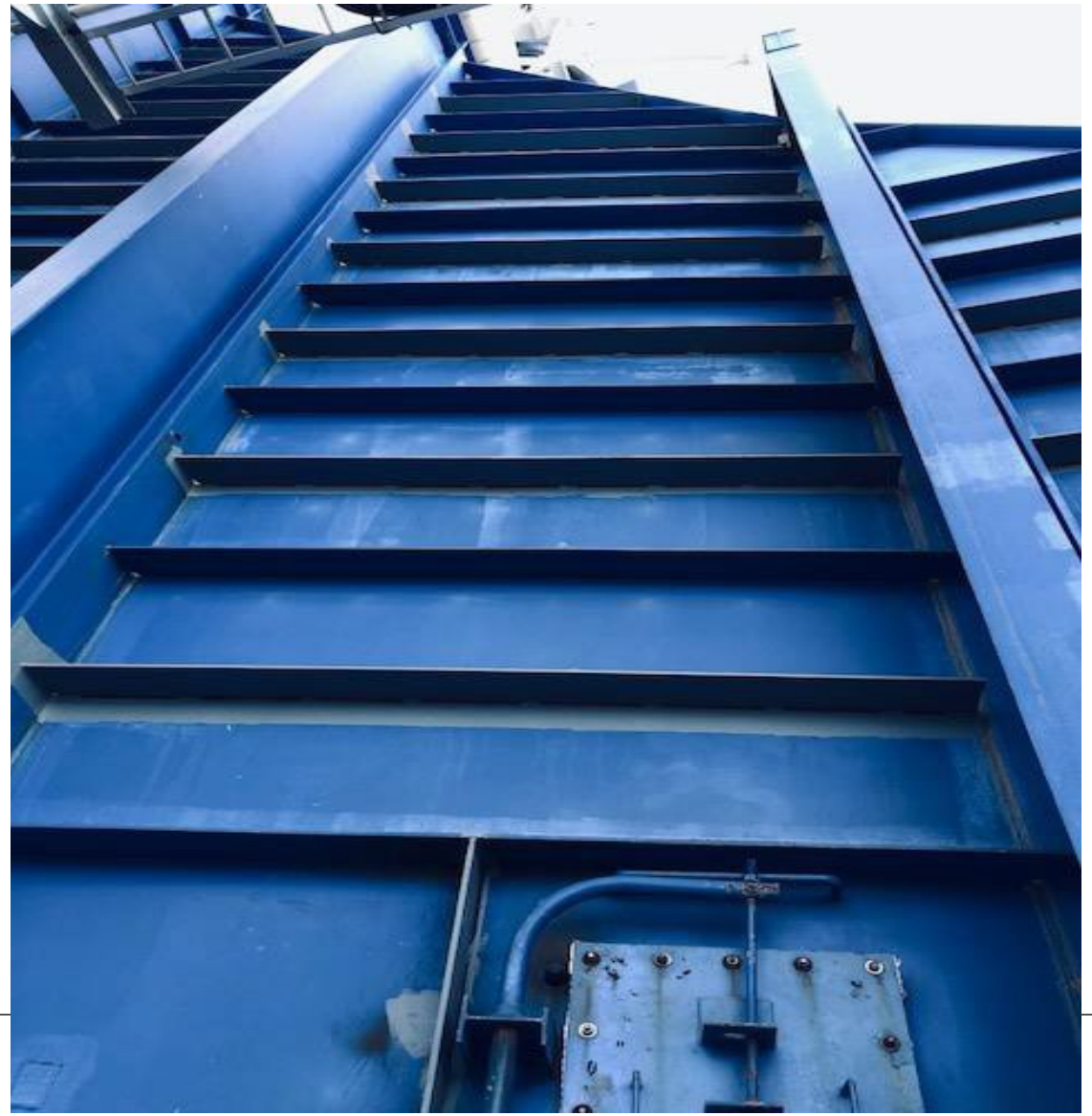
Unit 5 HRSG – Casing Stiffeners



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Unit 5 HRSG – Casing Stiffeners

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Questions?