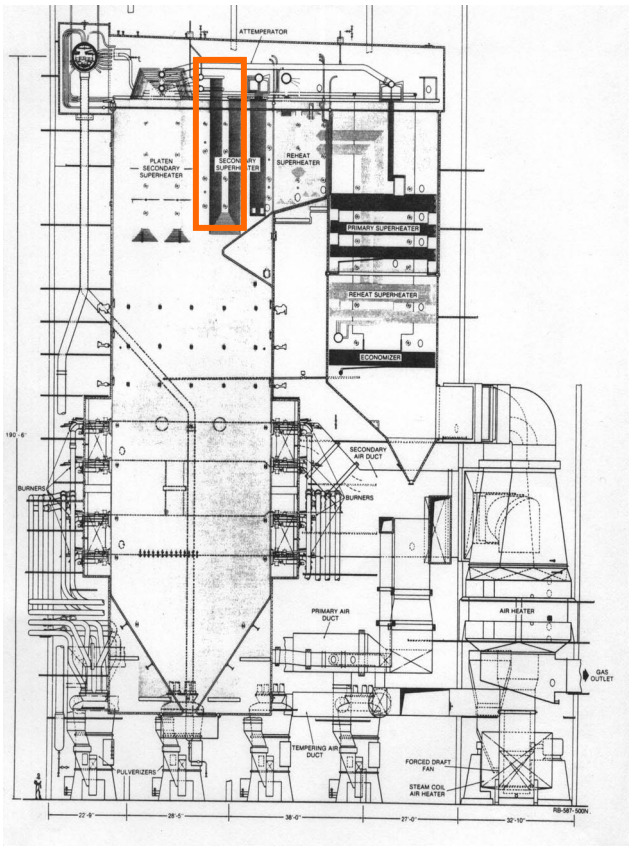
CHICAGO TUBE & IRON

REDESIGN OF A PENDANT SECONDARY SUPERHEATER

Feb. 12, 2004 Rev. Feb. 18, 2004



City of Lakeland, CD McIntosh Plant - Unit No. 3
Lakeland, FL

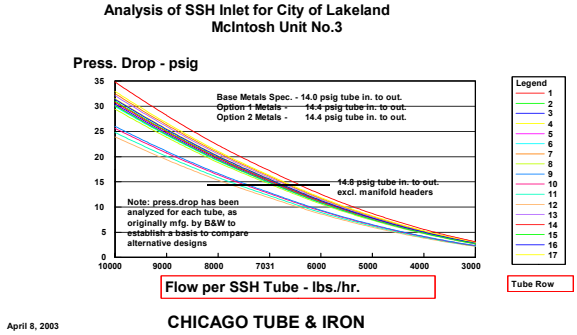
Commercial Operation	1982
Electrical Generation	364 MWe
Main Steam Flow lbs./hr.	2,510,000
SH Outlet Pressure	2640 psig
SH/RH Steam Temp.	1005/1005 F
Type of Firing	Balanced Draft PC
Boiler Manufacturer	Babcock & Wilcox

Although this is a fairly new unit, the City of Lakeland has been experiencing significant tube wastage in the secondary (SSH) inlet bank, due to fluid ash corrosion. As some quantities of municipal solid waste (MSW) were co-fired with coal, one possible explanation for this wastage is a chloride ion attack in addition to the more typical coal-ash corrosion. Other significant problems have involved failures of the penthouse seals at the tube penetrations through the roof, as well as failures of tube-to-tube ties in the lower elevations of the bank.

Both Storm Engineering & Associates and TJR Technical were contracted by the City of Lakeland to provide an independent analysis of these issues, and develop the specifications for the re-design. Part of their conclusions resulted in revisions to the design of the high crown seals. The final specification also called for an upgrade of the alloys from T12, T22 and TP304H to all T22 and TP-304H, and defined the tube OD, thickness and location of each alloy.

In order to fully comply with the intent of the specification, our engineers prepared an extensive pressure drop and flow analysis of the original design, the specified design, as well as a variety of alternative designs. As can be seen in the graph below, the original B&W design had a predicted flow variation greater than 2 to 1, between the leading edge tube and the inner flow paths. These flow variations tended to be exacerbated when the specified designs were analyzed. Our flow models indicated that flow reductions for the leading edge tubes would be experienced, while zones of lower heat absorption would see higher than normal steam flows.

To correct this situation led us to propose an alternate series of metal selections, using increased quantities and thicknesses of TP304H for the lower return loops and the majority of the upflow rows, while 2 different thicknesses of T22 tubes were used for the downflow inlet rows, as well as the interior flow paths in the outlet rows. This yielded a more balanced flow pattern, while still upgrading the materials where problems had occurred. This approach also assured that stress values were conservative and well within ASME Code allowables.



ONE CHICAGO TUBE DRIVE ROMEOVILLE, IL 60446 815/834-2500 FAX 815/588-3961
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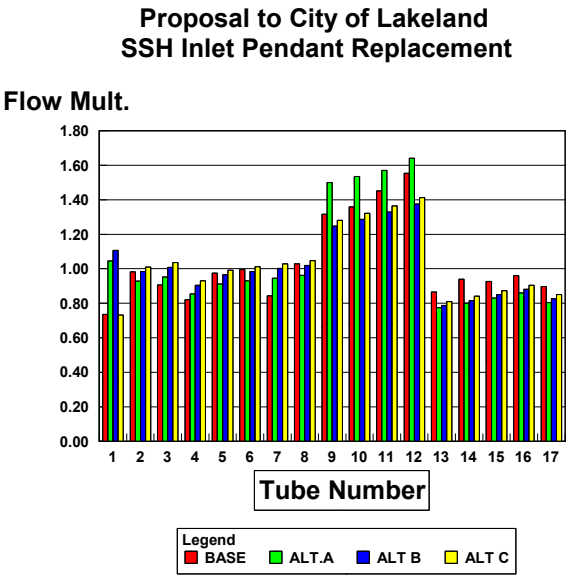
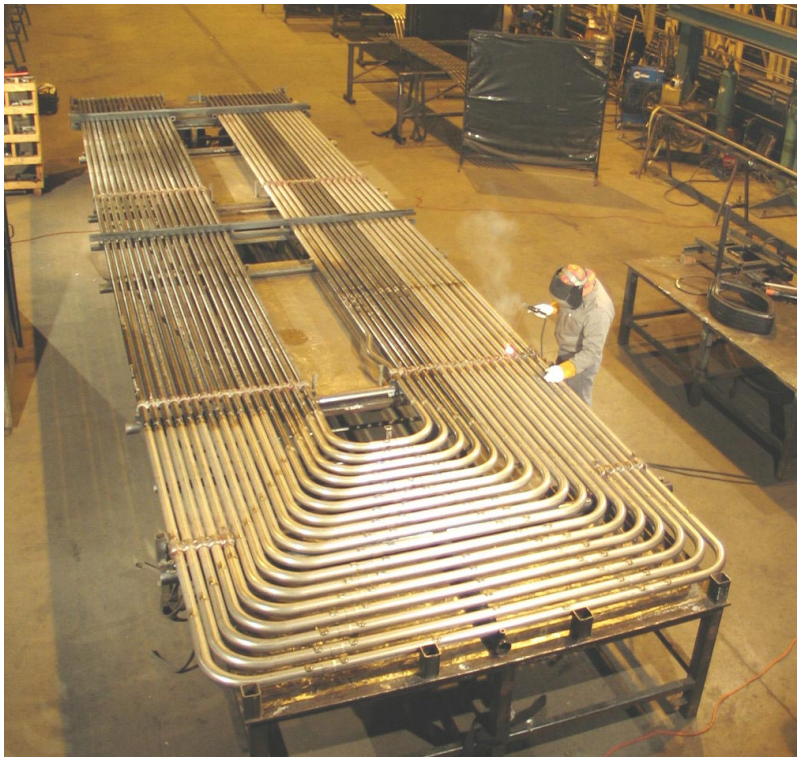


Following contract award, the design was optimized and details were finalized. This resulted in selecting Alternate C, which is shown in the adjacent graph.

Ultimately, superheat steam flow was balanced and proper metal temperatures attained without the use of orifices for adjustment. This helps to avoid future maintenance and operational problems, due to future wear and erosion on the orifice plates…leading to changes in flow and temperature patterns.

To resolve the tube tie breakage problems, we decided to employ multiple levels of split-ring (handcuff) style of castings. The upper levels were manufactured using inconel 600. The lowest level, which is exposed to the highest gas temperatures, were produced using a proprietary material, "SuperTherm (ST)". ST also uses a colbalt-based alloy with allowable temperatures in the 2100 F to 2500 F range.



Fabrication was completed and materials began shipping to the jobsite in January, 2004. This unit is scheduled to go back on-line, during the Spring of 2004.

While final operating results are not yet available, this project helps to demonstrate the degree to which Chicago Tube & Iron personnel work with our customers to find and implement unique solutions to their O&M (operating & maintenance) needs.

In the process, we have also helped to reduce the overall project cost for the City of Lakeland.

What can we help you accomplish at your power plant?

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