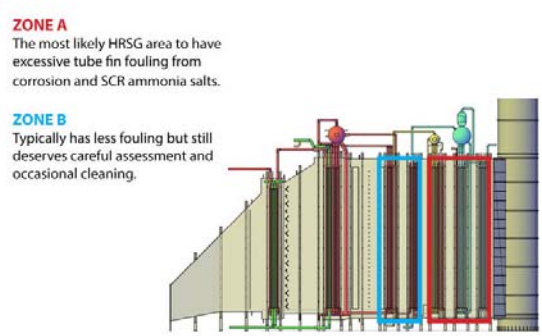
Improve HRSG performance and boost the bottom line

By Patrick Walker, HRST Inc. | Posted: Tuesday, August 11, 2015 10:14 am

Heat Recovery Steam Generator (HRSG) performance loss is usually very gradual and not picked up when comparing over a year-to-year basis. However when looking at data from earlier operational periods, say 5-6 years prior, the performance loss practically jumps out of the screen. Just think about all of the money left on the table by letting these seemingly small losses continue to snowball and steal from the bottom line.



HRSG zones

One of HRST Inc.'s clients was preparing for a new power supply contract with an emphasis on efficiency and output. The HRSGs onsite were approaching 20 years of service and the overall performance had taken a hit during that time. With so many potential problem areas, the plant wanted to know where to spend its money to get the best "bang for the buck."

HRST created a thermal model of the client's HRSGs using its proprietary software. The thermal model was validated by matching the OEM design case. The plant supplied current operational data for each of its units to act as a baseline of current performance. These values were compared against the OEM design case. This approach would identify sections within the HRSGs that were underperforming compared to design. Once the worst offending sections were identified, possible restorative actions were evaluated.

The initial thermal model showed a decrease in performance across both HRSGs, especially in the cooler sections. Past HRSG inspections indicated the presence of external tube fin fouling downstream of the HP evaporator panels, and frequent pressure part leaks in the cold end led to increased corrosion in these areas.

HRSG gas side cleaning had been discussed in the past, so it wasn't a surprise when the recommendation to clean was delivered. The problem with these HRSGs was the lack of gas side back pressure measurement equipment. In preparation for the upcoming cleaning, the plant installed several magnehelic gauges throughout the units where gas side pressure drop information was collected during typical loads. The areas selected to clean were based on the results from the thermal model, the back pressure data collected, and several years of HRSG inspection photos that confirmed visible fouling present in the areas in question.

The HRSG gas side cleaning work was performed using Precision IceBlast Corp. (PIC) from Wisconsin. Depending on the number of tube rows present in each of the bundles being cleaned, traditional surface blasting or tube spreading and deep cleaning were performed with assistance of HRST.

Upon completion of the outage work, the plant supplied DCS data that was reevaluated using the existing thermal model. An increase in performance was noted for the sections that were cleaned.

Overall, gas side ΔP was reduced by 2" W.C., and an average of 14 tons of debris were removed from each unit. Using GE predicted performance correlations for a GE7EA, each inch of back pressure recovered equates to an output increase of 0.105 percent and a heat rate decrease of 0.105 percent. Assuming the 7EA ISO rating is 85 MW per turbine, the net gain is: 85 x 0.21% = 0.1785MW per turbine.

The steam turbine was modeled using before and after cleaning data adjusted to design conditions for comparison. The overall output was increased by 1.3 percent (or 1.1MW). The gas and steam turbines benefited from increased efficiencies as a result of this gas side tube fin cleaning.

The total performance boost from gas side cleaning included:

• Steam turbine performance = 1.1 MW between both HRSGs at design case conditions

• Combustion turbine performance = 0.1785 MW per CT at full load

• Total 2 x 1 output boost = 1.457 MW

Assuming the plant sells power for $50/MW-HR and runs at full load for half of the year (4,380 hours), calculated savings exceed $319,000. The results identify quantifiable values that can be used to evaluate ROI depending on operation.

The plant was able to use thermal modeling to identify areas of the HRSG that were underperforming. Data acquisition was used to confirm elevated pressure drops across tube bundles that were underperforming. Photos of the sections over several years were used to confirm the presence of tube fin fouling. These items were jointly used to direct the HRSG gas side cleaning efforts. Once completed, the plant was able to use the thermal model to show gains in performance that were results from the work performed. These results were used to calculate R.O.I and justified the overall project.

Patrick Walker is a systems engineer for HRST Inc. and the HRSG Cleaning Department manager. He has a bachelor's degree in mechanical engineering from the University of South Florida. You may contact him by emailing editorial@woodwardbizmedia.com.