New Technologies in Energy Sector Case Study

ADVANCED BOILERS AT TUCSON MEDICAL CENTER

By Chuck Vaugh[1]

In 1998 the Tucson Medical Center initiated a project to replace its old steam boiler system. The Center's technical staff conducted a nation-wide search for the most innovative and best performing technology eventually finding it in its own neighborhood.

Tucson Medical Center (TMC) is a community hospital with 673 licensed acute and psychiatric beds and 90 bassinets, serving the Tucson metropolitan area, Southern Arizona and northern Sonora, Mexico including the US Air Force base in Tucson with over 6,500 aircraft. It is situated on 300 acres in the heart of Tucson and consists of over 1 million ft2 of single-story construction, making it the largest single-story hospital in the US. TMC operates with lowest cost per area. Heating, cooling and steam utilities are distributed from a central plant. Electrical and gas utility consumption occurs primarily in the central plant. TMC Plant Services Department is constantly looking for opportunities to reduce operating expenses by limiting energy costs and optimising energy use. TMC was in the process of engineering and budgeting for replacement of two 600HP steam boilers installed in 1978 and decided to partner with a local group maintaining a relationship with an overseas group disposing with advanced boiler technology called Warga boiler (www.wargaboiler.com) and facilities for ASME boiler manufacturing and testing. The partnership was solidified and the boiler replacement project was initiated in 1998. TMC was to provide installation, engineering and construction oversight, and said group was to provide three new steam boilers that would be the first of their kind installed with serial numbers 001, 002 and 003. In December 1998 TMC representatives ran an impressive factory test firing overseas. March, June and November of 1999, saw the start up of the very first three 400HP fire-tube steam boilers providing 120-psi steam for use in the central plant and throughout the hospital. All issues were successfully addressed as the project progressed through design, construction and commissioning. The parties involved with the project expected many differing benefits. Success of the project would be determined by attaining 15% improvement (10 percentage points) in boiler seasonal Input/Output efficiency. Monitoring, Rosemount equipment, verified this goal was exceeded with a minimum 20.5% improvement (up to 15 percentage points), or so much fuel less used for same amount of steam generated, respectively, although efficiency displayed by flue gas analyser improved marginally. Even with reduced steam usage, savings in first 2 years, 2000-2001 period, were $288k (chillers were set to run on power rather steam, hadn't that been the case, the savings would top $500k). This led to sub 3-year payback, a record value. The savings will continue to rise with fuel prices and usage. The key to success of this installation, besides its high tech Autoflame combustion controls and Weishaupt dual fuel burner, is attributed to a brand new fire-tube boiler design providing unique benefits in industry, such as minimum number of tubes (just 75, up to 237 in conventional same-sized units), no refractory at all, unique wet front/cooled door design that is applicable on hot water and steam boilers, double furnace units and at boiler rear, improved performance at part load, turndowns, respectively and absence of tubesheet cracks as a result of cooled door and optimally sized furnace. Inspector was impressed by the conditions of boilers after 4 years continuous operation and no spare parts have been needed to date. By the performance displayed at TMC and experience from the old installation, design has been found truly innovative, with no downsides and no negative side effects. There are no special requirements for the burner, as well on operation and maintenance whatsoever (f.i. US company Alzeta confirmed its single digit NOx gas burner could be applied on these boilers). There is no change in technology of boiler making, as verified by TMC delegation in the factory. The method of estimating payback and life cycle costs proved highly accurate and was useful when justifying the project. The unique boiler design technique, resulting from also unique understanding of heat transfer in boilers, has proven to be effective for the project at TMC. The designer's idea about the origin of shortcomings of conventional boilers, and what to do about them have been proven right. Verifying predicted improvements provides a sense of satisfaction that the project exceeds expectations for reduced operational expenses through the improved efficiency of the TMC boiler plant. It is comforting to know that installed boilers can be retrofitted to this design, at cost comparable to cost of major repair work because of tubesheet cracks, delivering permanent performance boost and overall cost reduction.

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Three fire-tube steam boilers of advanced design at Tucson Medical Center

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