

# **CFHT HEATER PERFORMANCE IMPROVEMENT**



# Case Study

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**Fired heaters are the major consumers of energy in the Refining and Petrochemical industries. Almost 40 to 70% of the total energy in this industry is consumed by fired heaters. Thus, revamping fired heaters is an effective solution to improve their performance and hence yield \$\$ savings.**

This study focuses on performance improvement of CFHT heater.

In February 2002, Furnace Improvements (FIS) carried out a Catalytic Feed Hydrotreater Heater (CFHT) revamp for a refinery situated in Illinois. CFHT heater is located in their Fluid Catalytic Cracking (FCC) unit. It is a natural draft vertical cylindrical furnace with a horizontal overhead convection section and three up fired low NOx natural draft burners.

Client was facing repetitive tube failures in this heater and solicited FIS to find the root cause of tube failures. FIS was also requested to provide the design of the new convection section and rerate the heater.

## **EXISTING DESIGN AND OPERATING DATA ANALYSIS**

FIS carried out a thorough analysis of the heater and found that the existing convection section was designed with very tight design parameters. The heater had a very high heat flux that resulted in high skin temperatures and subsequent tube failures. The burners had a very high heat release rate, which led to long flames and flame impingement.

## **PERFORMANCE IMPROVEMENT**

FIS redesigned the convection section within one week with a larger convection section that overcame the drawbacks in the original design. FIS also replaced the existing burners with six new low NOx burners and rerated the heater. FIS developed the detail engineering and fabrication drawings for the convection section and replacement of the burners. FIS also developed material and burner specifications, evaluated the vendor quotations, and witnessed the burner test.

Figure 1 depicts the schematic arrangement of convection section comparison for CFHT heater.

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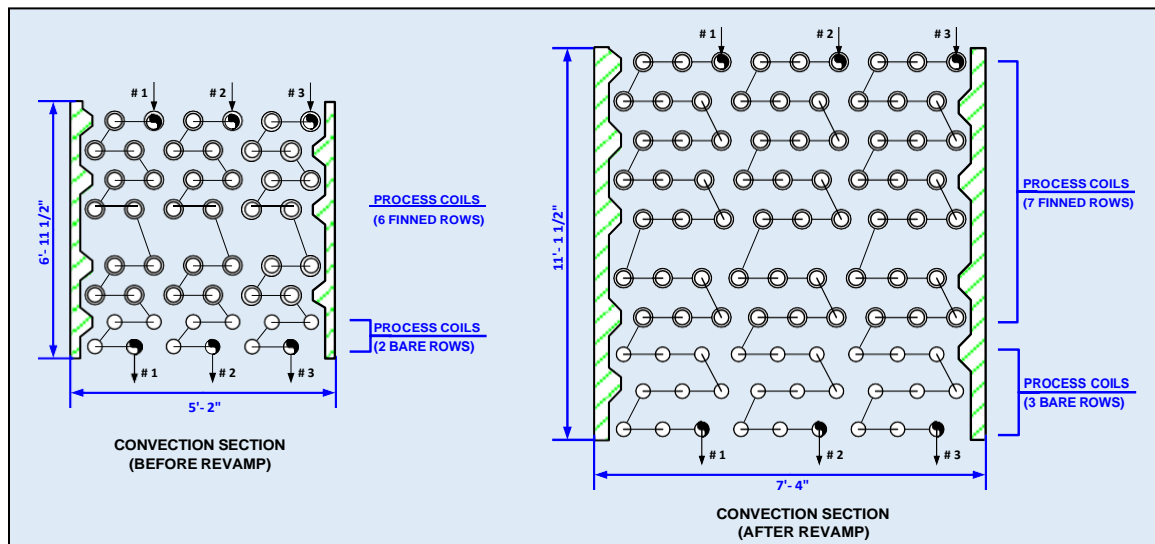


Figure 1: CFHT heater convection section comparison

CFHT Heater Parameters			
Parameter	Units	Original Design	After Revamp
Heat Duty	MMBtu/hr	21.1	22.43
Convection Sec. Flue Gas Mass Velocity	Lb.s/ ft <sup>2</sup>	0.85	0.38
Heat Flux in Lower Finned Tube Row	Btu/hr ft <sup>2</sup>	41,885	15,265
Tube Skin Temperature	°F	944	751
Convection Sec. Flue Gas Side Pressure Drop	inch WC	0.525	0.136
Stack Flue Gas Temp.	°F	891	693
Heat Release	MMBtu/hr	29.8	29.1
Efficiency	%	70.8	77

Advantages of the revamped design are as follows:

- Convection section skin temperatures are reduced by 193 °F.
- Thermal efficiency improved by 6.2%.
- Stack flue gas temperature is alleviated by almost 200 °F.
- Heat flux and flue gas mass velocity in convection section are significantly curtailed.
- Fuel savings were estimated to be **135,645 \$/year** based on 6 \$/MMBtu fuel price

The heater was successfully commissioned in October 2003.

# FIS Revamp Solutions

**FIS designs revamp solutions of the project based on customer specific requirements, which extend from an engineering study to detailed engineering and execution, as portrayed in Figure 5.**

FIS revamp projects are generally focused on following areas:

- Capacity Increase
- Efficiency Improvement
- NOx Reduction

FIS scope of services includes activities exhibited in Figure 6.

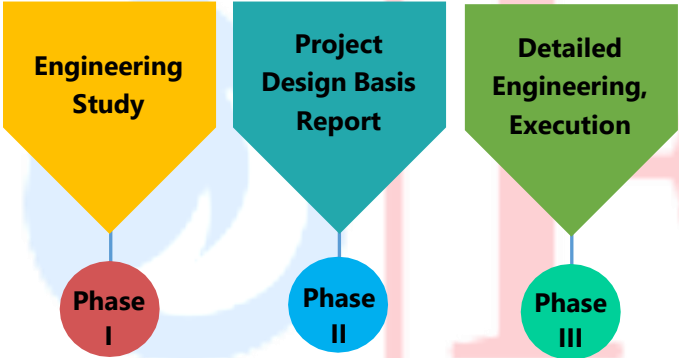


Figure 5: Typical fired heater/ boiler revamp project phases

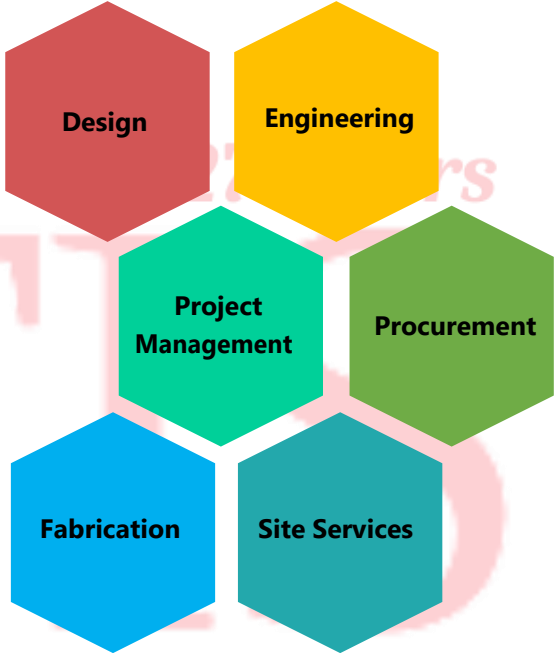


Figure 6: Furnace Improvements example of scope of services

## CONCLUSION

Fired heaters being major consumers of energy in the refinery and petrochemical industries, efficiency improvements even by 1-2% can lead to huge fuel savings.

**Furnace Improvements Services (FIS)** is based in Sugar Land, Texas. We have been improving the efficiency and capacity of our clients' fired heaters, boilers and waste heat recovery units and reducing their NOx emissions for over 23 years. We have handled more than 400 engineering studies and projects for Valero, Phillips66, Citgo, Total, Delek, Sasol and other refineries around the world.



*27 Years*

# FIS

Clean & Efficient Combustion

## Furnace Improvements Services

Uniform Heat Transfer in Fired Heaters

**Furnace Improvements Services**

1650 Highway 6, Ste. 440  
Sugar Land, TX 77478  
(281) 980-0325 Fax: 1-877-395-0760

**AG Furnace Improvements Pvt. Ltd.**

A-74, Ground Floor, Sector-2, Noida.  
Uttar Pradesh-201301  
Phone:+91-120-4146823

**For more information**

For more information please contact FIS by email at

[info@heatflux.com](mailto:info@heatflux.com)

or

Visit us online at [www.heatflux.com](http://www.heatflux.com)