CAPACITY IMPROVEMENT OF REACTOR CHARGE HEATER

Case Study

Fired heaters provide thermal energy to the fluid being heated by combusting fuel and hence accounts for upward of $2.5 billion per year on the fuel bill for a refinery in USA. Revamping fired heaters to improve the heater performance, maximizes the usage of existing components and in consequence, capital investment and downtime are minimized.

This study emphasizes the capacity improvement of reactor charge heater.

Fired heaters being the largest consumer of fuel, refiners tend to operate these units at their maximum capacity. Revamping of heaters is the most effective way of getting extra capacity from the existing heaters.

SPLIT FLOW TECHNOLOGY

When refiners wish to increase the capacity of their fired heaters, FIS patented **"Split Flow Technology"** aims to improve the utilization of thermal energy for process heating. This design works very well to increase the capacity of fired heaters without increasing the process side pressure drop. This is achieved by splitting the process fluid into two parallel streams as- Main Stream and Split Stream. In Main Stream the fluid is heated in the radiant or a combination of radiant and convection section. In Split Stream the fluid is heated in the convection section. The two streams are then combined at the heater outlet. The split is designed by balancing the heat transfer and pressure drop with the radiant stream. Advantages of revamped design based on Split Flow Technology are as follows:

FIS has developed patented **SPLIT FLOW TECHNOLOGY** to increase the capacity of fired heaters with limiting pressure drop.

- Increased capacity at a lower pressure drop
- Improved efficiency
- Lower radiant heat fluxes
- Lower firebox temperatures
- Lower TMTs
- Lower installation costs

This concept has proven to be very helpful to many fired heaters. This paper describes how this technology has helped a refiner in East Texas to improve the capacity of their fired heater. The schematic representation of Split Flow Technology for reformer heater is as portrayed in Figure 1.

Introduction

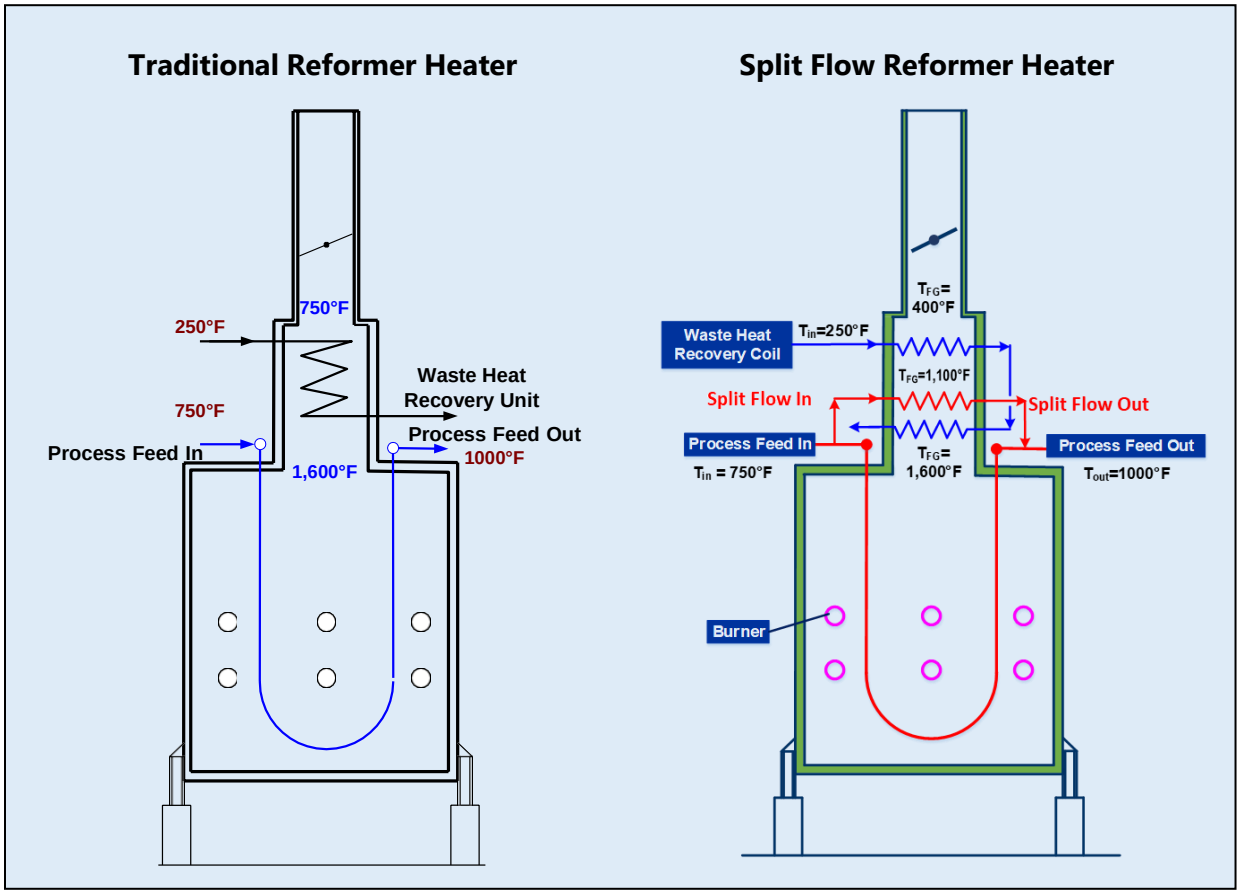

Figure 1: Reformer Heater Split Flow Technology

Case Study

In 2005, Furnace Improvements Services (FIS) was employed by a refinery in Texas to carry out a capacity improvement of the Reactor Charge Heater (80-H-01). Client wanted to increase the process heat duty from 30 MMBtu/hr to 37 MMBtu/hr. The maximum firing rate limitation was 54 MMBtu/hr.

This heater was originally built in 1965 as a natural draft all radiant heater. It was modified in 1980 to increase its thermal efficiency from 55% to 89% by adding a convection section for steam generation. However, the heater was operating at 85% efficiency.

FIS was solicited by the refinery to develop an economical scheme for increasing the capacity. FIS redesigned the heater with FIS patented **Split Flow Technology**, as exhibited in Figure 2.

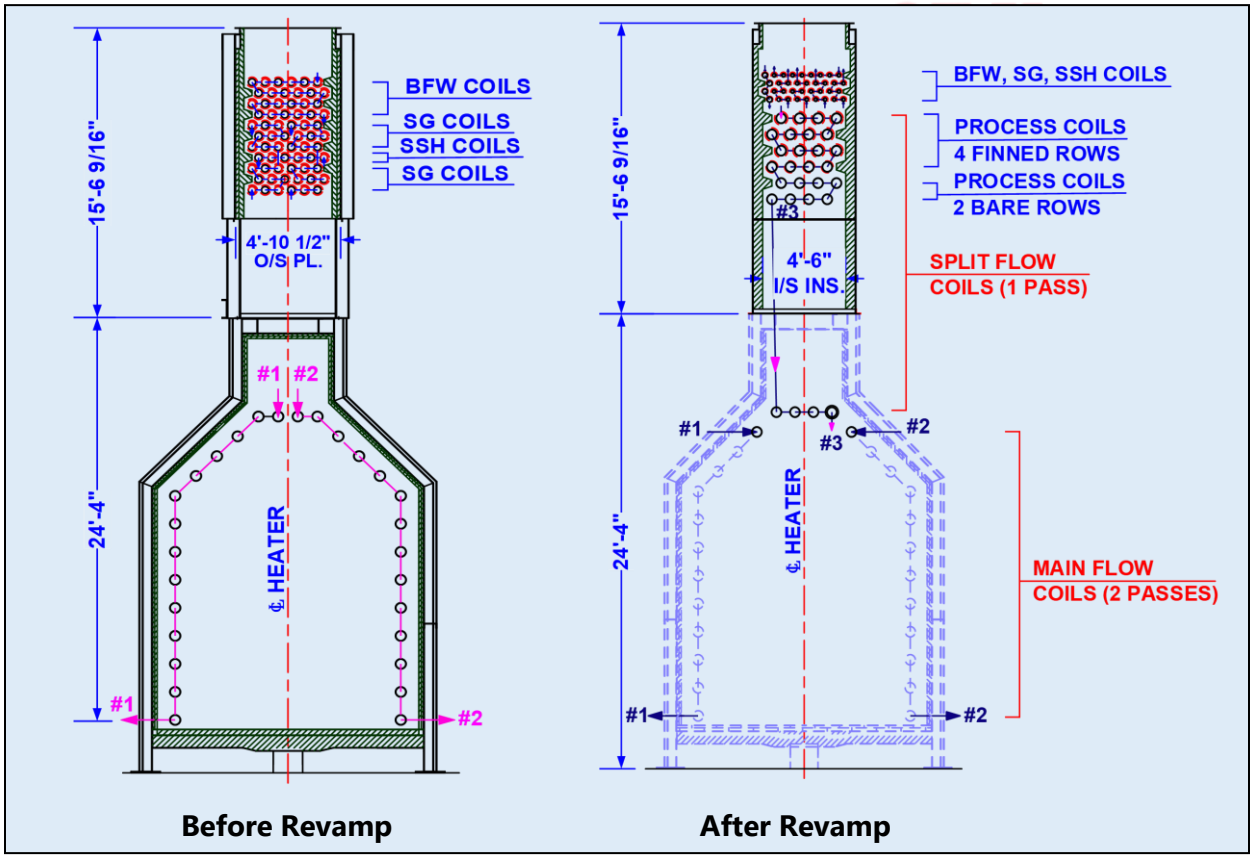

Figure 2: Capacity improvement of reactor charge heater

Case Study

Reactor Charge Heater Data Comparison				
Parameter	**Units**	**Design**	**Operating**	**Revamp**
Total Absorbed Duty	MMBtu/hr	47.7	55.48	42.6
Process Duty (Total)	MMBtu/hr	29.9	37.68	36.96
Process Radiant Duty	MMBtu/hr	29.9	37.68	24.71
Process Convection Duty	MMBtu/hr	-	-	12.25
Steam Service Duty	MMBtu/hr	17.8	17.8	5.64
Total Fuel Firing Rate	MMBtu/hr	53.24	64.83	51.46
Firebox Temperature	°F	1550	1632	1554
Radiant Average Heat Flux	Btu/hr/ft^2	11,790	14,852	9,740

Salient features of the revamped design are as follows:

- Utilizing FIS patented Split Flow Technology, the process stream was split in two streams, 33% flow in the convection section and 67% flow in the radiant section
- Total process duty of the heater was increased by 23%
- Firing rate of the heater was well under the limitation of 54 MMBtu/hr
- Reduction in average radiant heat flux
- No radiant section modification – existing tubes and supports were reused
- Lowest cost
- Shortest turn-around time

FIS carried out the entire scope of activities from conceptualization to commissioning of this heater revamp. The heater was successfully commissioned in April 2006.

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 3.

FIS revamp projects are generally focused on following areas:

- Capacity Increase
- Efficiency Improvement
- NOx Reduction

FIS scope of services includes activities exhibited in Figure 4.

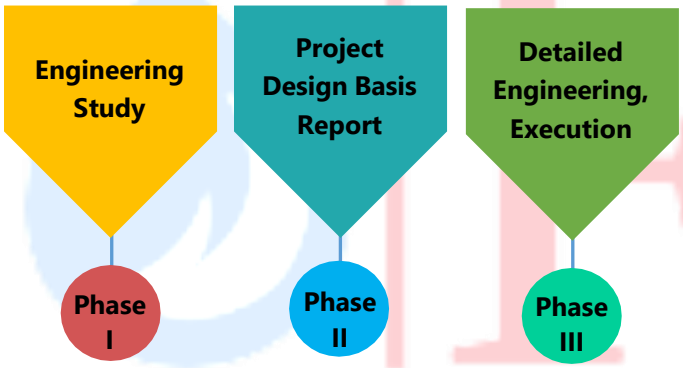

Figure 3: Typical fired heater/ boiler revamp project phases

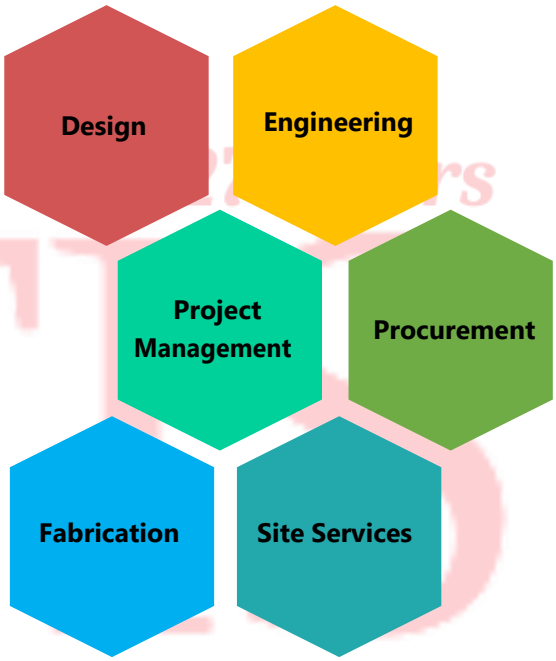

Figure 4: Furnace Improvements example of scope of services

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.

Furnace Improvements Services

Uniform Heat Transfer in Fired Heaters

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