From:	Warnement, Tom E
To:	Wilson, Aimee
Cc:	Lundgren, Andrew A.
Subject:	Equistar Channelview - Olefins Expansion Project
Date:	Thursday, March 28, 2013 9:48:32 AM
Attachments:	CVO Heater Efficiency.docx

Aimee,

Attached is the efficiency, stack temperature and production data that you requested for the proposed Channelview Olefins 1 and 2 heaters. Following refinement of the proposed heater design, the stack temperatures and efficiency data have been updated. The stack temperature has been updated to 408 degrees Fahrenheit and the efficiency target updated to 89.5 percent. Details regarding the refinement of heater temperature and efficiency are located in the attached MS Word document.

Total increase production resulting from the construction of both cracking heaters is approximately 750MM lbs/year per heater.

Please do not hesitate to contact me if you have any questions.

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Furnace Efficiency – Channelview

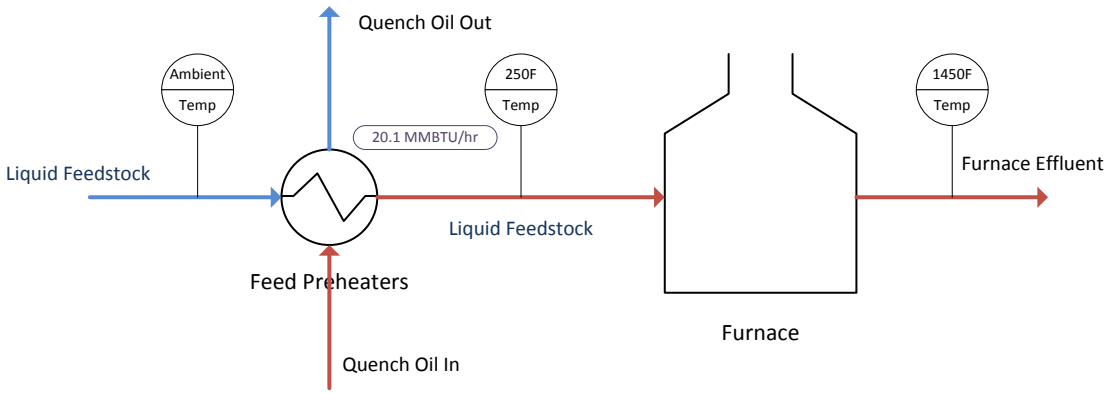
Original Proposal
Equistar's furnaces were projected to have energy efficiencies during operation ranging from 90.3% (LHV) in worst case conditions to 91.1% (LHV) as targeted design with a maximum annual average stack temperature of 340°F.

New Proposal
Design refinement has resulted in changes to both the expected efficiencies of the furnaces and the stack temperatures. Based on vendor calculated furnace design simulation and original plant design process and utility operating conditions, the efficiency is target to be no lower than 89.5% with a maximum annual average stack temperature of 408°F.

The reason for the lowered furnace efficiency and higher stack temperature is due to higher temperature streams feeding the upper levels of the furnace convection section. The higher temperature feed results from capture of heat energy in the feed streams prior to entry to the furnace. The proposed Equistar furnaces are designed for cracking liquid feeds, not ethane feeds, and efficiencies should not be compared to ethane cracking furnaces.

Equistar is proposing the addition of new furnace capacity as a debottleneck to the existing units, not as a part of a greenfield new plant construction. As such, the new furnaces must be designed within the existing constraints of the unit versus designing an entirely new plant free from such constraints. Two major design differences that affect furnace efficiency are furnace feed temperature and boiler feed water temperature. These are the two most important items with regards to reducing stack temperature and ultimately increasing furnace efficiency.

Feed Temperature Impact
Typical liquid hydrocarbon feed temperature designed for a new unit would be in the range of 100-150°F. Equistar's existing feed system design provides feed to the furnaces at 250-260°F, as required by the existing 30 liquid furnaces. The feed preheaters provide an efficient way to recover energy from the quench oil circulation loop into the feed. This allows the furnaces to fire less, with lower overall emissions. If the feed heaters are bypassed, the furnace stack temperature will decrease and the furnace efficiency will increase, but the overall fired duty and emissions of all the furnaces will increase to account for the loss of feed preheat.



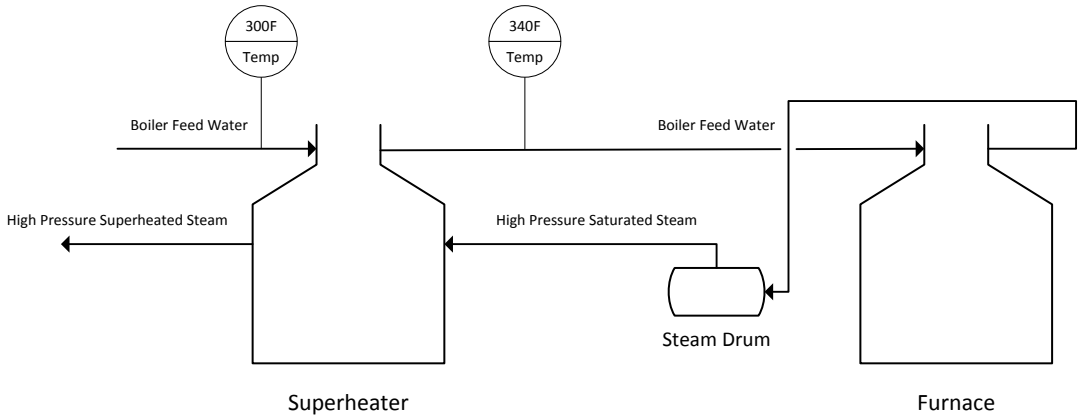
Since the feed systems *cannot* be segregated to only the new furnace, bypassing the feed preheaters would increase the firing rate of all the furnaces on liquid feed, resulting in an overall increase in emissions from the stack. The additional heat not rejected from the quench oil into the feed would have to be rejected into cooling water.

In addition, there are operational and heat balance impacts to the gasoline fractionator system, which also constrain operational parameters. These constraints are not an issue with a full vapor cracker since there is no generation of quench oil with a plant that only runs vapor feeds. Simply stated, a liquids cracking unit is substantially different than an ethane cracking unit.

Boiler Feed Water Temperature Impact

Typical boiler feed water temperatures designed for a new unit would be in the range of 190-200°F. Equistar's existing boiler feed water design provides boiler feed water to the furnace convection section at 340°F. Because heat transfer is dependent on temperature differential, the ability to capture heat from gases in the furnace convection section becomes impractical as the feed water temperature approaches the combustion gas temperature. This is the case with the Equistar project where operational constraints prevent introduction of cooler boiler feed water.

The boiler feed water is used initially to recover energy from the convection section of the superheaters and then recover additional energy from the convection section of the furnaces. The boiler feed water is used to generate high pressure saturated steam which is then routed back to the main sections of the superheater to add superheat. The high pressure superheated steam is used to drive the steam turbines on the main cracked gas and propylene refrigeration machines.



Due to heat recovery design of the superheater and existing furnaces, the boiler feed water temperature cannot be lowered without either rejecting usable heat to the cooling tower or another source to further improve furnace efficiency. This would be a net loss in energy efficiency for the system and would not result in a reduction of emissions from the furnace stack.