



SULZER

Upgrading a FCC Main Fractionator to Improve Operational Reliability and Flexibility

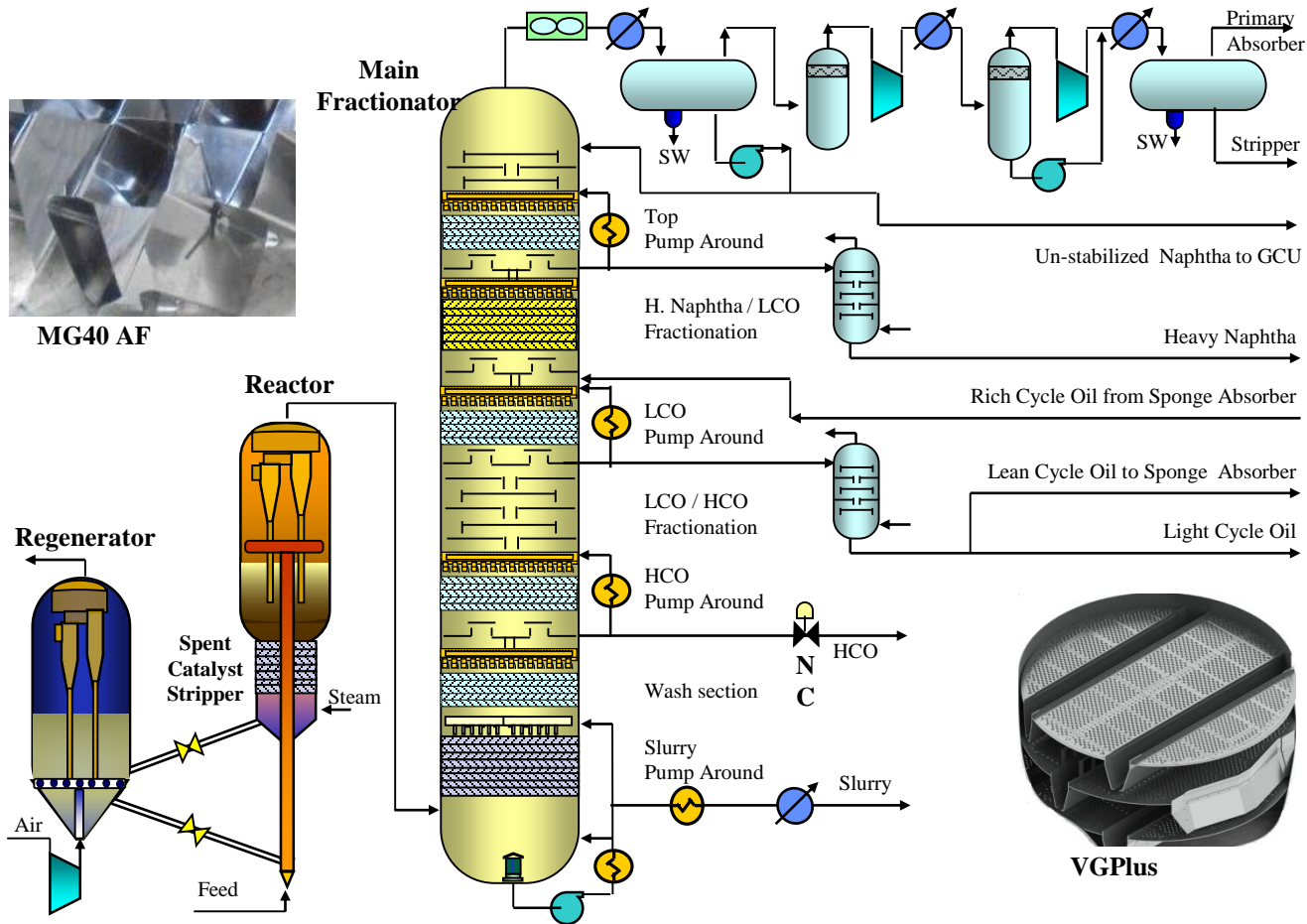
Giuseppe Mosca | RefComm conference, Budapest 4,5 October 2017



Agenda

- FCCU flow diagram
- Major concerns of the existing Unit
- Plant Survey
- Modifications of the Main Fractionator
- Plant feed back data
- Conclusions

FCC Unit Flow Diagram



Unit Background

- The Unit was licensed by UOP, and commissioned in 1984 with a capacity of 1 MM t/a
- A first revamp was implemented in 1994 to boost the capacity by 50%, i.e. 1.5 MM t/a
- A second revamp was implemented in 2005 to further increase the capacity up to 1.75 MM t/a
- The third revamp was implemented in 2012, same capacity, 1.75 MM t/a, but lighter feed and higher conversion than 2012 revamp.

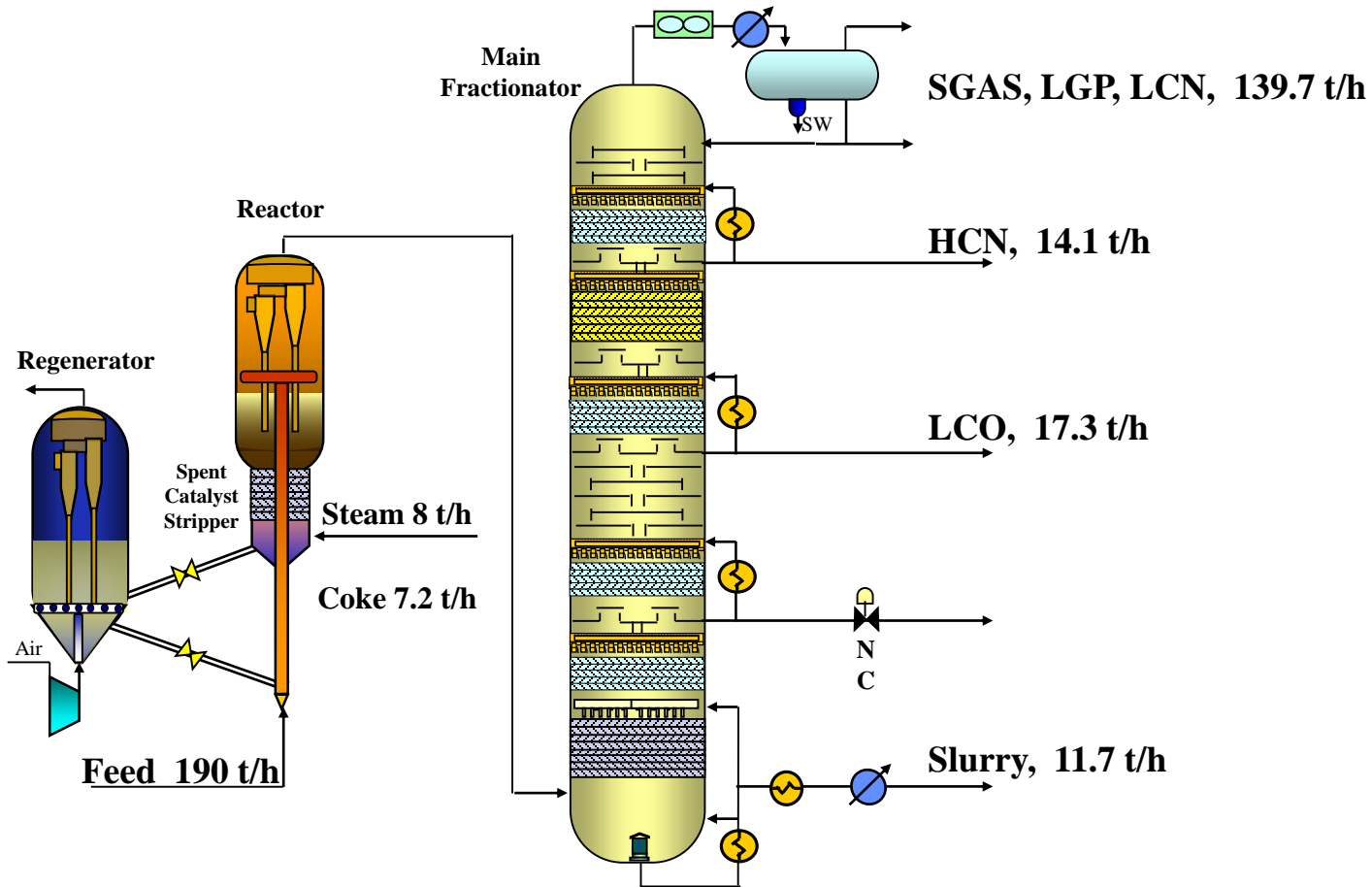
Unit Major Concerns

- In 2014, after 2 years operation from third revamp, the Unit started to face instable operation at Main Fractionator
- The pressure drop across the tower started to increase
- The Unit could not operate anymore at maximum capacity, it was reduced down to 85% of the target
- The reactor temperature was reduced with a consequent reduction of the conversion.

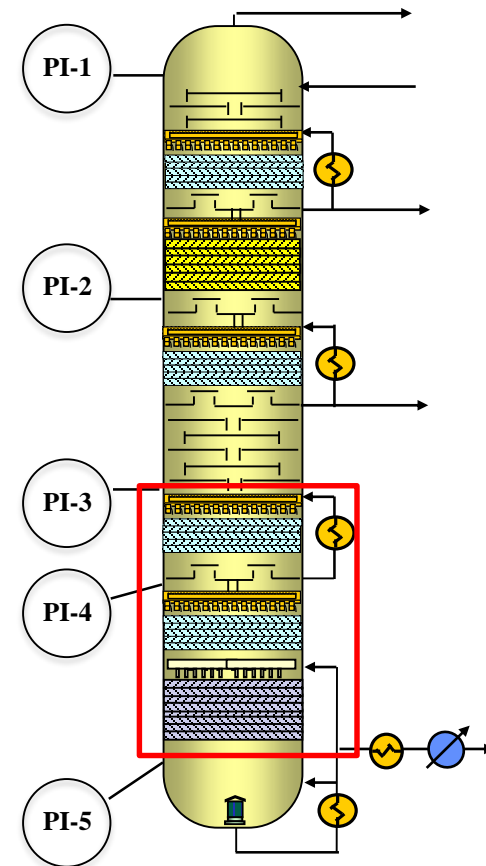
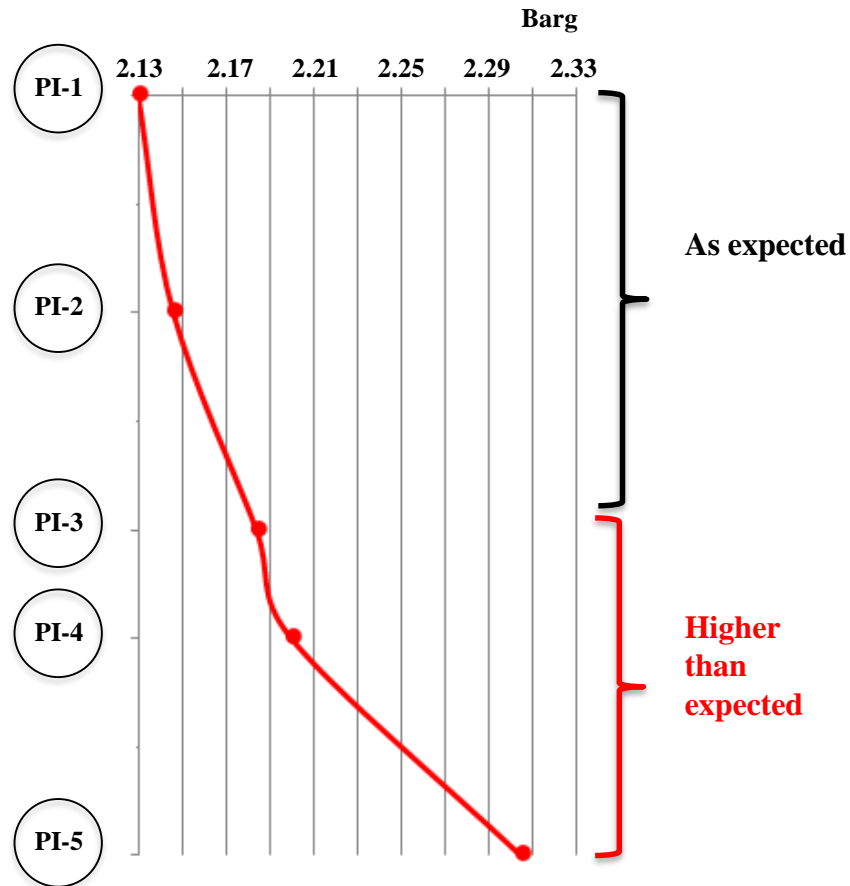
Plant Survey

- In 2015 the team “Engineered Solutions Refinery” of Sulzer was appointed to troubleshoot the Main Fractionator
- A test run was performed with Sulzer people at site, the following main data was gathered:
 - Temperature and pressure profiles of the Main Fractionator and GasCon towers
 - Flow rates of the Pump Arounds, refluxes, and run down products
 - Distillation curve and density of the liquid products
 - Composition of the LPG and Gas

Unit Material Balance



Pressure survey at Main Fractionator



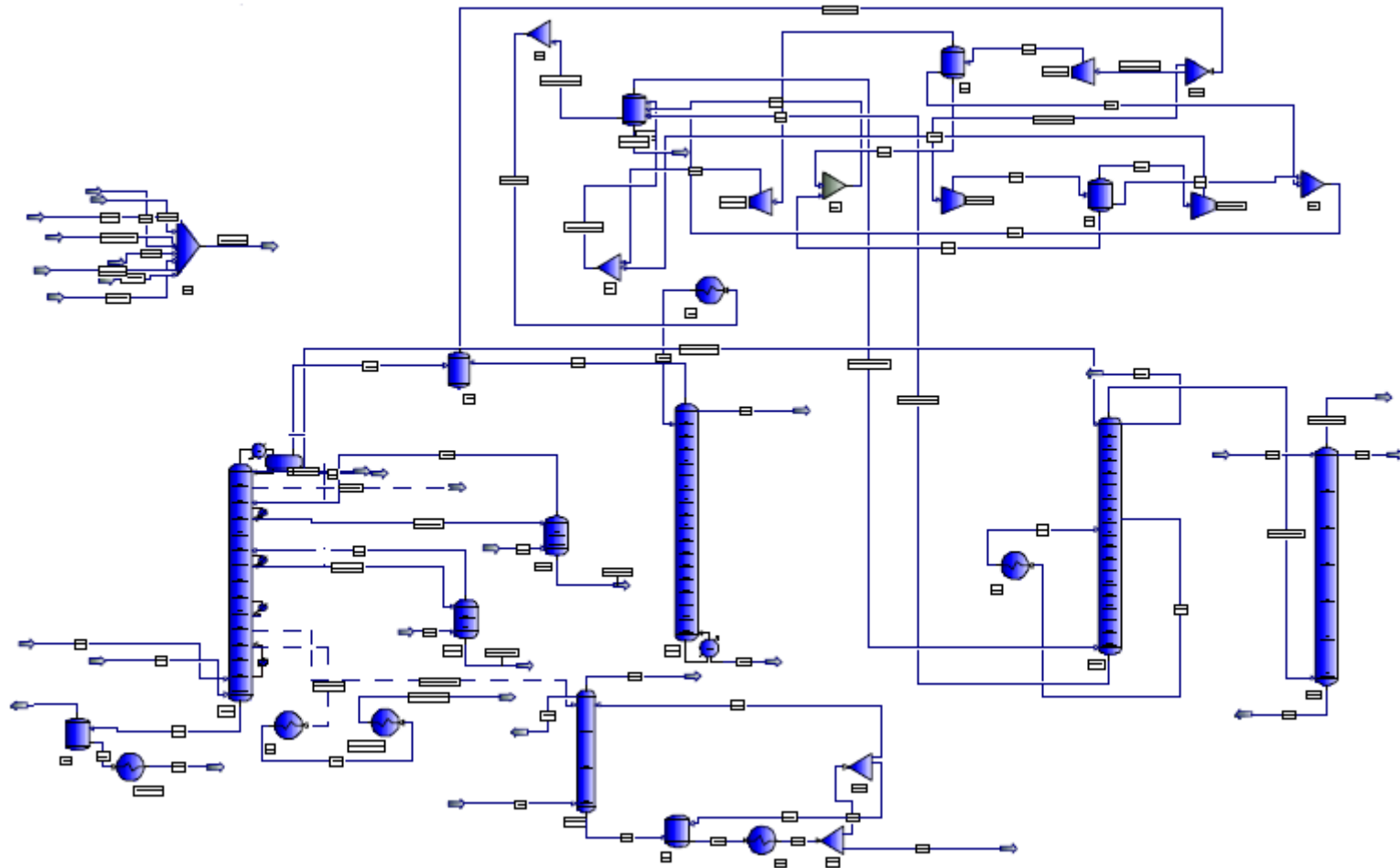
Liquid Streams Analysis

	VGO	LCN	HCN	LCO	HCO	CLO
Distillation Method		D86	D86	D86	D86	D1160
Sp. Gr.	0.8805	0.7218	0.8867	0.9440	0.9486	1.0387
IBP °C	290	31	168	126	164	282
5 % "	356	45	186	218		341
10 % "	377	49	190	241	310	356
20% "	398	55	195	260	324	373
30% "	412	60	201	272	340	386
40% "	424	66	210	281	340	397
50% "	436	75	217	289	348	408
60% "	449	90	224	298	353	418
70% "	465	111	233	306	358	430
80% "	485	136	243	317	362	446
90% "	511	158	256	333	372	471
95% "	530	173	266	347	383	491
FBP "	553	197	281	359	394	520

LPG and Gas Composition

Gas Analysis			
Component Mole %	LPG	WGC	Sponge Gas
C ₁		6.2	29.1
C ₂	0.3	3.0	10.4
C ₂ ⁻		5.2	21.3
C ₃	11.6	6.4	0.9
C ₃ ⁻	24.2	24.4	3.2
IC ₄	27.1	13.5	0.6
NC ₄	5.3	2.4	0.1
1C ₄ ⁻	7.1	3.3	
IsoC ₄ ⁻	10.7		
T ₂ C ₄ ⁻	8.2	4.1	0.1
C ₂ C ₄ ⁻	5.4	2.5	0.1
IC ₅		5.7	0.4
NC ₅	0.1	0.4	0
1,3,C ₂ C ₄ ⁼			0.1
H ₂		1.4	6.3
O ₂		2.2	1.5
N ₂		13.9	21.4
CO ₂		1.1	4.2

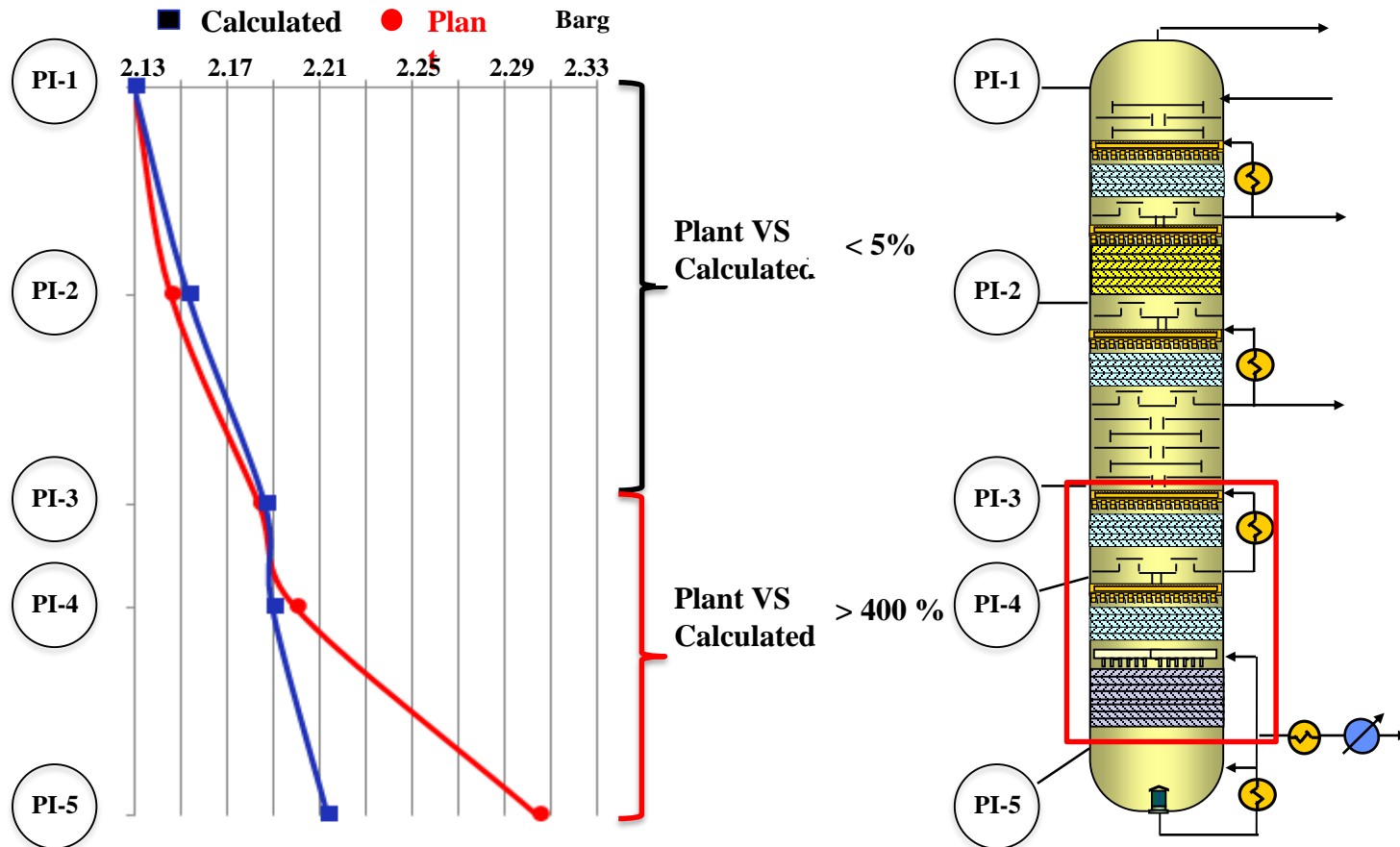
Process Simulation Model



Hydraulic Rating of Main Fractionator

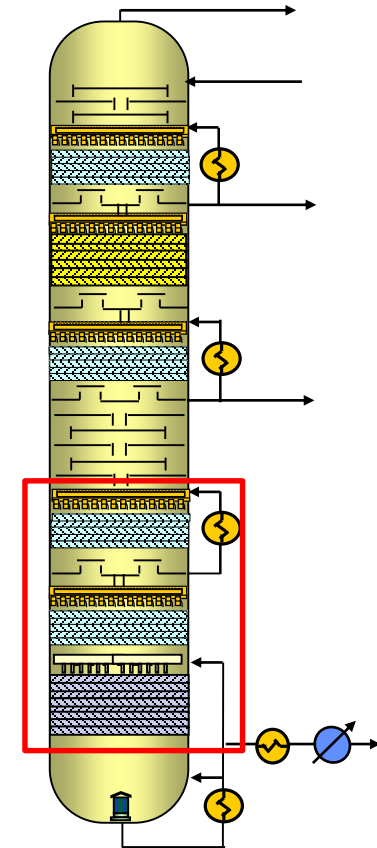
Tower Section	MTC	Hydraulic Flood
Top fractionation	Conventional Trays	Moderate
HCN PA	Structured Packing	Moderate
HCN / LCO fractionation	2nd Generation Structured Packing	Moderate
LCO PA	Structured Packing	Moderate
LCO / HCO fractionation	High Performance Trays	Moderate
HCO PA	Structured Packing	Moderately high
Wash Bed	Structured Packing	High
Slurry PA	Structured Grids	High

Pressure Profile: Plant data VS Calculated one

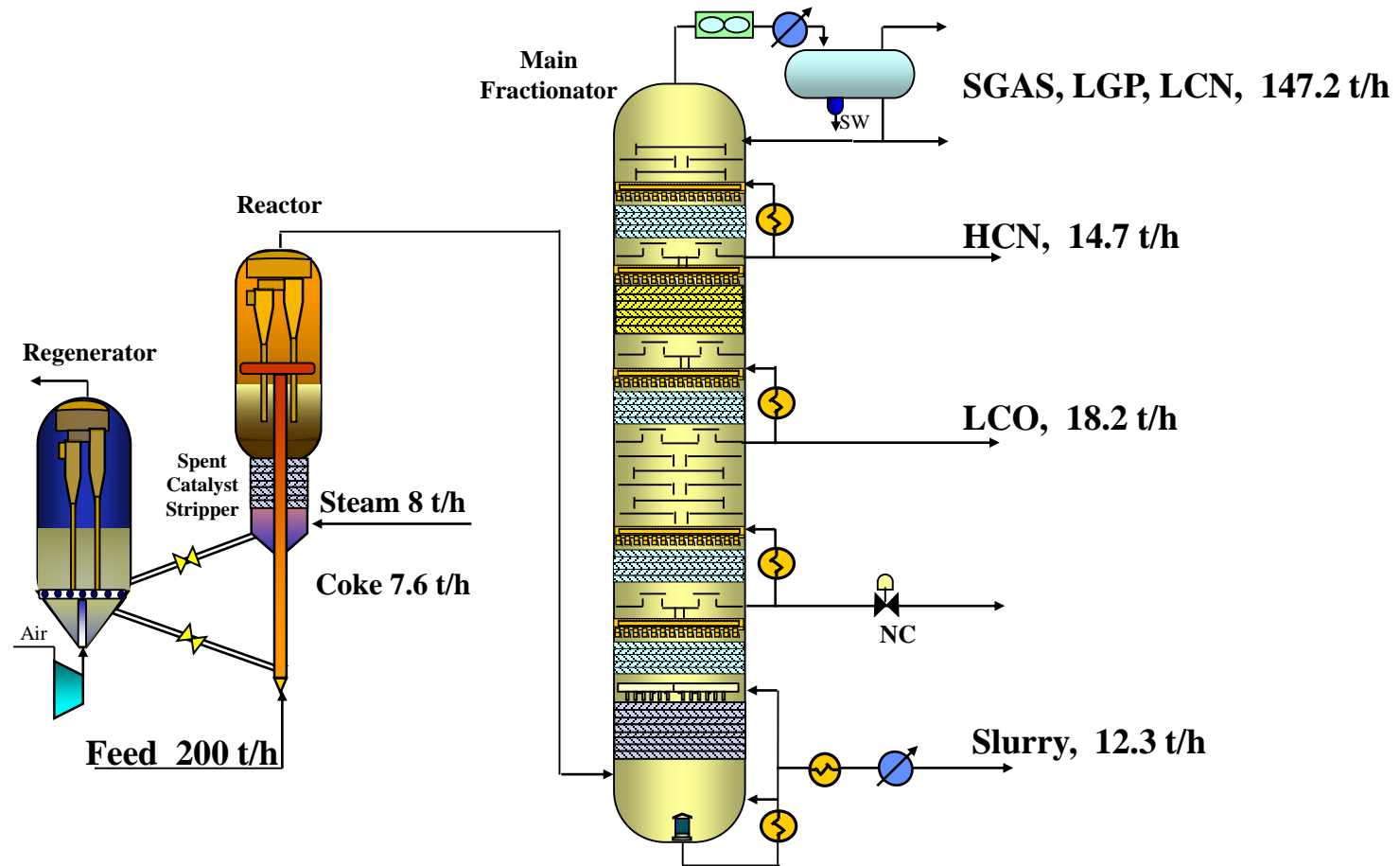


Plant survey: Findings

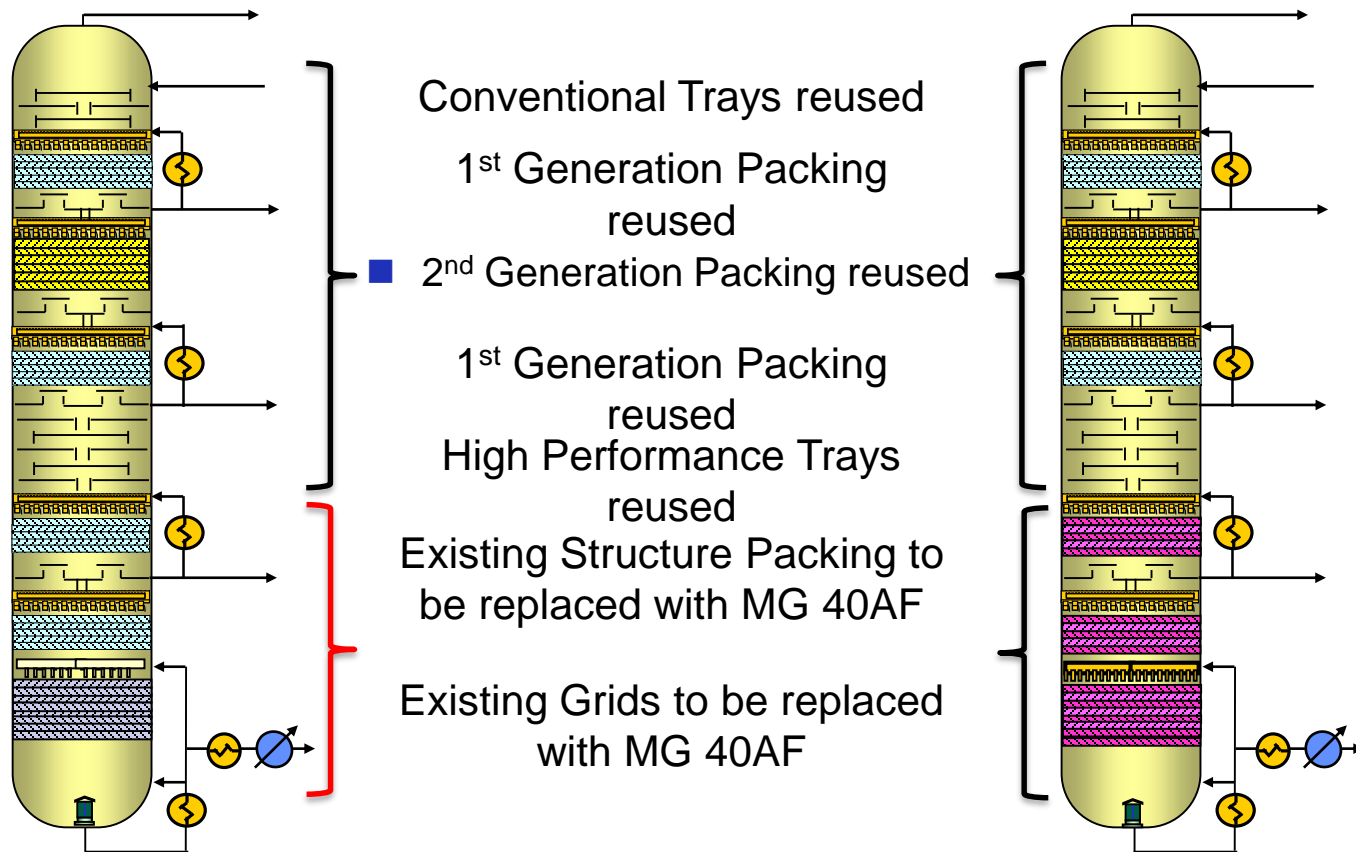
- The top sections of the Main Fractionator are working fine, i.e. HCN PA, HCN / LCO fractionation, LCO PA, LCO / HCO fractionation
- The bottom 3 sections are the bottleneck, i.e. HCO PA, Wash section and Slurry PA
- The bottleneck is more related to fouling accumulation than hydraulic limitation of the existing Mass Transfer Components



Required Material Balance for future operation

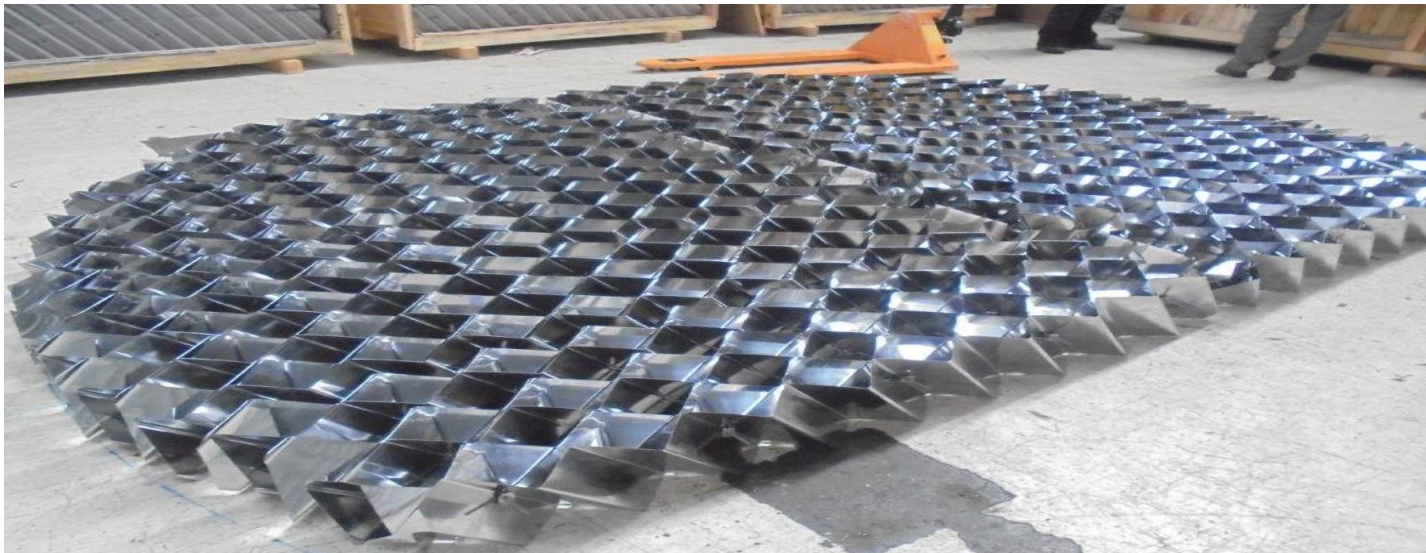


Main Fractionator Modifications

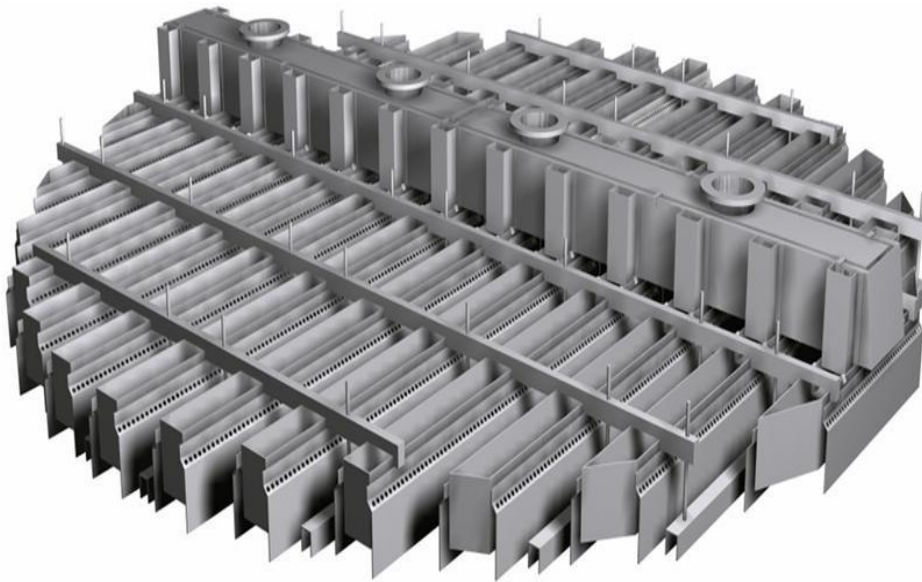


New Anti-Fouling Grid Packing MG40 AF

- Highest hydraulic capacity
- High heat transfer efficiency
- Superior fouling resistance
- Superior mechanical stability

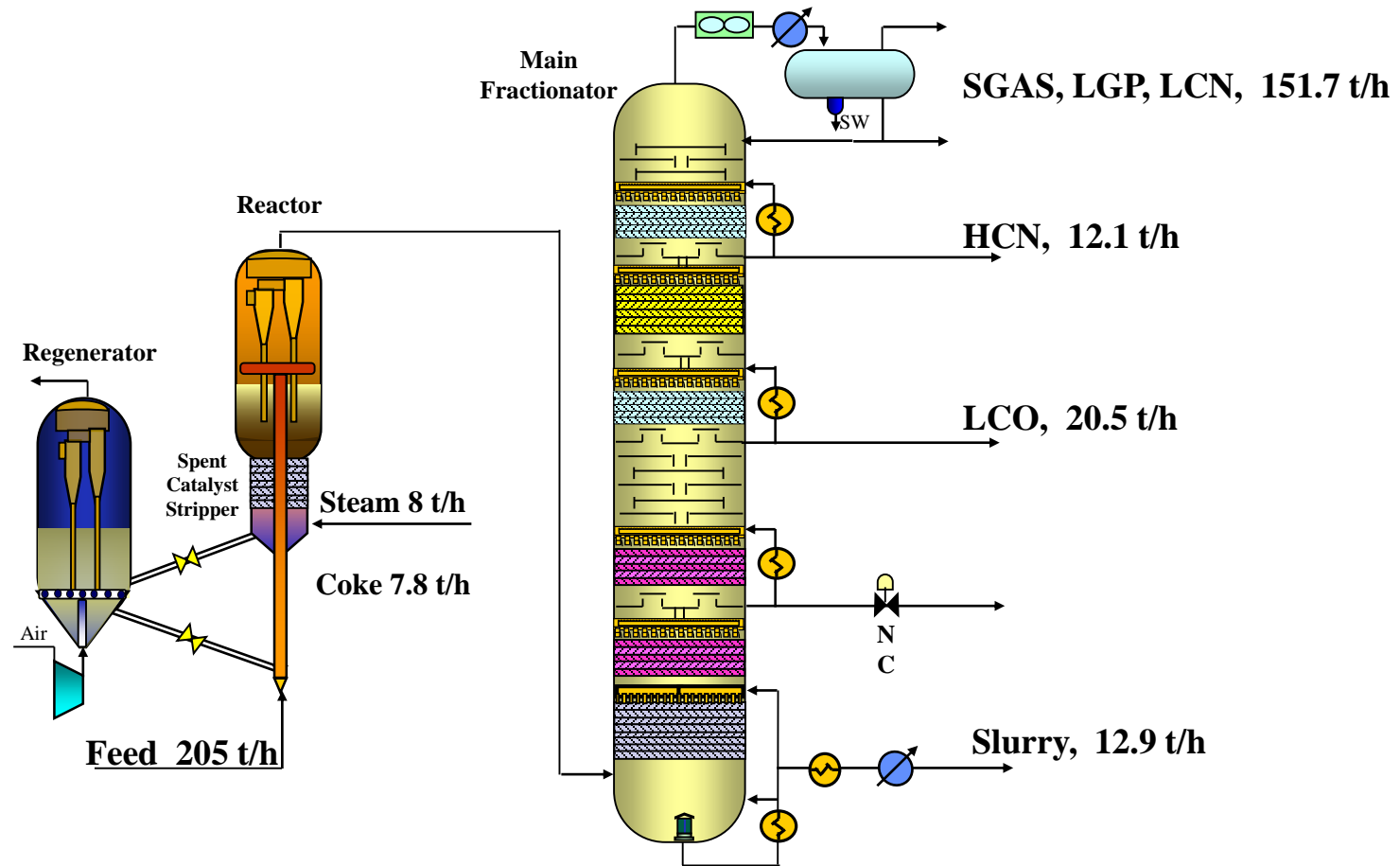


Anti-Fouling liquid distributor VES



- Through type liquid distributor
- Suitable for high liquid loadings
- Suitable for handling solid debris
- Great resistance to fouling
- Good distribution efficiency
- High mechanical stability

Test Run data after revamp



Conclusions

- The upgrading of the Main Fractionator was implemented in the planned turnaround, and the plant was successfully re-started last October 2015
- The Unit is operating at capacity even higher than revamp target, with smooth column operation and desired products qualities
- There is still a room to further boost the throughput, the ultimate capacity will be checked when the feed will be made available.

