Shell Catalysts & Technologies

Shell Turbo Technologies

A Novel Column Internal that Unlock Existing Gas Treating Unit's Potential

Case Study: How to approach gas treating unit debottlenecking with STT

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Shell's operating plan and outlook are forecasted for a three-year period and ten-year period, respectively, and are updated every year. They reflect the current economic environment and what we can reasonably expect to see over the next three and ten years. Accordingly, the outlook reflects our Scope 1, Scope 2 and NCI targets over the next ten years. However, Shell's operating plan and outlook cannot reflect our 2050 net-zero emissions target, as this target is outside our planning period. Such future operating plans and outlooks could include changes to our portfolio, efficiency improvements and the use of carbon capture and storage and carbon credits. In the future, as society moves towards net-zero emissions, we expect Shell's operating plans and outlooks to reflect this movement. However, if society is not net zero in 2050, as of today, there would be significant risk that Shell may not meet this target.

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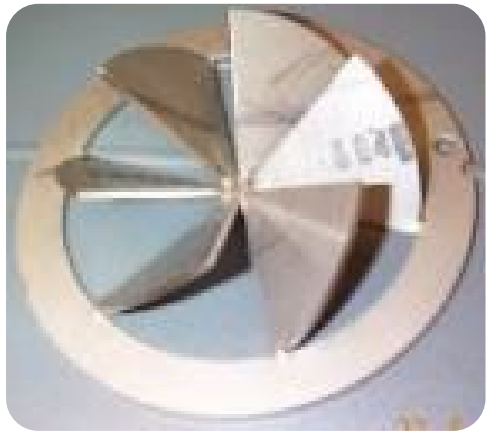
STT advance column internals meets Shell gas treating expertise

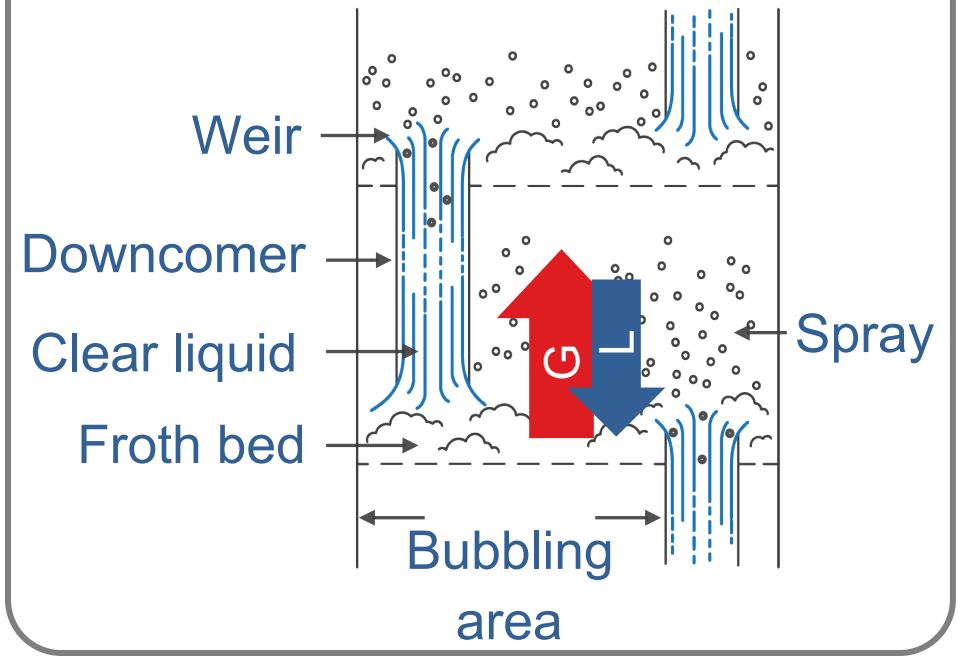
Generation I	Generation II	Generation III	Generation IV	Generation V	Generation VI
Swirl tube	Heavy-duty swirl	Compact swirl	ConSep tray	ConSep X tray	**Shell Turbo Technologies**
1989	1995	2001	2004	2014	2019



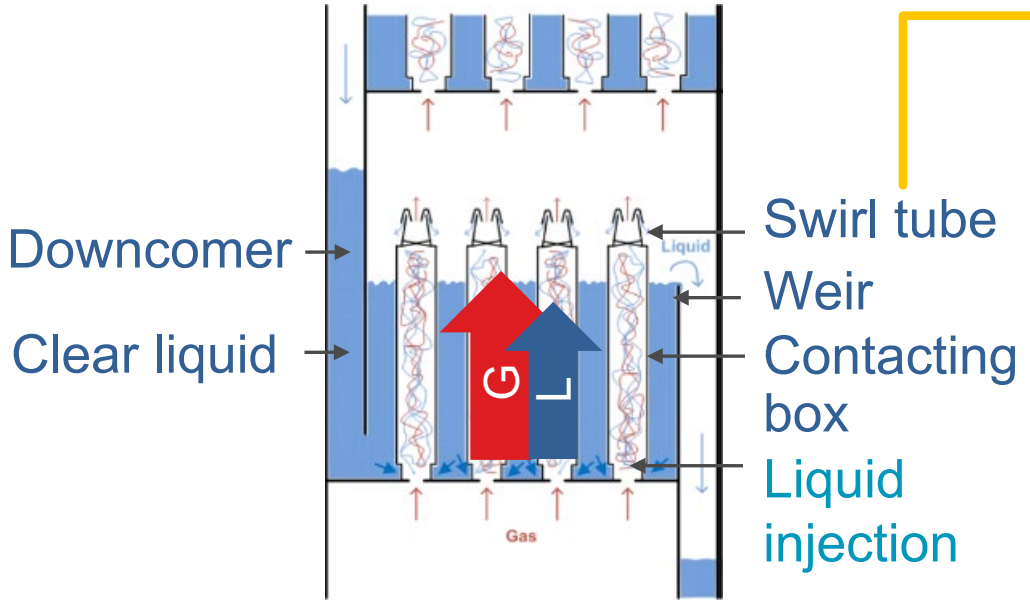


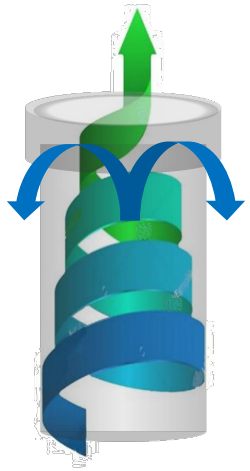
STT offer enhanced mass transfer and gas throughput

Conventional tray



Shell Turbo Tray





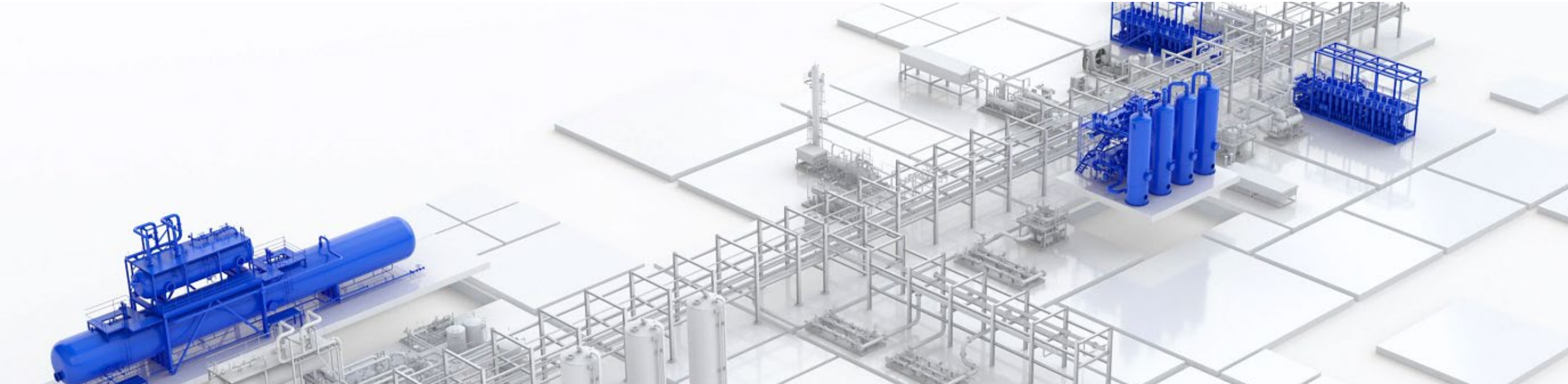
Swirl tube

Increased mass transfer
Through co-current turbulence mixing

Improved gas throughput
Through cyclone gas/liquid separation

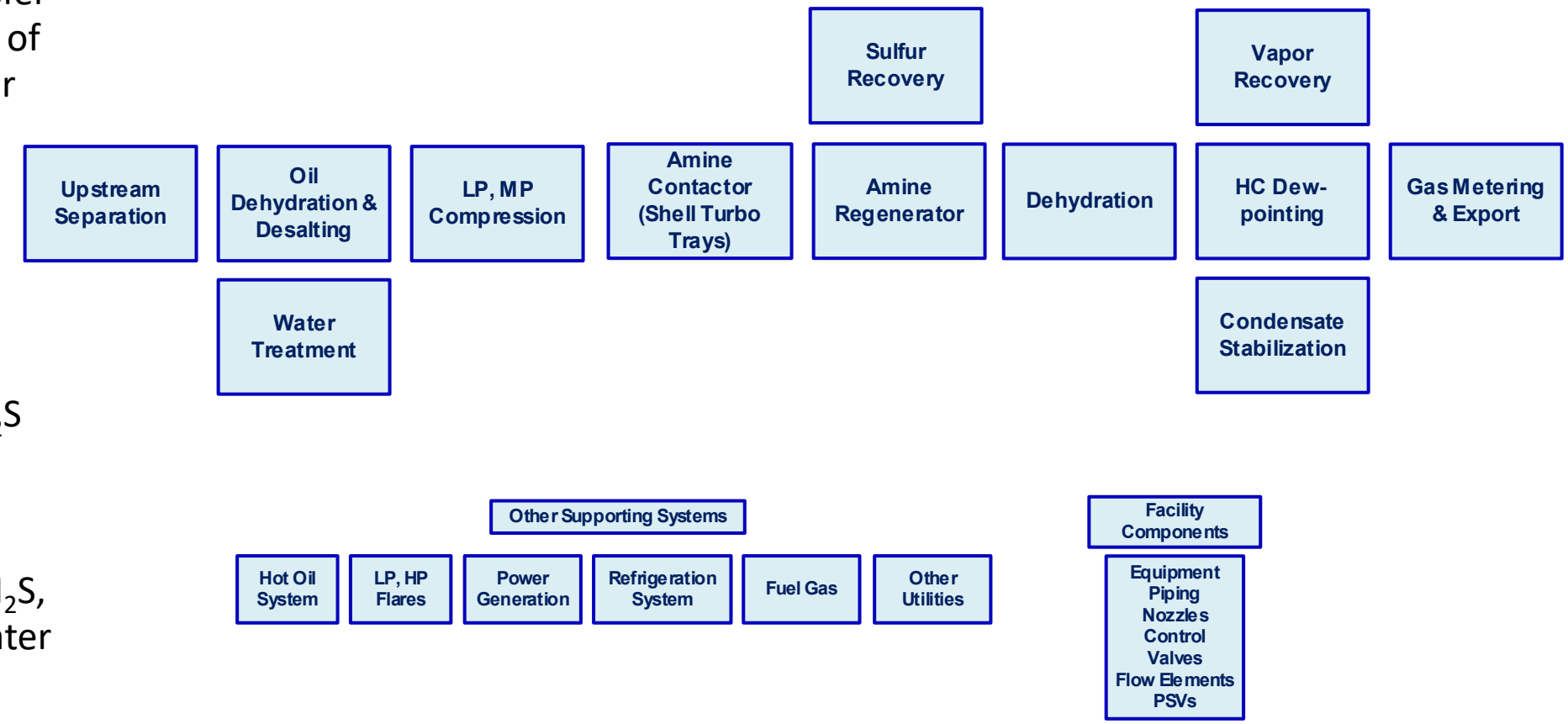
Shell Turbo Trays

Facility Debottlenecking Case study



Facility debottlenecking – Middle East

- SLB Built-Own-Operate-Transfer (BOOT) the facility consisting of oil & gas treatment and sulfur recovery systems
- Requirement to increase the plant processing capacity by 20% from 40,000 bpd oil and 130 MMscf/D gas with 4% H_2S and 2% CO_2
- Export specifications 4ppm H_2S, 1.7% CO_2 and 7 lb/MMscf water



Plant Adequacy Check

Gas Systems

- Comprehensive process and hydraulic studies and process checks were conducted
- Amine circulation rate and reboiler duty were maintained within the 10% equipment design margin
- Validation of the TEG system with increased inlet temperature
- Validation of LP & MP compressors was performed with vendors

Liquid Systems

- Oil processing equipment needed to handle more flow; state of the art Dual-Frequency desalters were found suitable for higher oil load
- Water handling system was assessed and found adequate
- Crude export pump needed larger sizes impeller, but lower delivery pressure was acceptable eliminating the modification

Plant wide

- Hot oil capacity was increased mainly due to more oil treatment and stabilization system
- Process parameters like gas velocities, nozzle momentum, PCVs, PSVs and flare network validated
- About 10 minor piping and instrumentation modifications were addressed
- Hazop was conducted with third party to ensure all safety aspects are fully reviewed

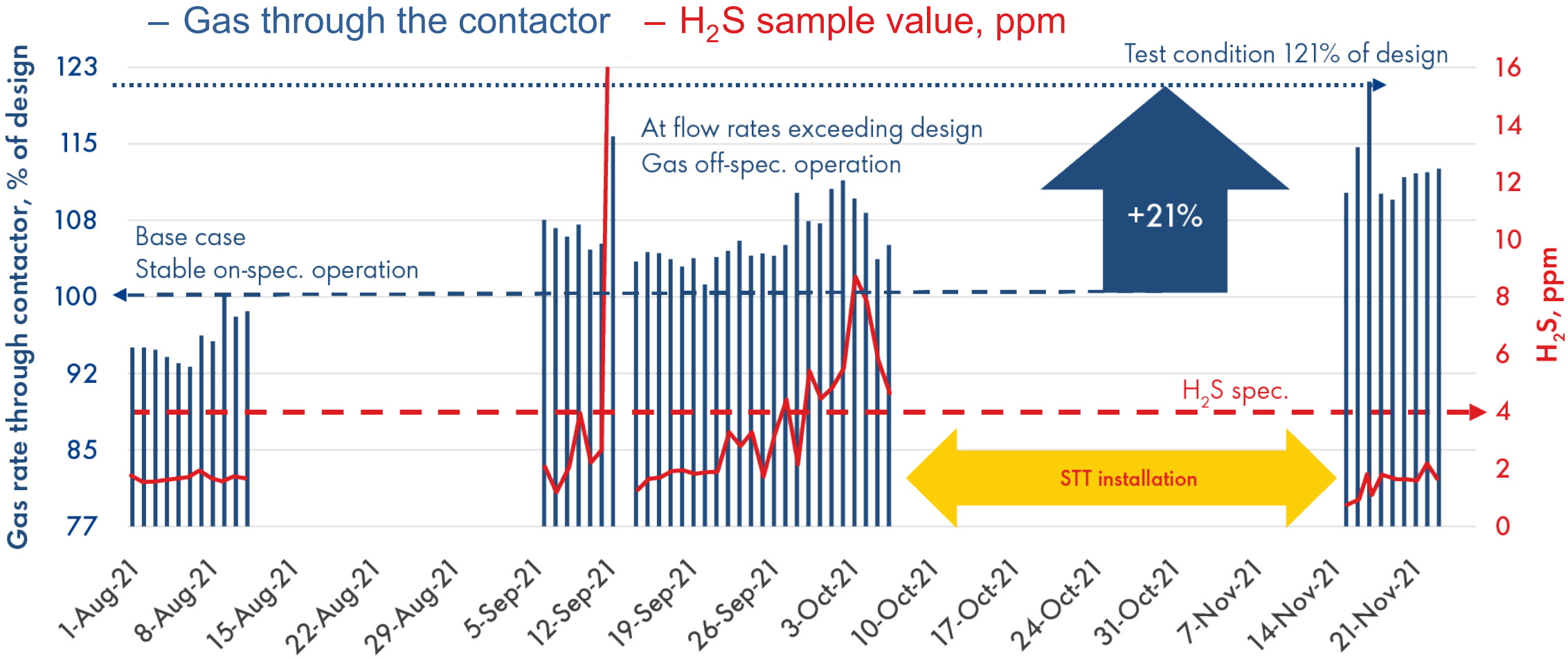
Installation and performance tests

- Hot welding and recertification was avoided by using available cleats, rings and hangers; drop-in solution to replace existing 21 Shell HiFi trays to 9 Shell Turbo Trays + 1 de-entrainment tray
- P&IDs, line lists, operating manuals and other key engineering documents revised as per updated as-built conditions
- Shutdown was planned to implement the debottleneck modifications during regular plant-wide shutdown
- Sampling and analysis of gas streams was conducted by a third party
- Successful performance test run conducted for 96 hours

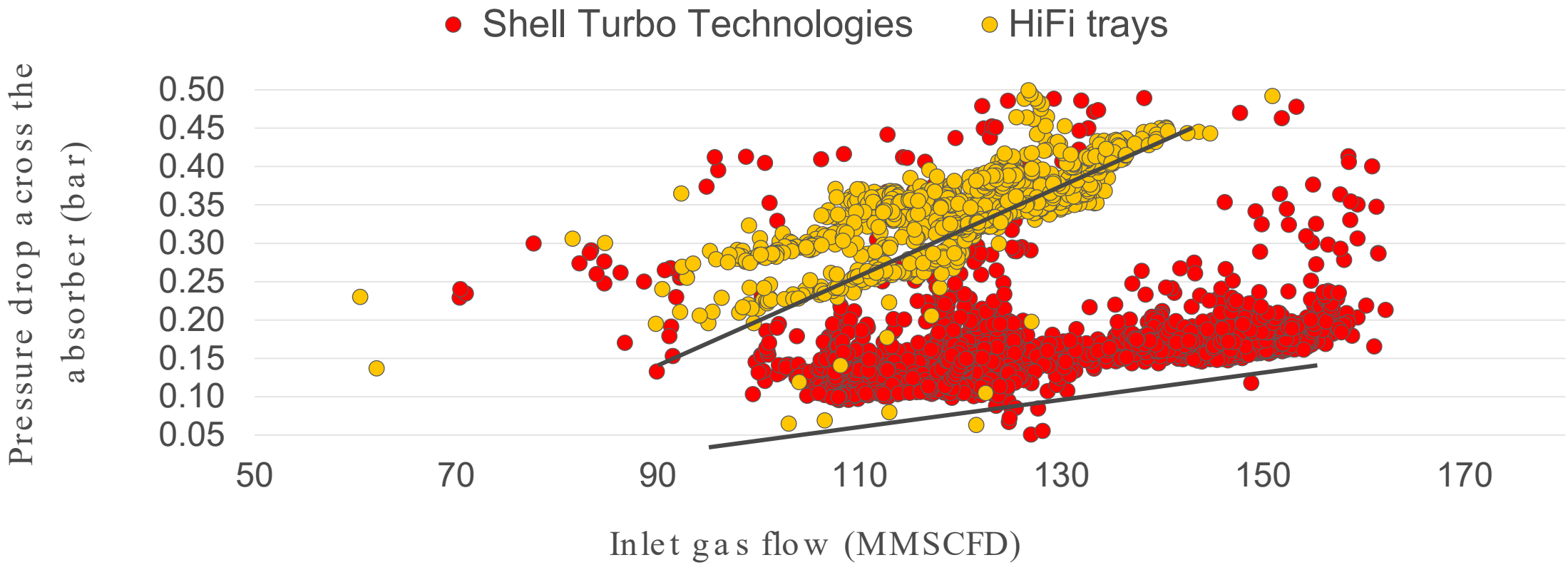
AGRU deployment result

20%
production increase

Improved operation
Stable operation

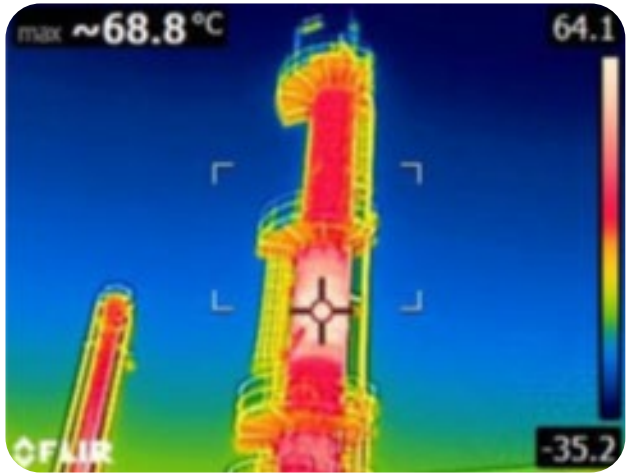


AGRU deployment: Pressure drop versus gas flow



Lower overall column pressure drop with Turbo Trays owing to fewer trays required

AGRU deployment: Column profiles – lower temperature bulge with Turbo Trays



Conventional trays

Turbo Trays

- Absolute temperatures have been reduced, better heat dissipation
- Temperature profile shifts toward the top of the column impacting the downstream system

Shell Turbo Technologies add value in greenfield and brownfield applications

Greenfield (onshore and offshore)

Absorber benefits:

Up to **40%** smaller — Diameter

Up to **50%** lighter — Weight and FOB cost

- Very suitable for offshore, premium space and weights

Brownfield

Low capex solution to increase gas treating unit performance

- TEG and AGRU application
- Drop-in solution for absorber
- Maximize existing equipment margin for throughput increase
- Reduce OPEX in AGRU
- Reduce solvent losses
- Resilient to foaming

(*) compared to high -capacity internals

Up to **50%** greater*

Gas flow