Sjoerd Hoogawater

Brazed Aluminum Heat Exchanger Dashboards

Seeq conneqt

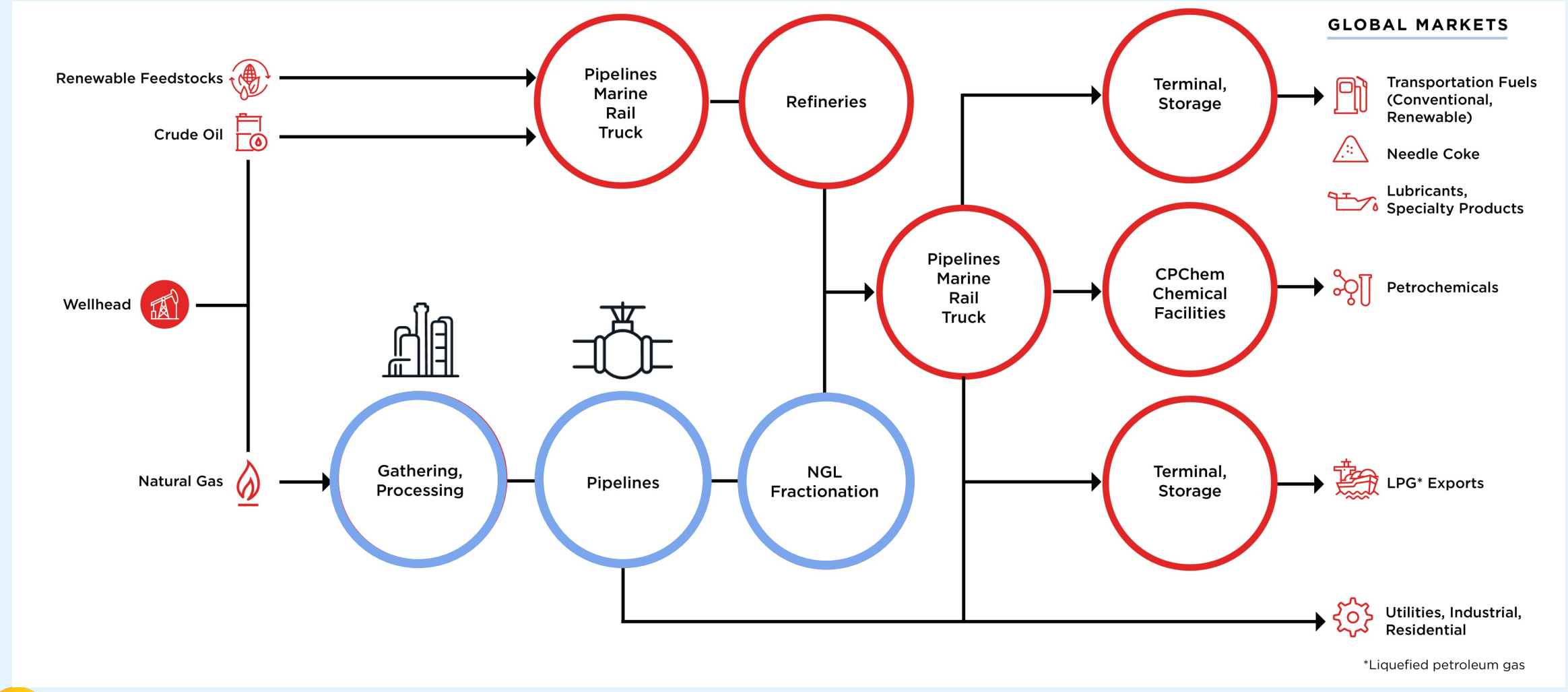
PROVIDING ENERGY. IMPROVING LIVES.

Brazed Aluminum Heat Exchanger Dashboards

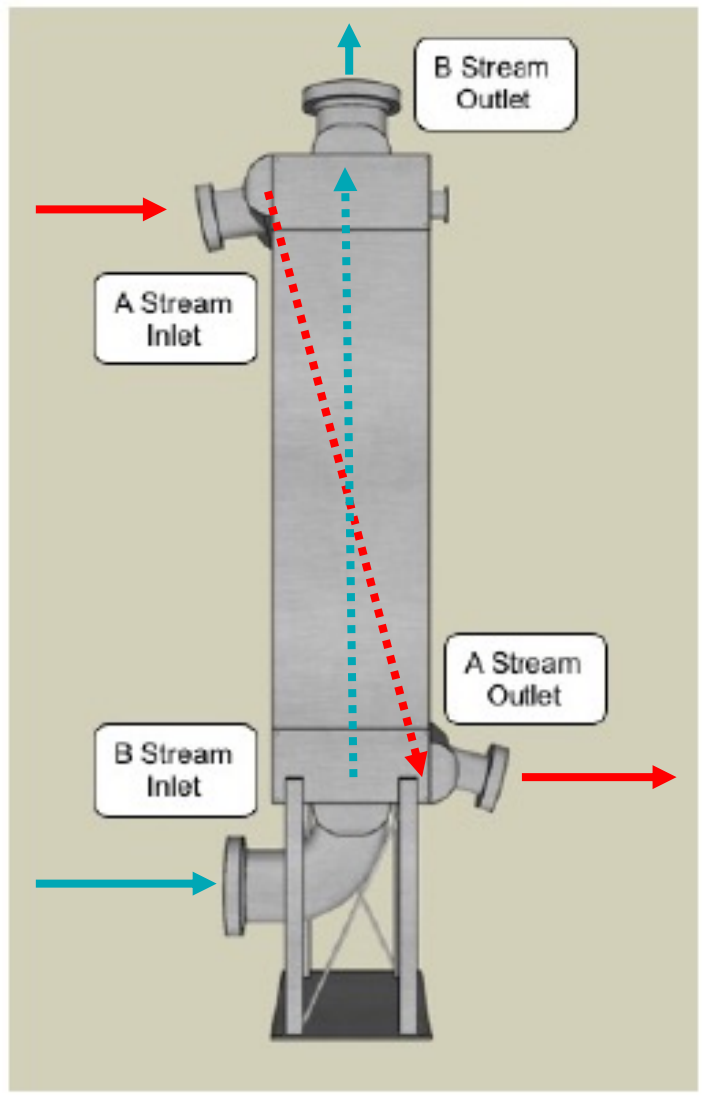
SJOERD HOOGWATER
PHILLIPS 66 COMPANY
MIDSTREAM OPERATIONS

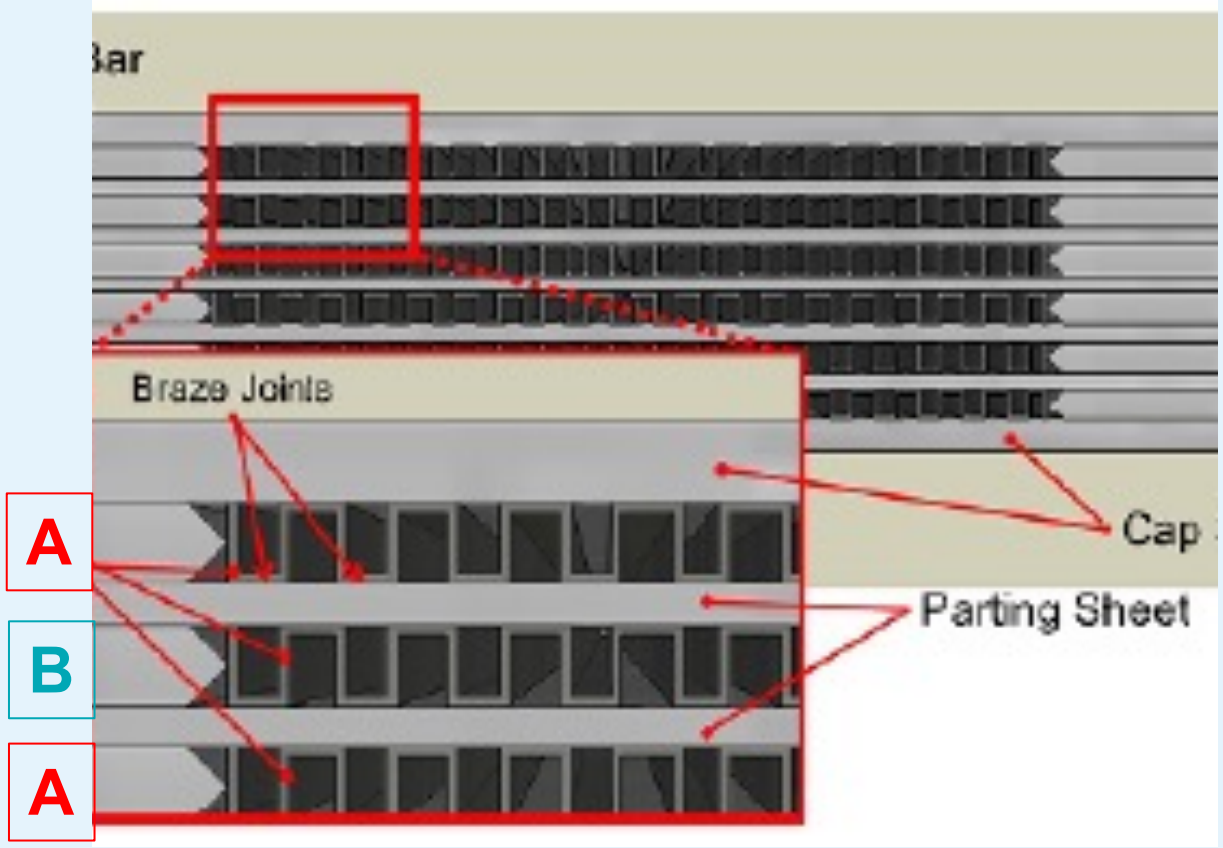
May 2024

Phillips 66 Midstream Operations Overview



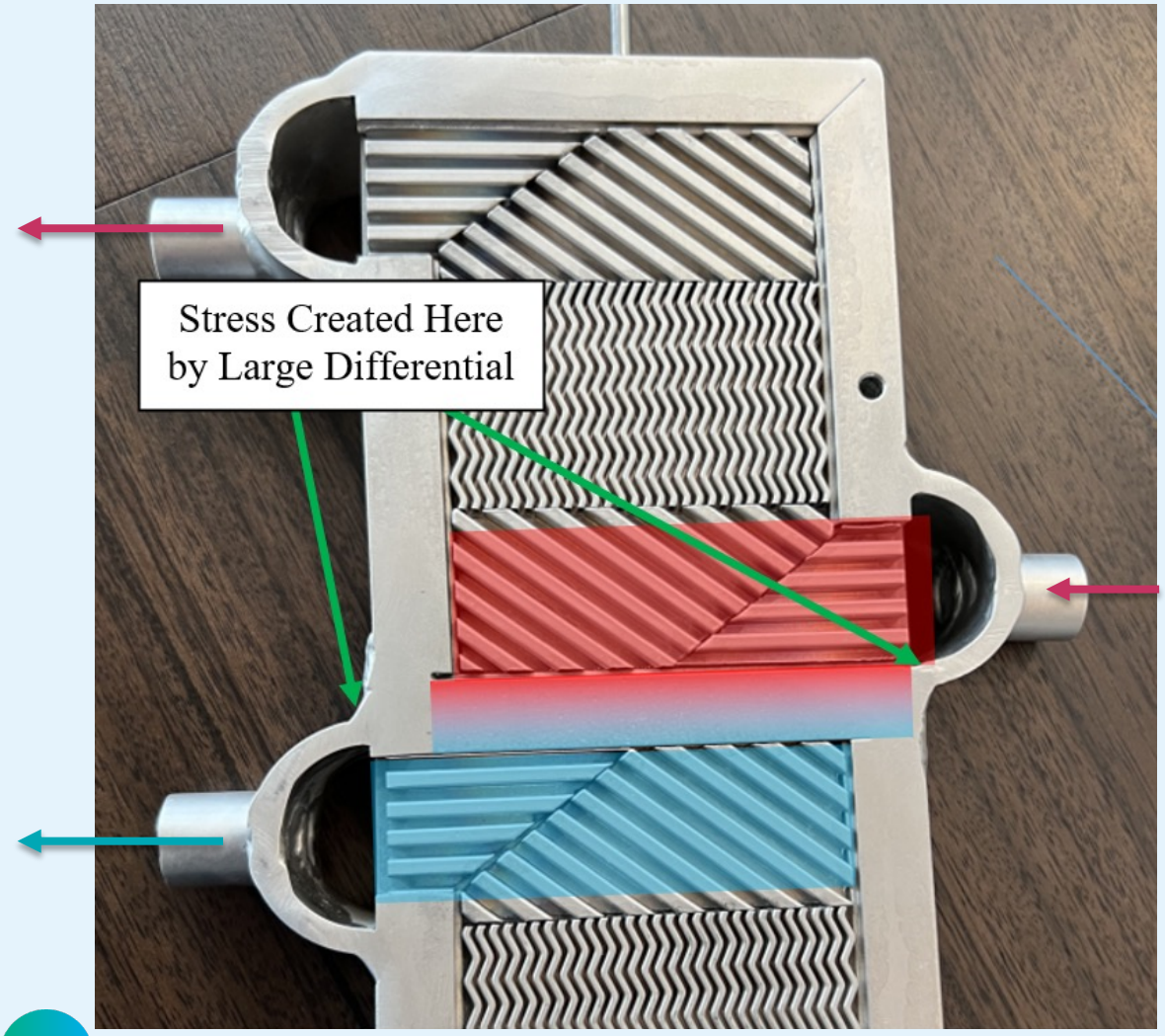
Brazed Aluminum Heat Exchanger Design





Source: Chemical Safety Board (CSB) report No. 2016-02-I-MS Figure 5 and 6, page 15

BAHX Stress due to High Temperature Differentials

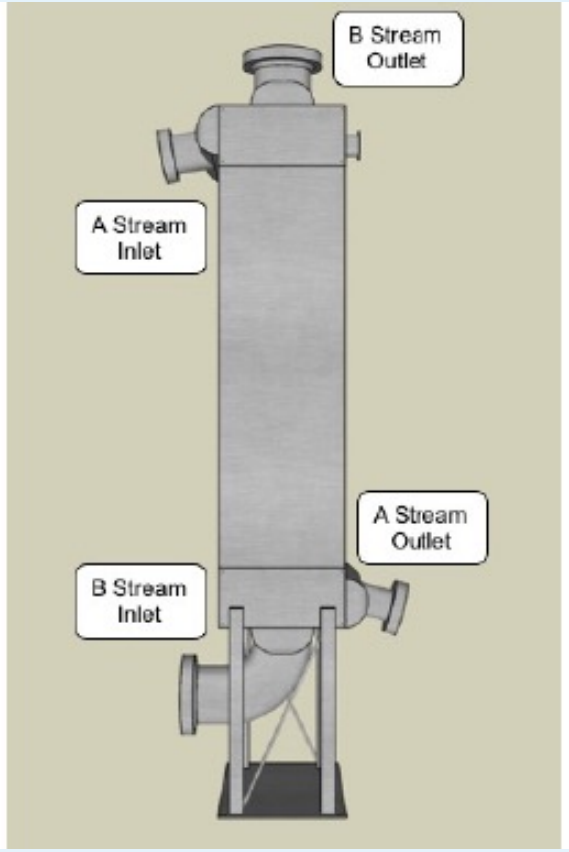


BAHX Damage

Source: Chemical Safety Board (CSB) report No. 2016-02-I-MS Figure 12, page 21

Published Recommended BAHX Operating Limits

- Not more than 36-54°F difference between adjacent two-phase streams
- Not more than 1.8°F/min rate of change at steady operation
- Not more than 3.6°F/min rate of change during startup/shutdown/transients



Sources:
Standards of the Brazed Aluminum Plate-Fin Heat Exchanger Manufacturer's Assiocation (ALPEMA), 2000, page 31, 37, 58
GPA Midstream Technical Bulletin GPA-TB-001, December 2020, page 12

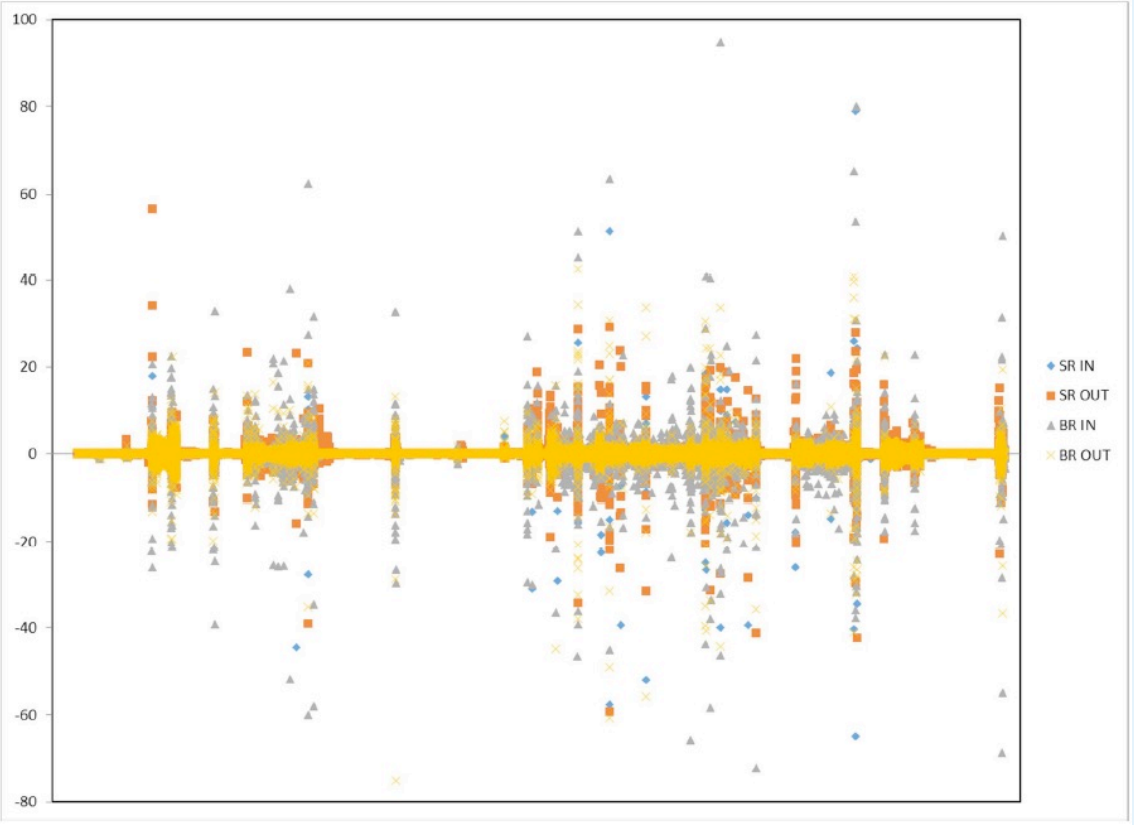
Why do we Monitor Temperature Excursions?

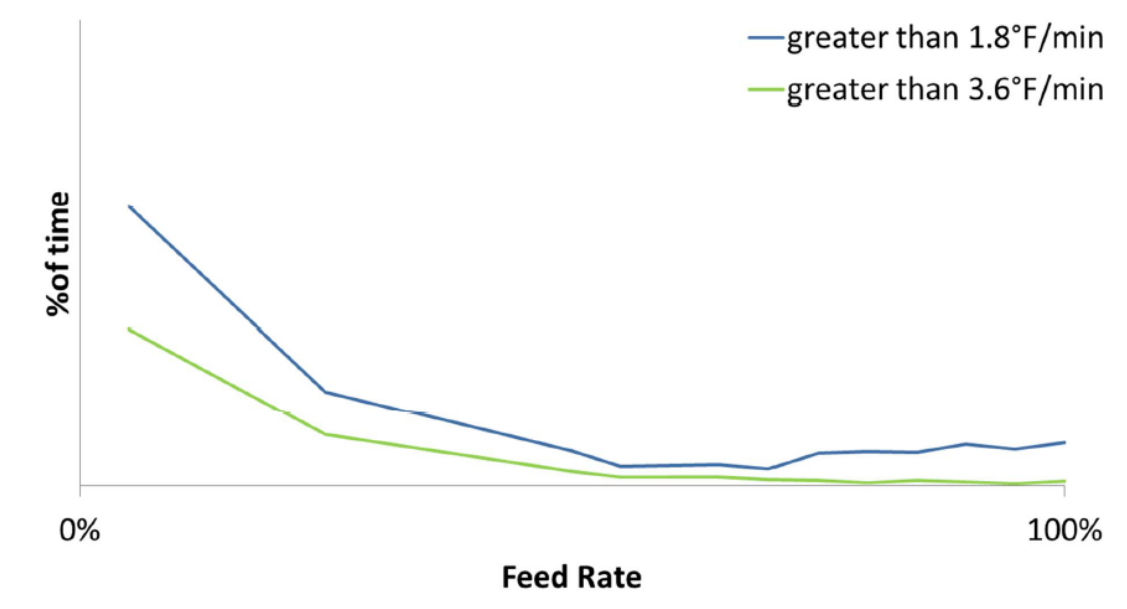
CHALLENGE	We know BAHX may fail if they see too many temperature cycles or excessive differentials
SOLUTION	Proactively monitor temperature excursions to prevent damage
RESULTS	Comprehensive tool to monitor all BAHX in the fleet

DCS Implementation

HEAT EXCHANGER RATE OF CHANGE TEMPS IN DEGF/MIN																			HI HI ALARM > 1.8 DEGF/MIN FOR ONE MINUTE
NGL PRODUCT HEATER	TI-1 0.0																		
DEMETHANIZER BTM REBOILER	TI-2A 0.1	TI-2B 0.8																	
DEMETHANIZER SIDE REBOILER	TI-3A 3.3	TI-3B 1.8																	
INLET GAS CHILLERS	TI-4A 1.8	TI-4B 0.8	TI-4C 0.2																
REFRIG HEAD DRUMS	TI-5A 0.0	TI-5B 0.1	TI-5C 0.2	TI-5D 0.1															
GAS/GAS EXCHANGER	TI-6A 0.1	TI-6B 0.0	TI-6C 0.1	TI-6D 0.0	TI-6E 0.4	TI-6F 0.1	TI-6G 0.0	TI-6H 0.0	TI-6J 0.2	TI-6K 0.0	TI-6L 0.0	TI-6M 0.0	TI-6N 0.4	TI-6P 0.1					
NRU FEED/TOWER REBOILER	TI-7A ***	TI-7B 0.0	TI-7C ***	TI-7D 0.0															
NRU FEED/TOWER REFLUX EXCHANGER	TI-8A 0.1	TI-8B 0.0	TI-8C 0.0	TI-8D 0.0	TI-8E 0.0	TI-8F 0.0	TI-8G 0.0	TI-8H 0.2	TI-8I 0.2	TI-8K 0.3	TI-8L 0.0	TI-8M 0.0	TI-8N 0.0						
H.P. NITROGEN RECTIFIER REBOILER	TI-9A 0.0	TI-9B 0.0	TI-9C 0.0	TI-9D 0.1															
NRU REBOILER/CONDENSER	TI-10 0.1																		
L.P. COLUMN FEED SUBCOOLER N2 CONDENSER	TI-11A 0.1	TI-11B 0.0	TI-11C 0.1	TI-11D 0.1	TI-11E 0.2	TI-11F 0.8	TI-11G 0.2	TI-11H 0.3	TI-11J 0.1	TI-11K 0.2	TI-11L 0.1	TI-11M 0.1	TI-11N 0.1	TI-11P 0.0					
ACK	ACK ALL	DTL	TOGGLE														A/M	R/L	PREV DISP

Historian Data in Excel



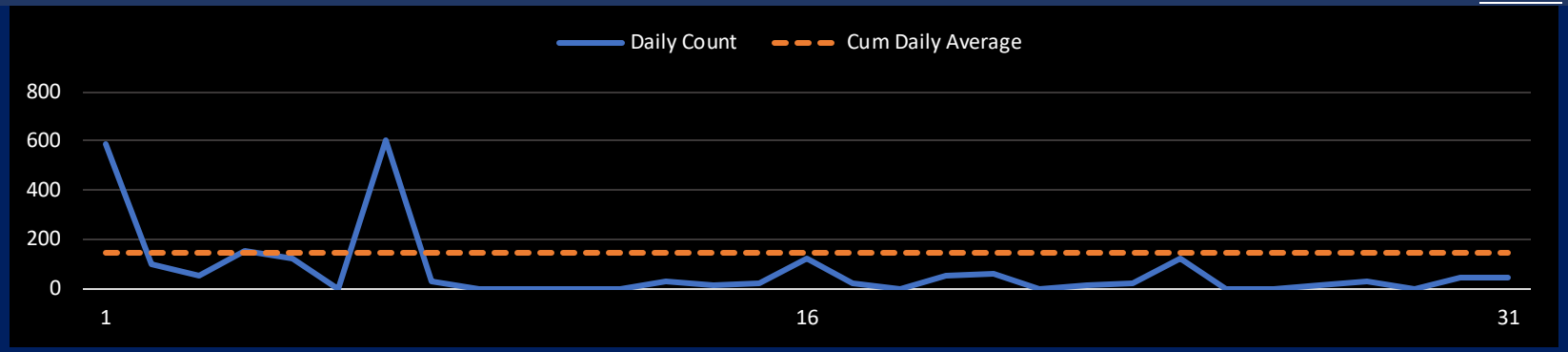


PI System Explorer

E-201 Gas/Gas Exchanger

Details

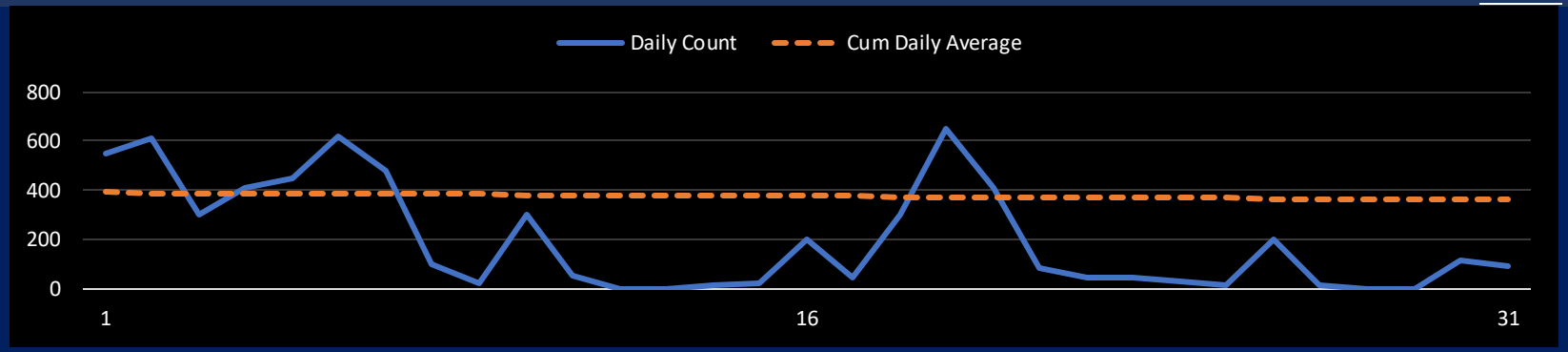
Stream	Cumulative since 2019 Cum. Count	Daily Avg Count
Cold Stream Out	106,102	55
Hot Stream In	34,673	18
Hot Stream Out	131,842	68



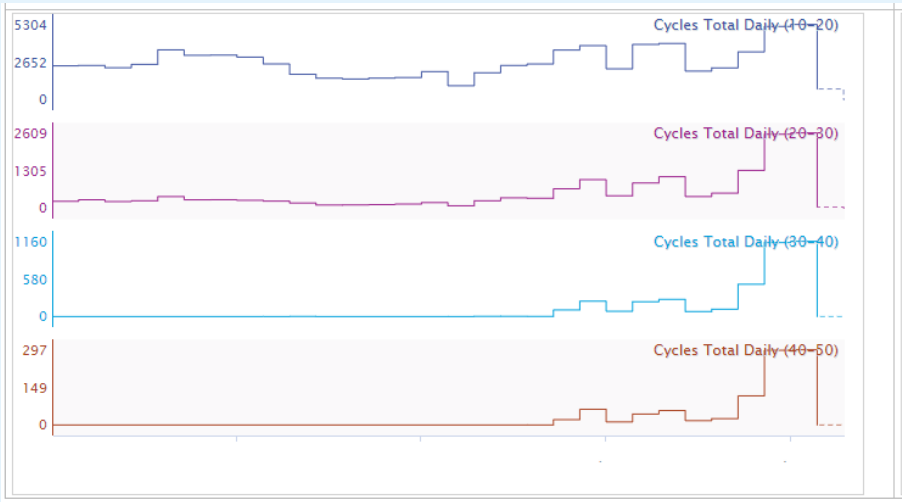
E-204 Demethanizer Reboiler

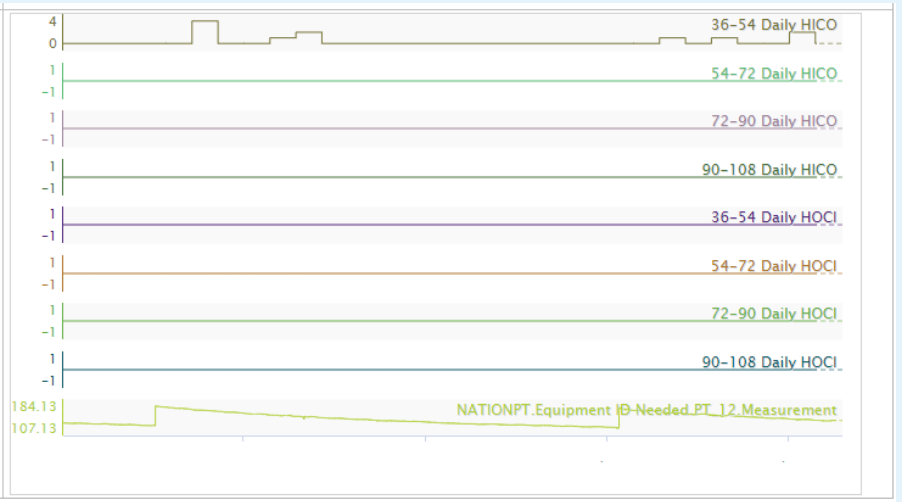
Details

Stream	Cumulative since 2019 Cum. Count	Daily Avg Count
Cold Stream Out	235,415	121
Hot Stream In	483,486	251
Hot Stream Out	21,452	11



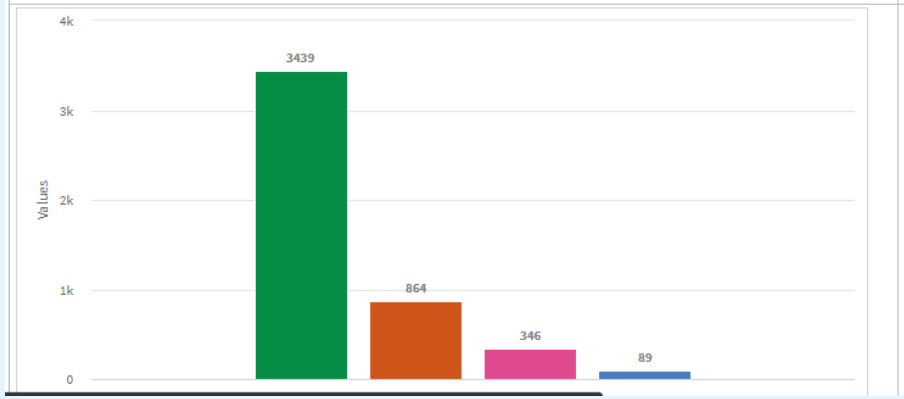
Initial Seeq Solution





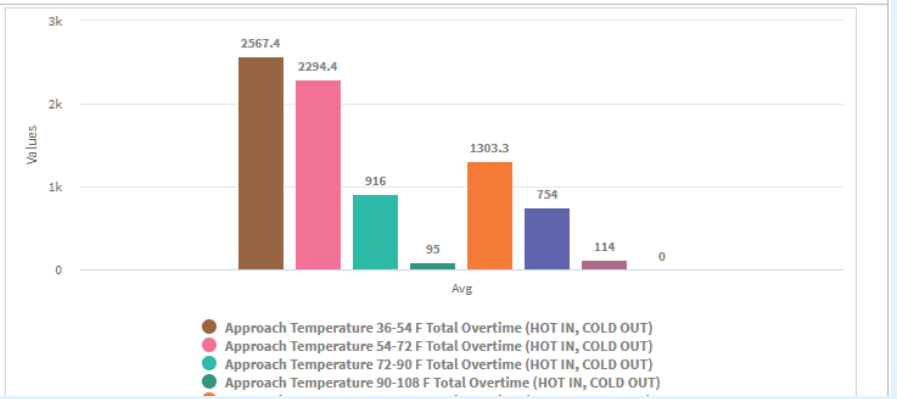
Total Cycle Counts [redacted]

NGL exchanger



Total Approach temperature counts [redacted]

NGL exchanger

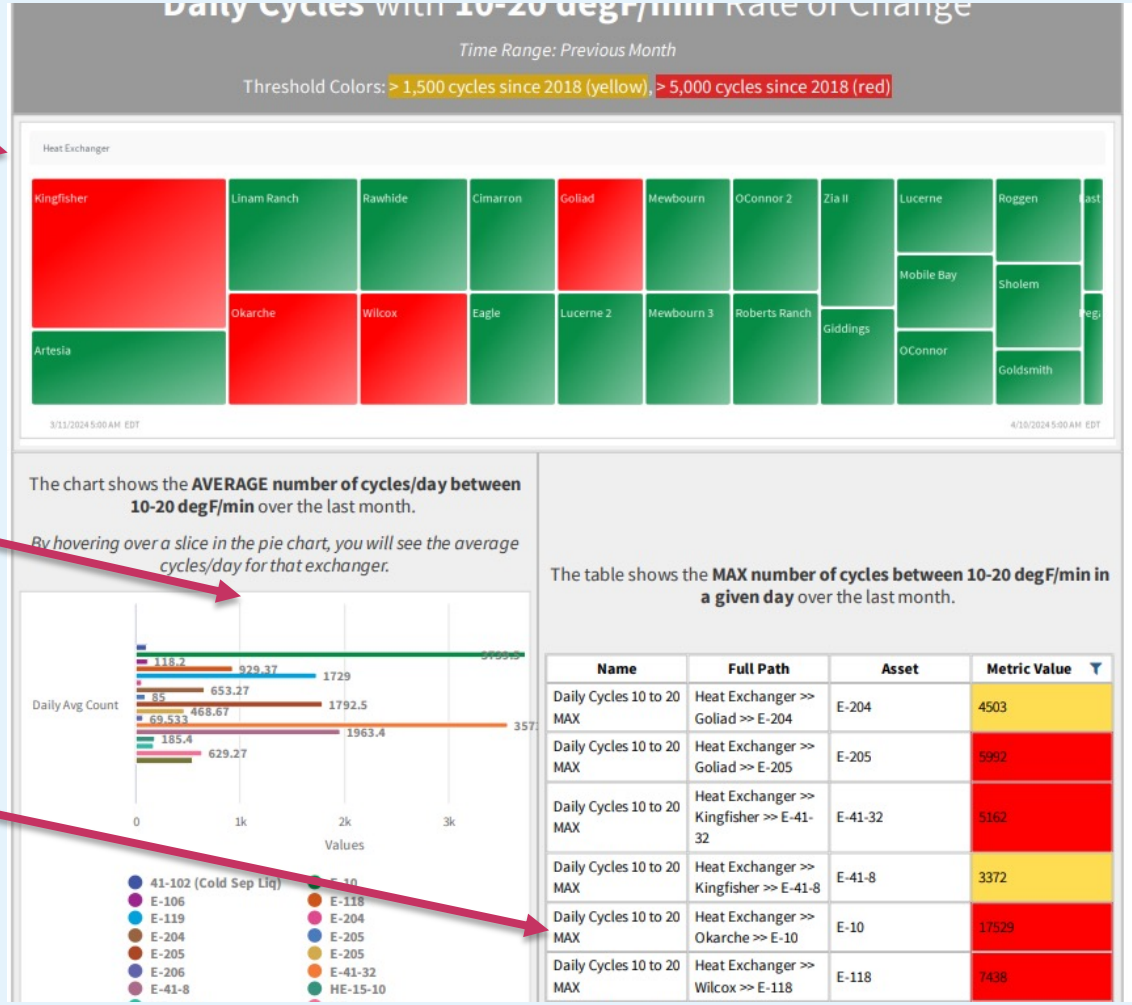


Improved Seeq Solution

- Re-tooling and creating a dedicated asset framework to look at all 99 BAHX in the fleet
- One comprehensive dashboard for all plants
- No need to re-generate for every heat exchanger
- Collaboration with Seeq support engineers
- Separate Data Lab script automatically generates the asset framework

Dashboard (Thermal Cycles)

- Treemap shows which facilities need attention
- Bar Chart shows which exchangers had a lot of cycles over the last month
- Table shows which exchangers had the most cycles during one particular day

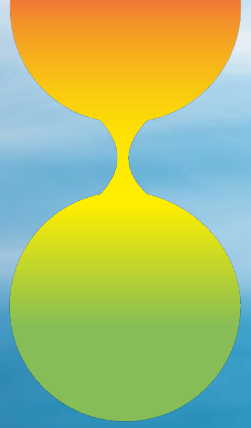


Impact to the Organization

- Engineers
  - Identification of problematic BAHX
  - Identification of problematic operating conditions
- Operations
  - Highlighting potential operational improvements
- Maintenance
  - Early warning system for potential failures
  - Focus on the bad actors

What is Next?

- Roll-out to the asset engineers
- Roll-out to other parts of Phillips 66
- Implementing more dashboards with a similar concept:
  - Compressor issues
  - Corrosion issues
  - Preventative maintenance



Thank You

conneqt