



Eliminating process hazards in a Debutaniser Column: A real life example

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European Process Safety Centre (EPSC)

Shell Deutschland Oil GmbH,
Rhineland Refinery

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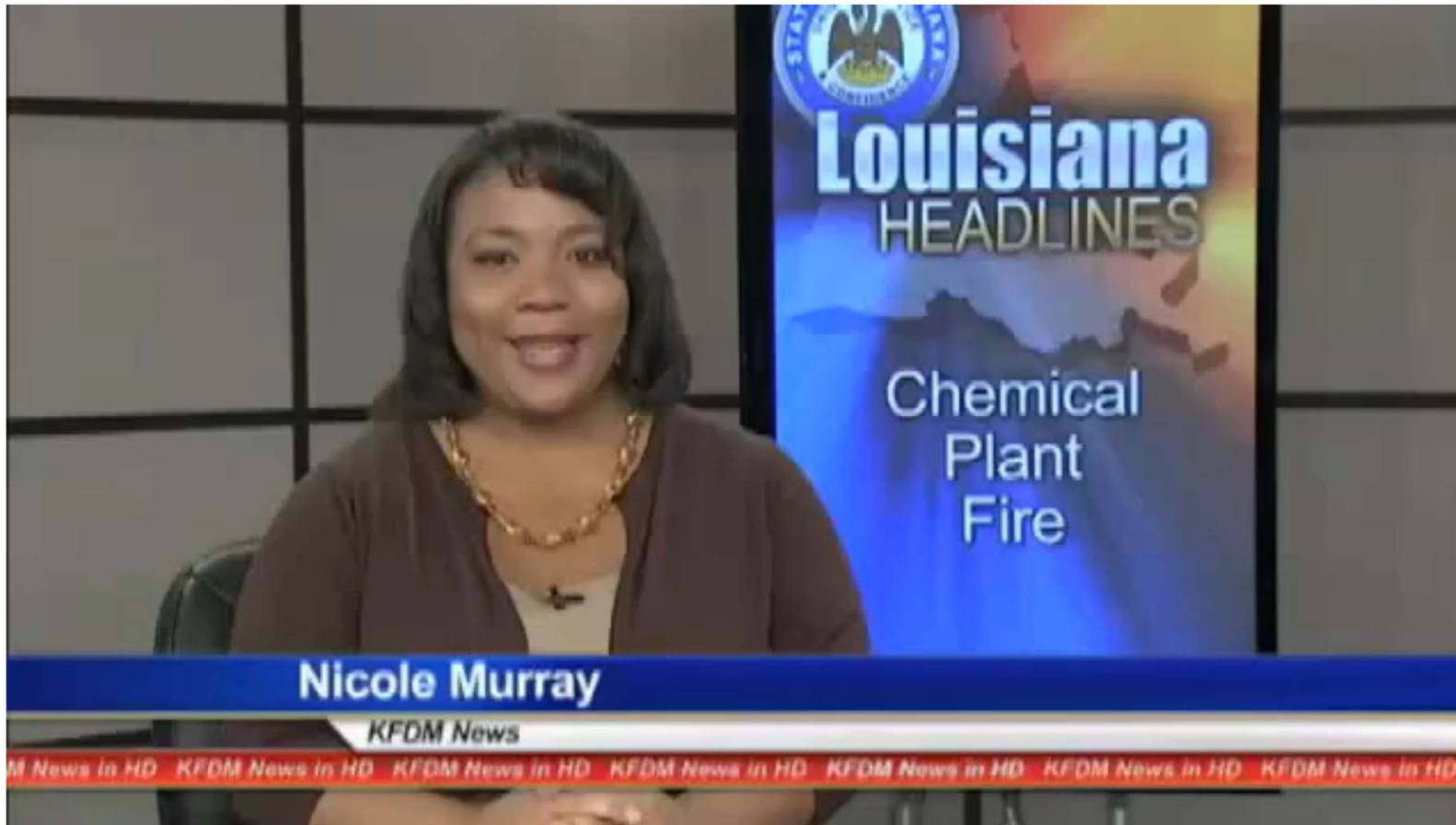
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Back in Time ... 2013, Williams Olefins, Geismar Louisiana



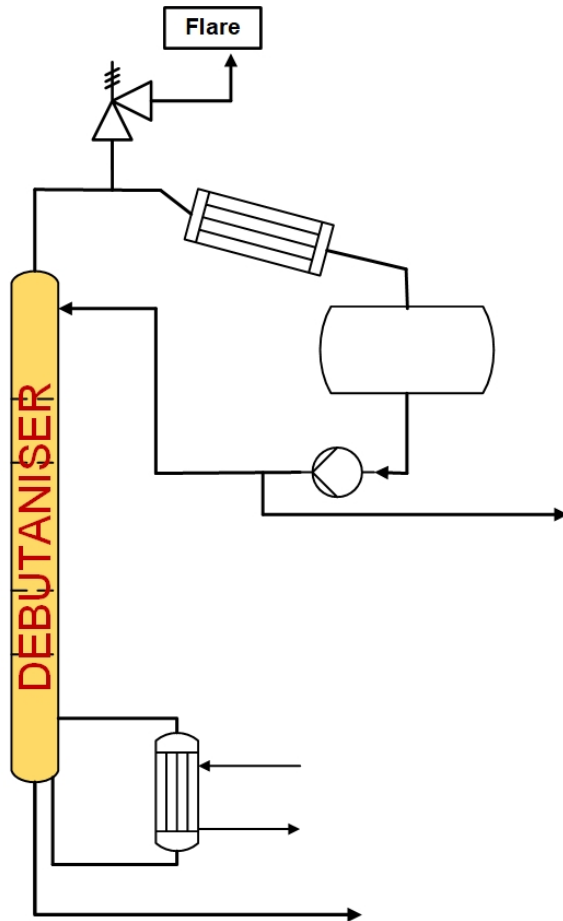
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Back in Time ... 2013, Williams Olefins, Geismar Louisiana

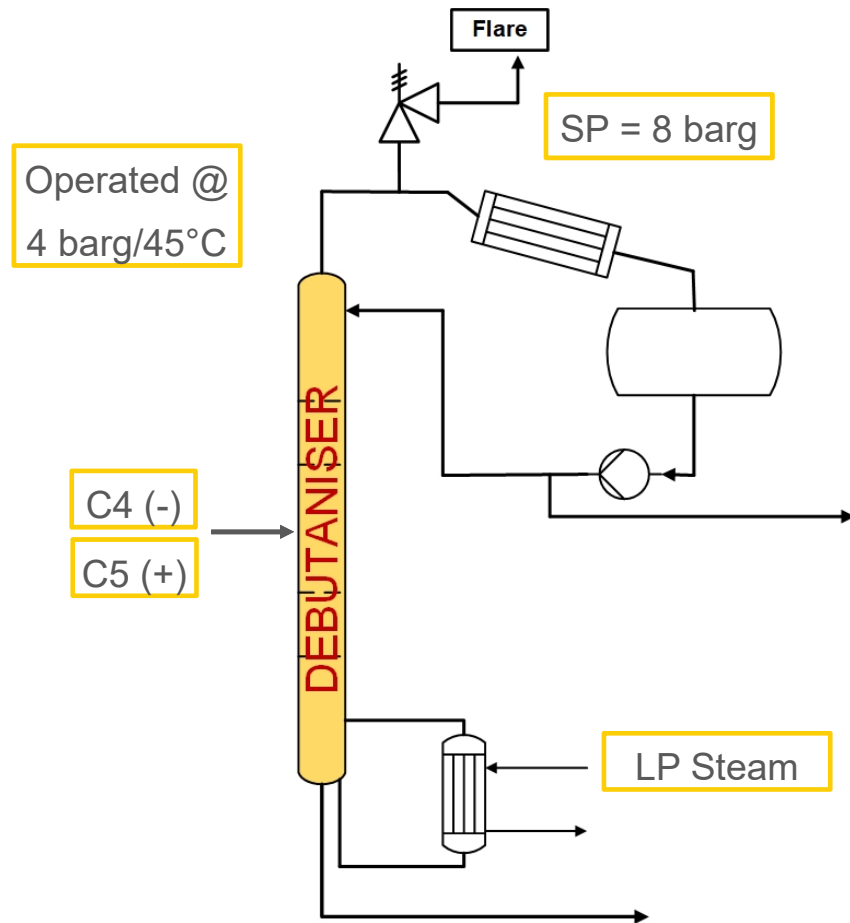


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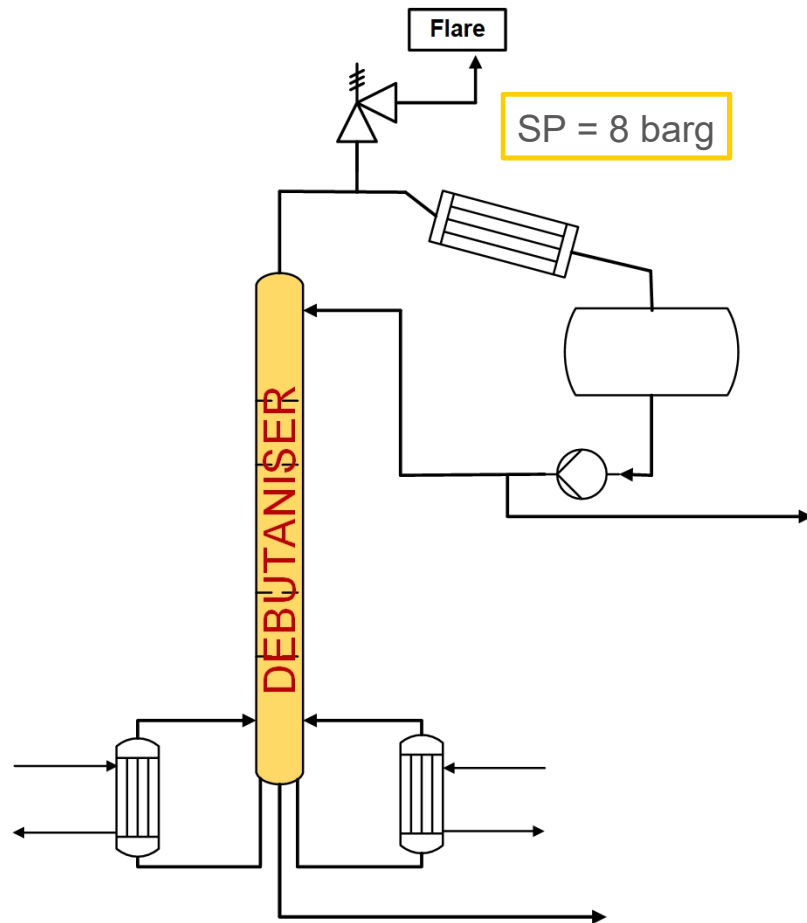
The Debutaniser at Shell Rhineland



The Debutaniser at Shell Rhineland

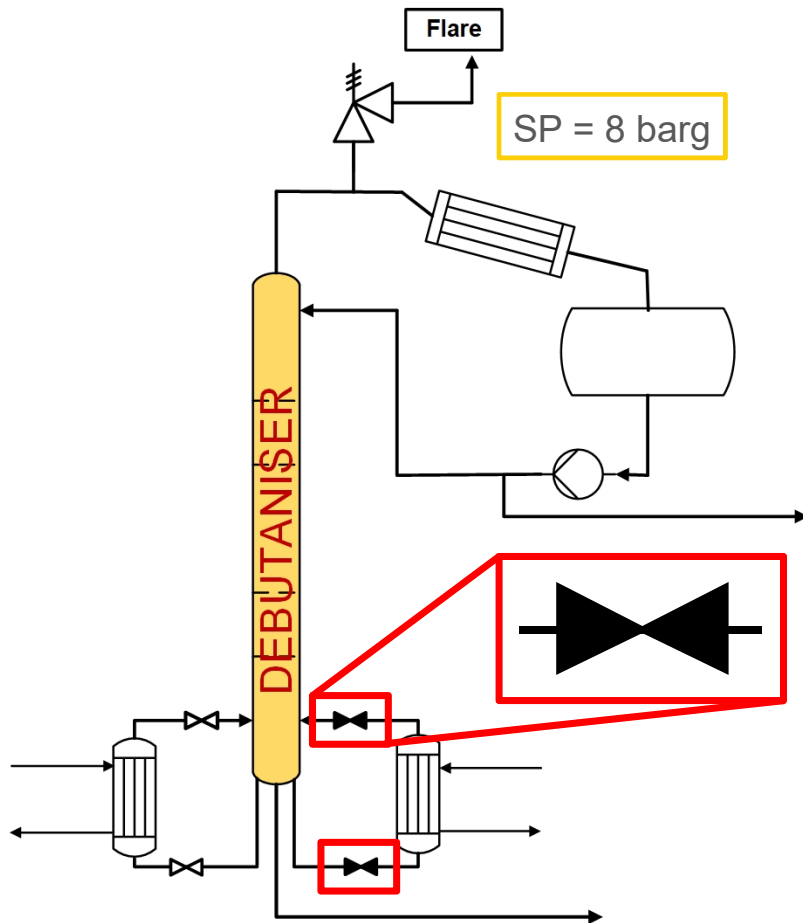


The Debutaniser at Shell Rhineland



- Two reboilers, one of them in spare.

The Debutaniser at Shell Rhineland



- Two reboilers, one of them in spare.
- Spare is “blocked-in”.

What happened at Williams Olefins?



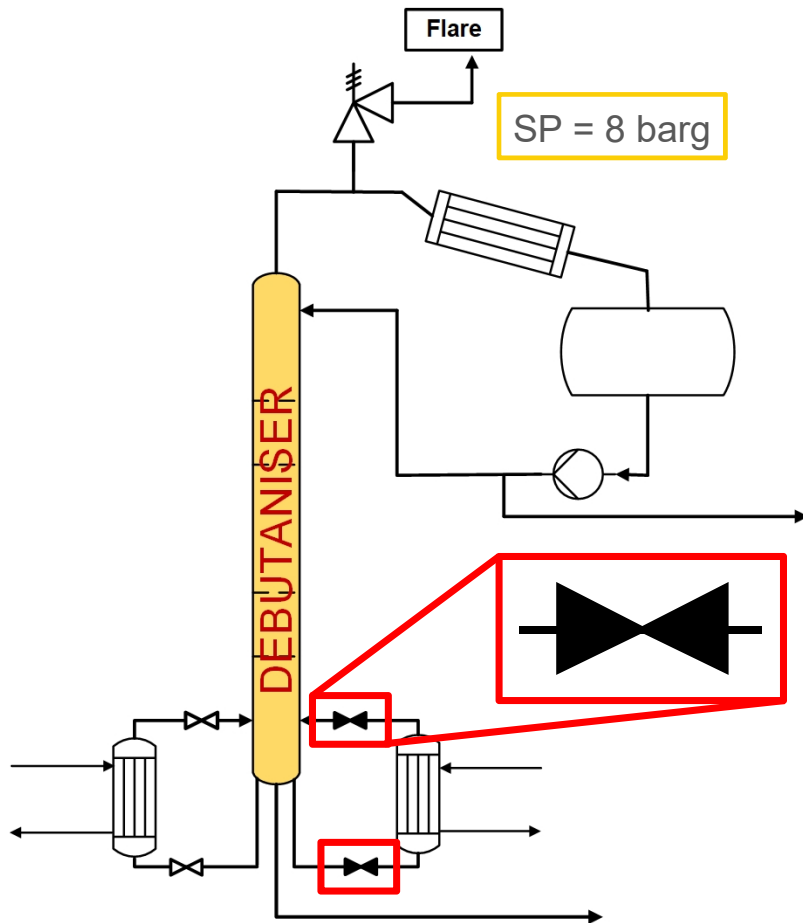
Source: USCBS Video on YouTube (<https://www.youtube.com/watch?v=TIFrxqzdAMw>), shortened

What happened at Williams Olefins?



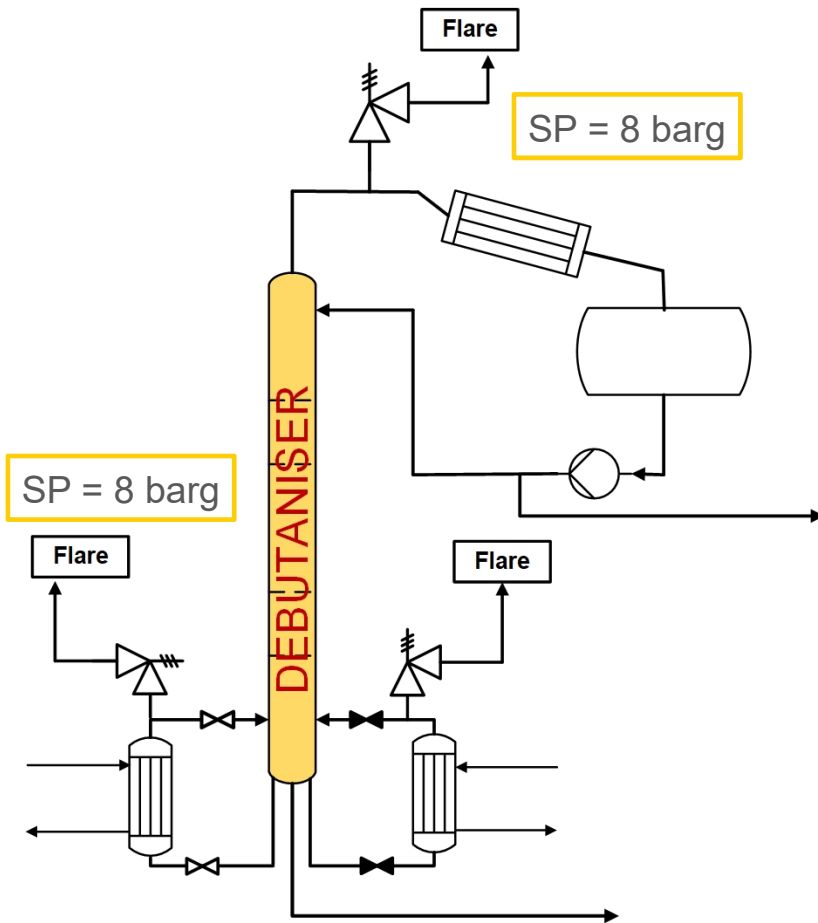
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The Debutaniser at Shell Rhineland



- Two reboilers, one of them in spare.
- Spare is “blocked-in”.

What we did at Shell Rhineland



- Two reboilers, one of them in spare.
- Spare is blocked in.
- At Shell protected by Pressure Relief Valve.
- Design case „blocked in“ scenario.

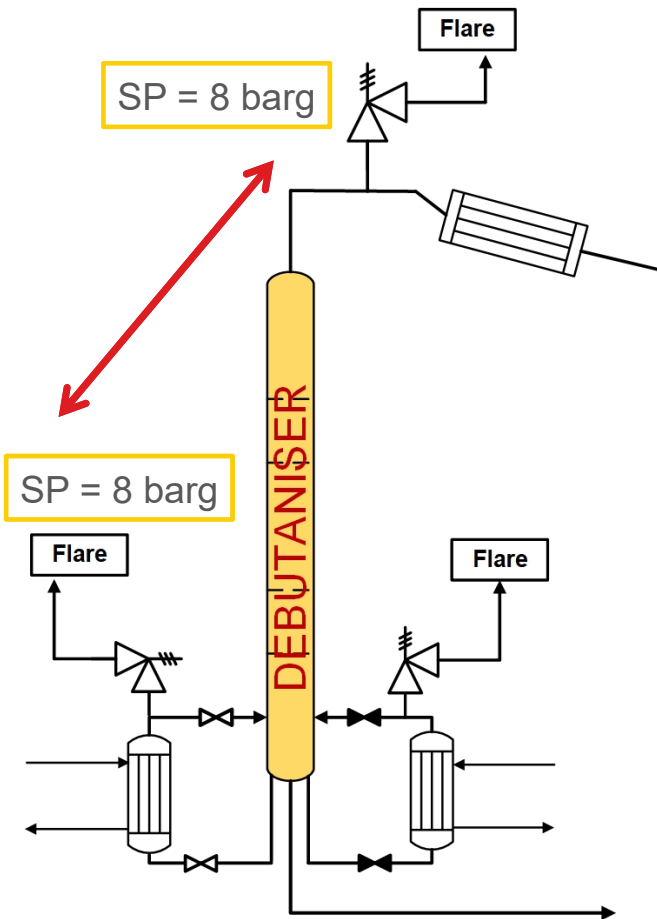
1985 - Incident in Priolo, Italy



- Major incident killed 23 people.
- Process piping failed due to chattering of the reboiler pressure safety valve.
- Priolo column had top and bottom pressure safety valve at same set pressure.
- Same set-up as we have on the Debutaniser.

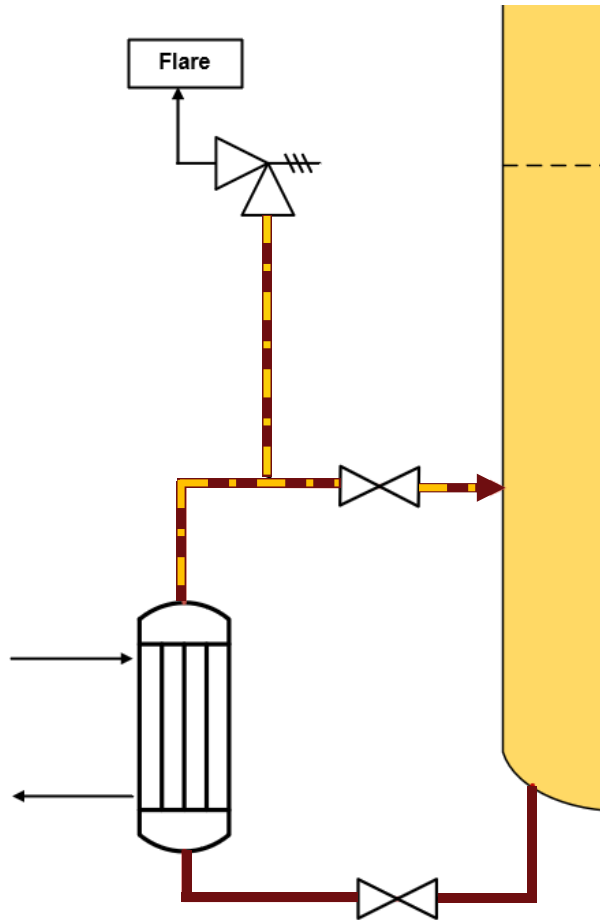
is our Debutaniser at risk?

Risk of Chattering in Debutaniser



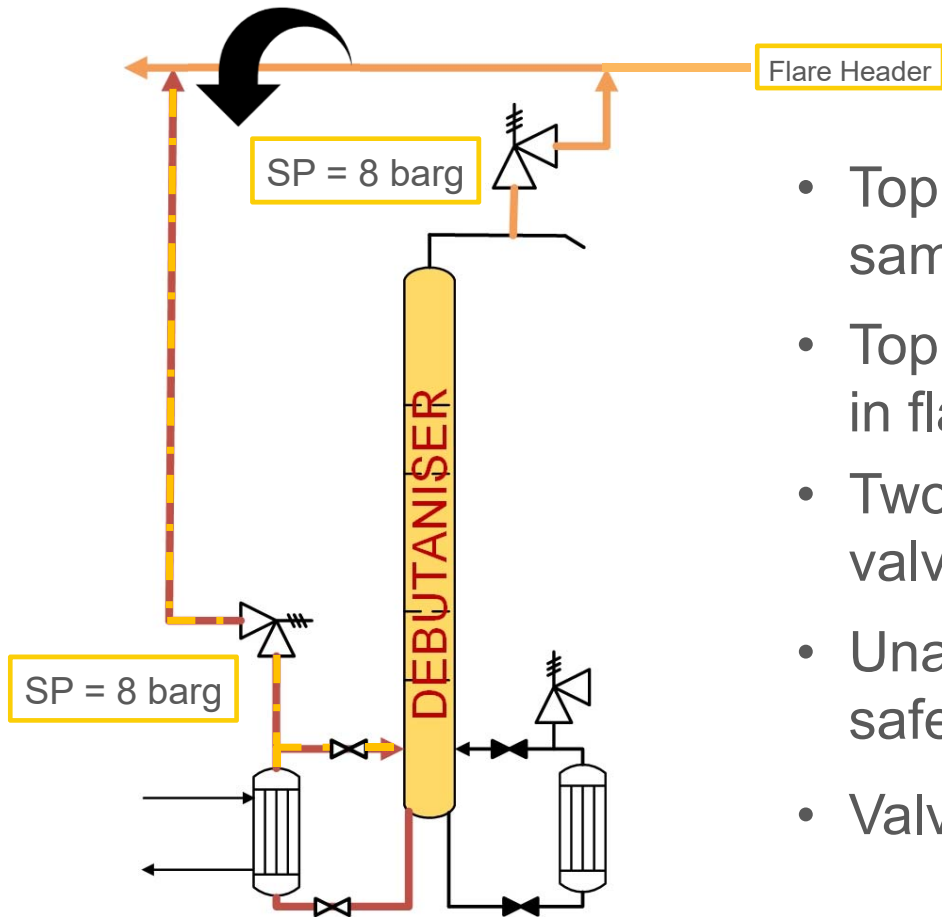
- Top and bottom pressure safety valves at same set pressure.
- Top and bottom pressure safety valves will open simultaneously
- More than 140% of required relief capacity leading to 'over relieve' the system.
- Valves prone to chattering.
- Chattering can cause significant mechanical strain on pipes and components.

Risk of Chattering in Debutaniser



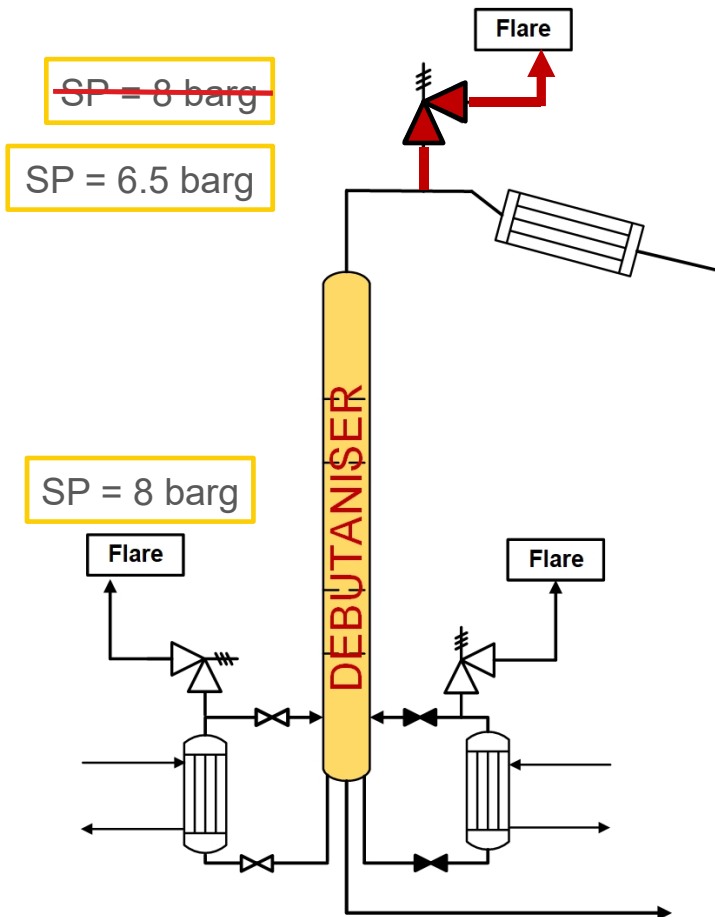
- Two phase flow into valve
- Increased pressure drop in inlet line to safety valve
- More than 3% of safety valve set pressure
- Valves prone to chattering.

Risk of Chattering in Debutaniser



- Top and bottom pressure safety valves at same set pressure and connected to column.
- Top pressure safety valve pops causing pressure in flare header
- Two phase flow from reboiler pressure safety valve causes pressure in tail pipe to increase
- Unacceptable backpressure on pressure safety valve
- Valves prone to chattering.

What we did at Shell Rhineland



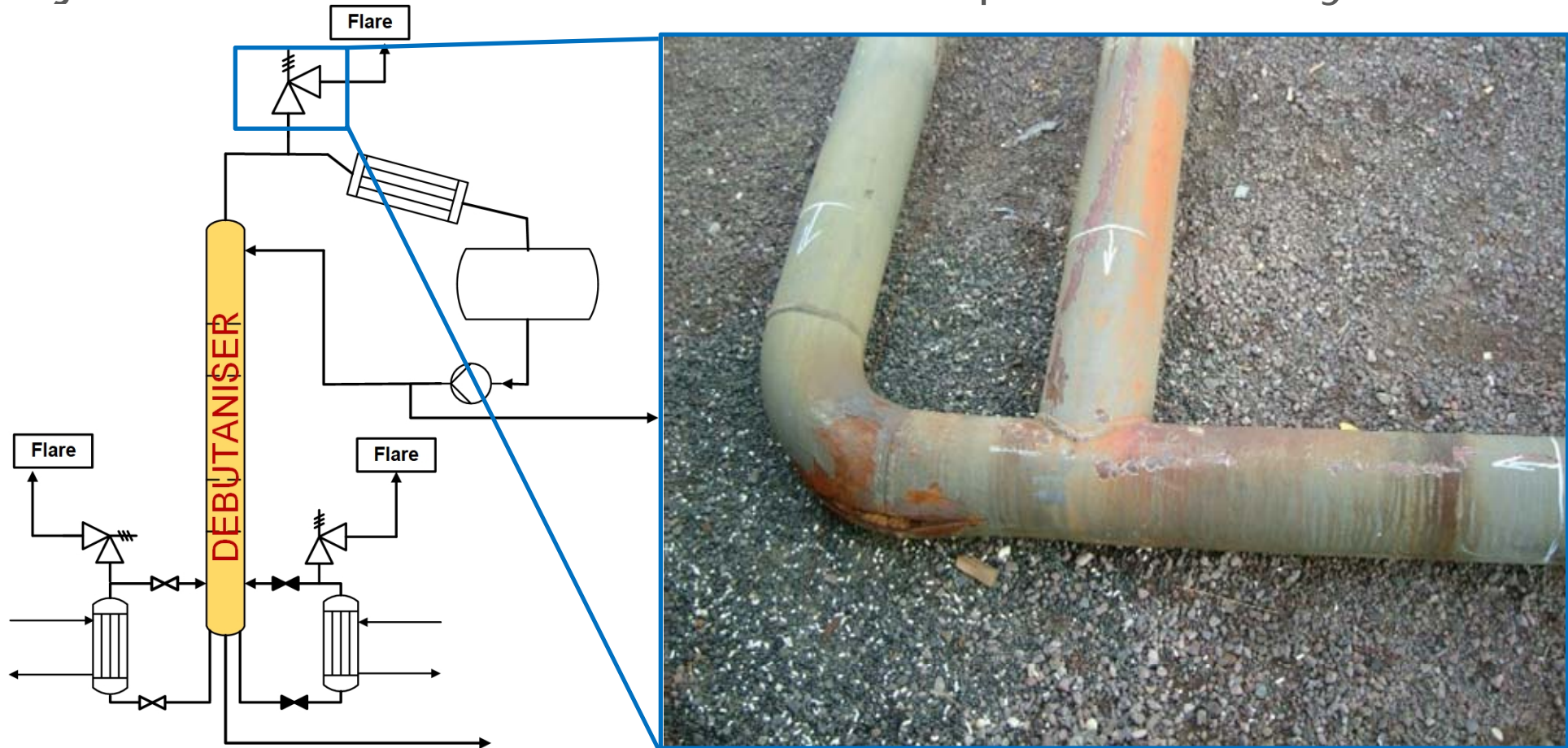
- New Pressure Safety Valve (larger size)
- New inlet piping for the Pressure Safety Valve to fulfill 3% rule
- New tail piping for the Pressure Safety Valve

All risks eliminated?

Major incident on the Debutaniser prevented by 'luck?!'



Major incident on the Debutaniser prevented by 'luck?!'



Popcorn Polymer



What we did at Shell Rhineland



- Continuous flushing of the stagnant volume to the pressure safety valve.
- Updated commissioning procedure to reduce oxygen content to about 20 ppm.
- Passivation treatment before start-up
- Neutron Backscatter Scan of equipment once a year
- Installed SIL1 shut-off safety function in case of high pressure.

Summary and Key Learnings

- The debutaniser at Shell Rhineland is a real life example for the following:
 - Process safety is a journey. Continuous improvement is a must.
 - Attention to the detail is critical. Really understand background and scenarios.
 - Learn from history and previous incidents.
 - Nobody knows all. Keep in touch with other internal and external experts.

Improving the safety of the Debutaniser has been happening over many years, based on insights from past accidents and detailed investigations to understand causes. This has helped us to install technical barriers to mitigate the risks. We will continue to keep in touch with relevant industry partners and experts. The journey might not yet be finished.



Acknowledgments

Peter Loecker

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Jos Reinders

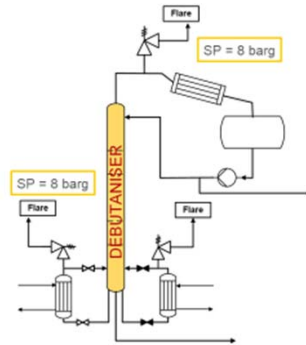
Thank you

Back in Time ... 2013, Geismar, Louisiana



Source: YouTube (<https://www.youtube.com/watch?v=3V7y67GTM>)

What we did at Shell



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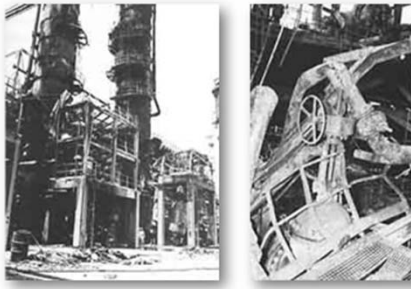
Popcorn Polymer



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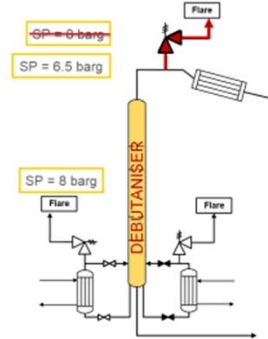
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1985 - Incident in Priolo, Italy



Source: https://aresweb.priolo.it/struttura/ceded/sistemaperiodico/s14/s14_1_05.html

What we did at Shell



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