Cost Conscious Coker Unheading Valve Hydraulic System Design

Neal Cammy
Engineering Manager, BLAC INC.

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Agenda

- Comparisons to FCC
- History
- System Design
- Cases

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FCC

- Throttling service
  - for up to 6yrs
- Valve is process control, not pressure boundary
- ESD function critical to process protection
- Redundant and back-up systems required

Delayed Coker

- Cyclical on-off service
  - Strokes every ~12-16hrs
- Valve is process pressure boundary
- ESD function doesn't exist
- Redundant and back-up systems in spec

FCC

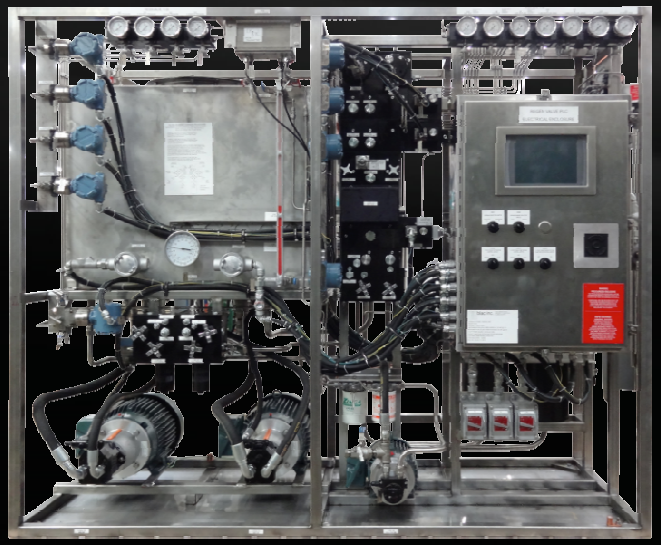
- 5 s throttling / 2 s ESD
- Failure to control properly
  - causes process upset
  - lost profits
- Spurious ESD
  - process upset
  - lost profits
- Failure to ESD
  - possible equipment damage
  - lost profits

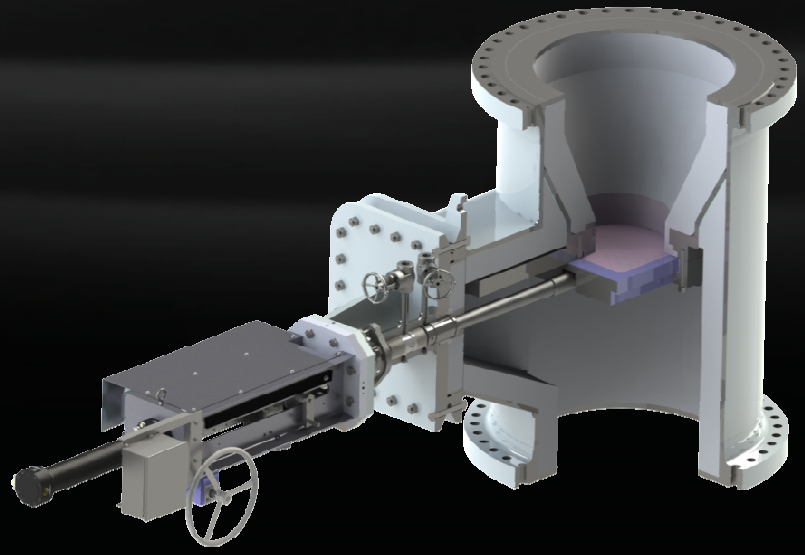
Delayed Coker

- 4 minute stroke speed
- Failure to move properly
  - delays coking cycle
  - lost profits
- Unintended opening while in service is worst case scenario
  - loss of process containment
  - HSE consequences

FCC Slide Valve Actuator History

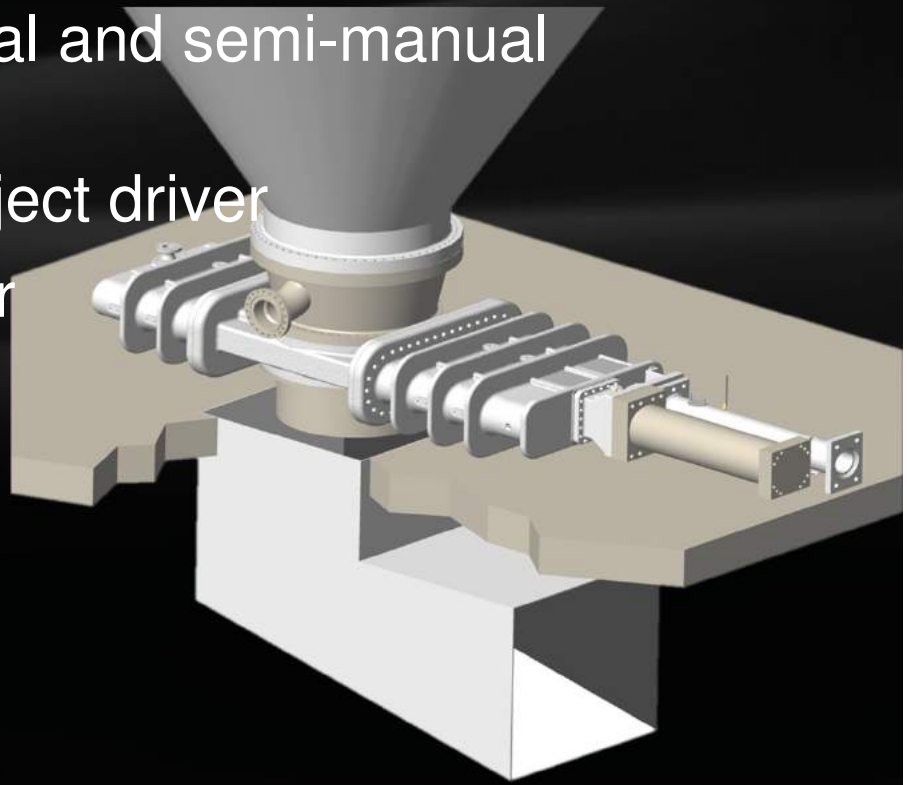
- Sophisticated throttling control valve positioner
- Generally one HPCU per operated device
  - One PLC or analog position controller per valve
- Highly available with backup and redundant systems
  - Developed over many years of experience (since late 1970's)





Coker Unheading Valves Hydraulic Actuators History

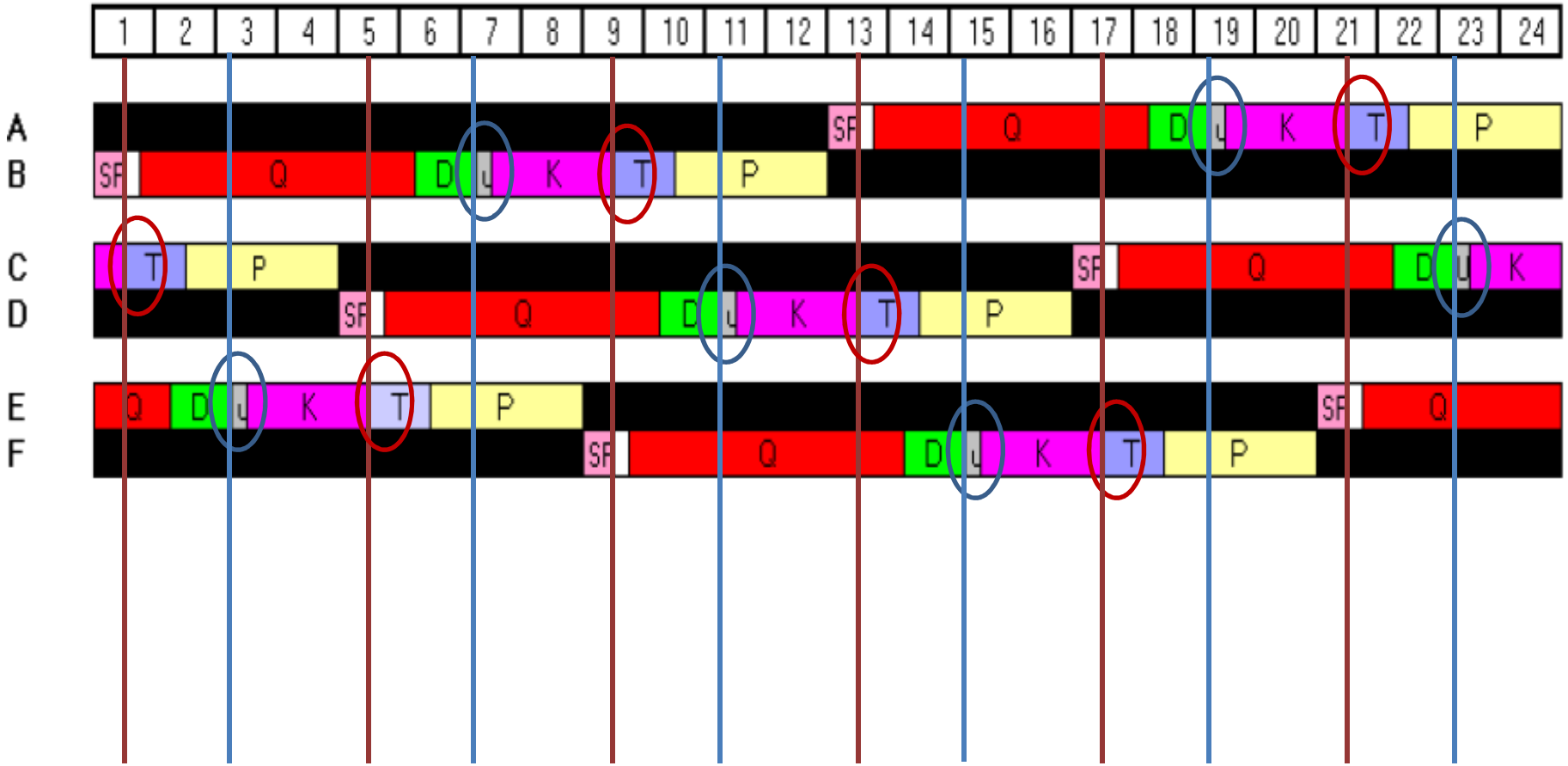
- First Installations in 2001
- Relatively new to process (compared to FCC)
- Previously, refiners used manual and semi-manual unheading systems
- Personnel safety is biggest project driver
- Increased throughput and lower operational/maintenance costs are also drivers



From DeltaValve, used with permission

Coker Unheading Valve Hydraulic System Design

6 Drum Coker - 12 hr Cycle



Once every 2 hours, a BUD and TUD is moved for 4 minutes each

Some questions…

- Which Hydraulic Power Unit design requires higher operational "availability" – FCC or Coker?
  - **FCC**: HPU requires 100% availability
  - **Coker**: Every 2 hours, a main pump runs for 8 minutes (96 minutes in 24 hrs – 6.7% required availability)
- Which Hydraulic Control Unit design requires higher operational "availability" – FCC or Coker
  - **FCC**: HCU requires 100% availability
  - **Coker**: In 24 hrs, each HCU operates for 8 minutes (0.56% required availability)

Some more questions…

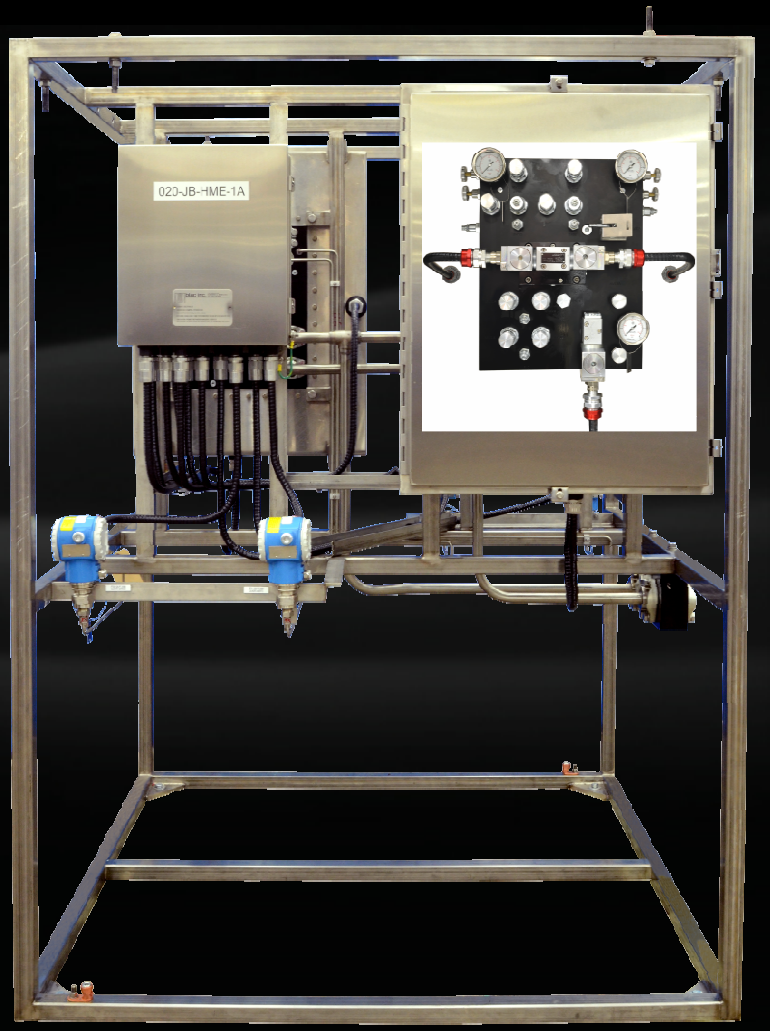
- Which system operates in a harsher environment – FCC or Coker?
- What backup systems are needed?
- What redundant systems are needed?
  - Redundant PLC control processors?
  - Redundant I/O?
- Do these systems require “SIL” rated instrumentation?
  - What does SIL mean anyway?
- What spare parts do we need?

How To Reduce Project Costs?

- Almost 40 yrs of FCCU electrohydraulic system experience
- Coker unheading projects should leverage that experience
- Projects should recognize intermittent nature of Coker operation (vs. FCCU)
  - However, many project specs seem to ignore that fact
- Excessive design requirements and over-specification causes project costs to skyrocket
  - We wish to supply safe and optimum designs

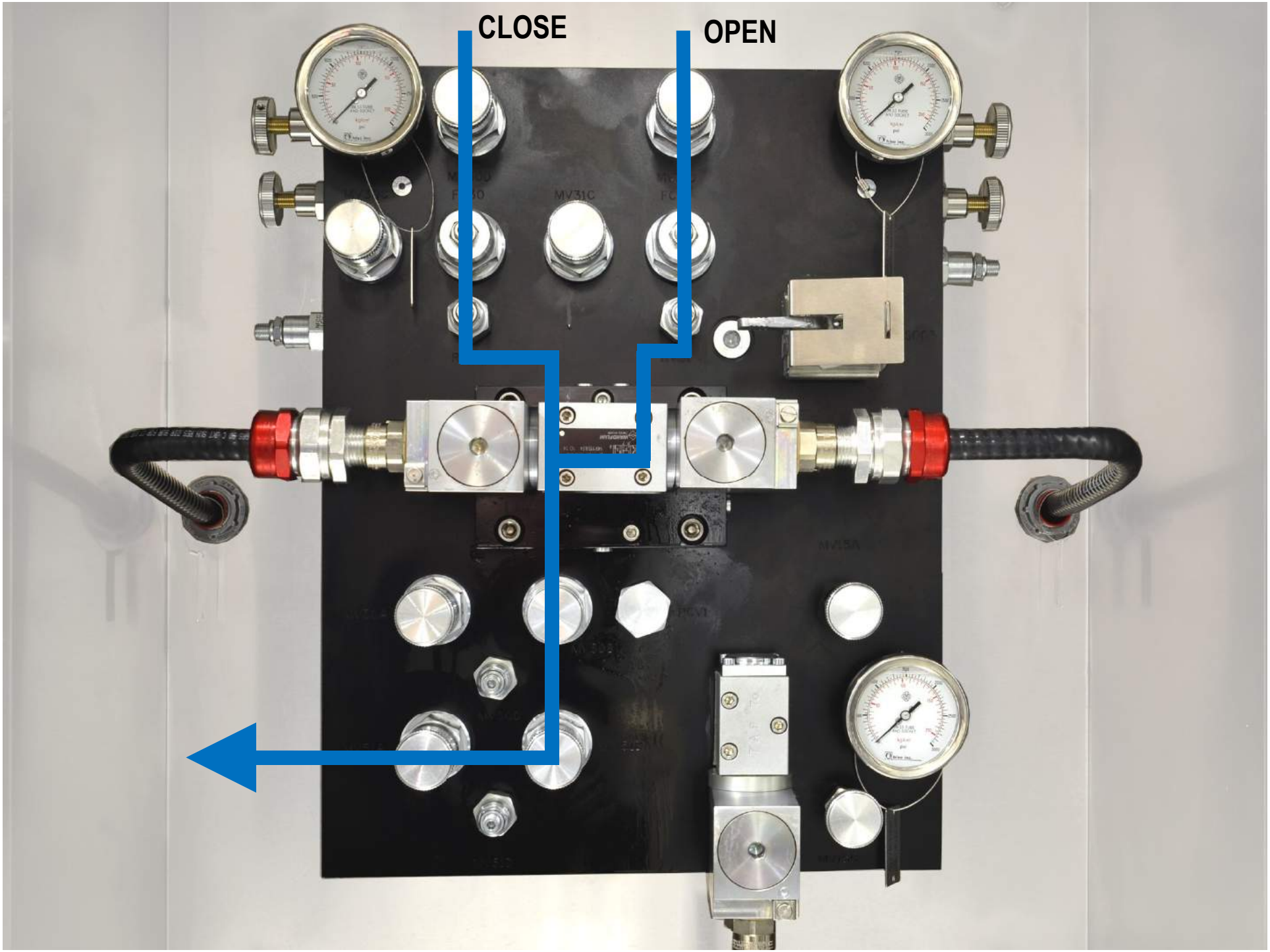
Let's Design a BUD/TUD Hydraulic System

- Move when commanded to move
- Prevent unintended movement of unheading valve!!
  - Prevent process energy from moving valve
  - Prevent external energy to actuator from moving valve
- A failure should not cause valve movement
- Inherent design of unheading device makes a difference



BUD/TUD Hydraulic Control Circuit

- Directional control valve design
  - One “open” solenoid, One “close” solenoid
  - Power off means hydraulic cylinder open to tank
  - Both sides of cylinder tied together
- Pressure isolation valve
  - Power off means no pressure to directional valve
- Permissive signal from refinery prevents unintended power to reach solenoid valves
  - Need permissive to permit power to solenoids
- Fail safe – no movement!
  - All solenoids are “energize to move”
- Pressure isolation valve plus directional control valve provides “double block and bleed”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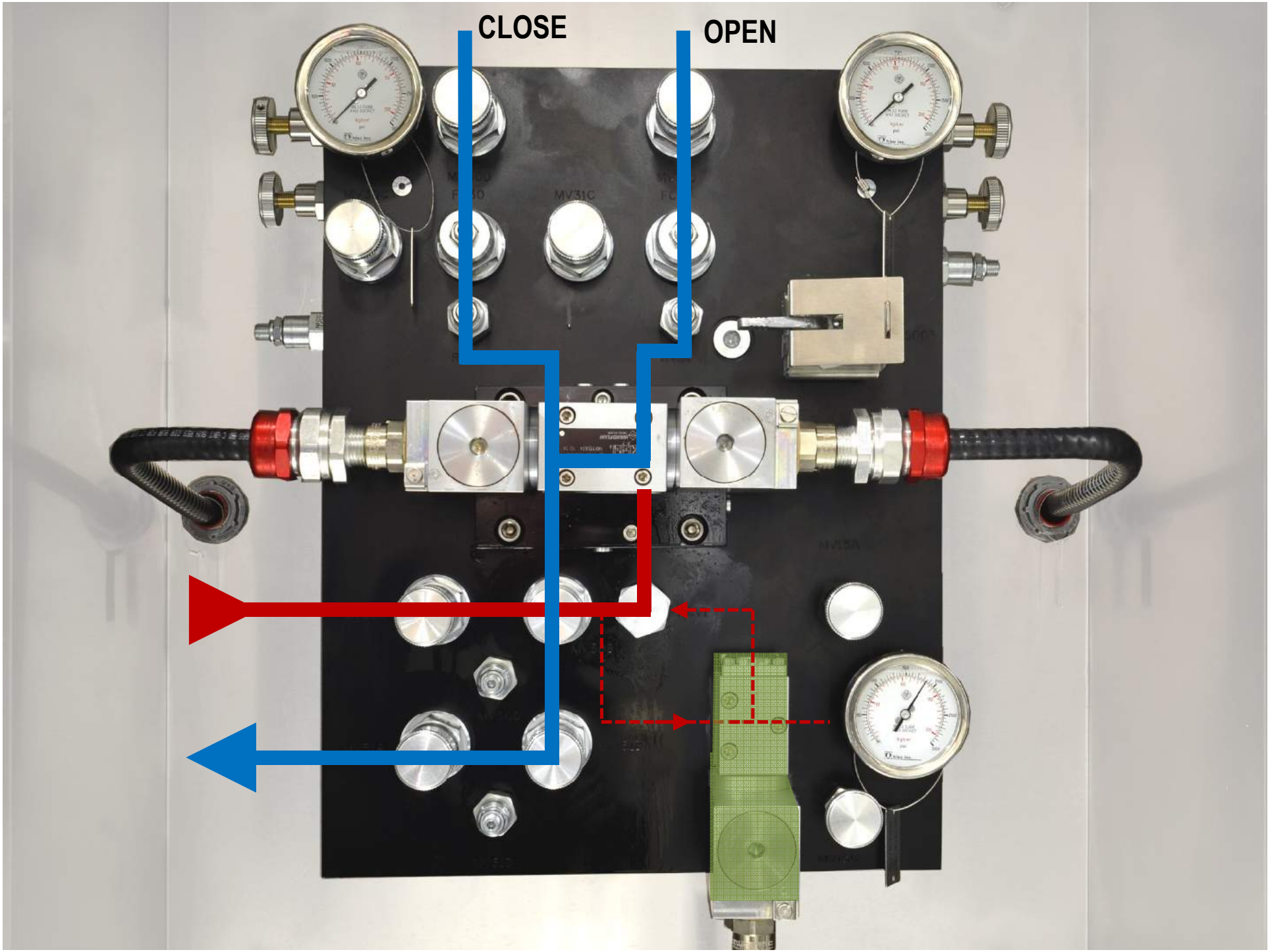
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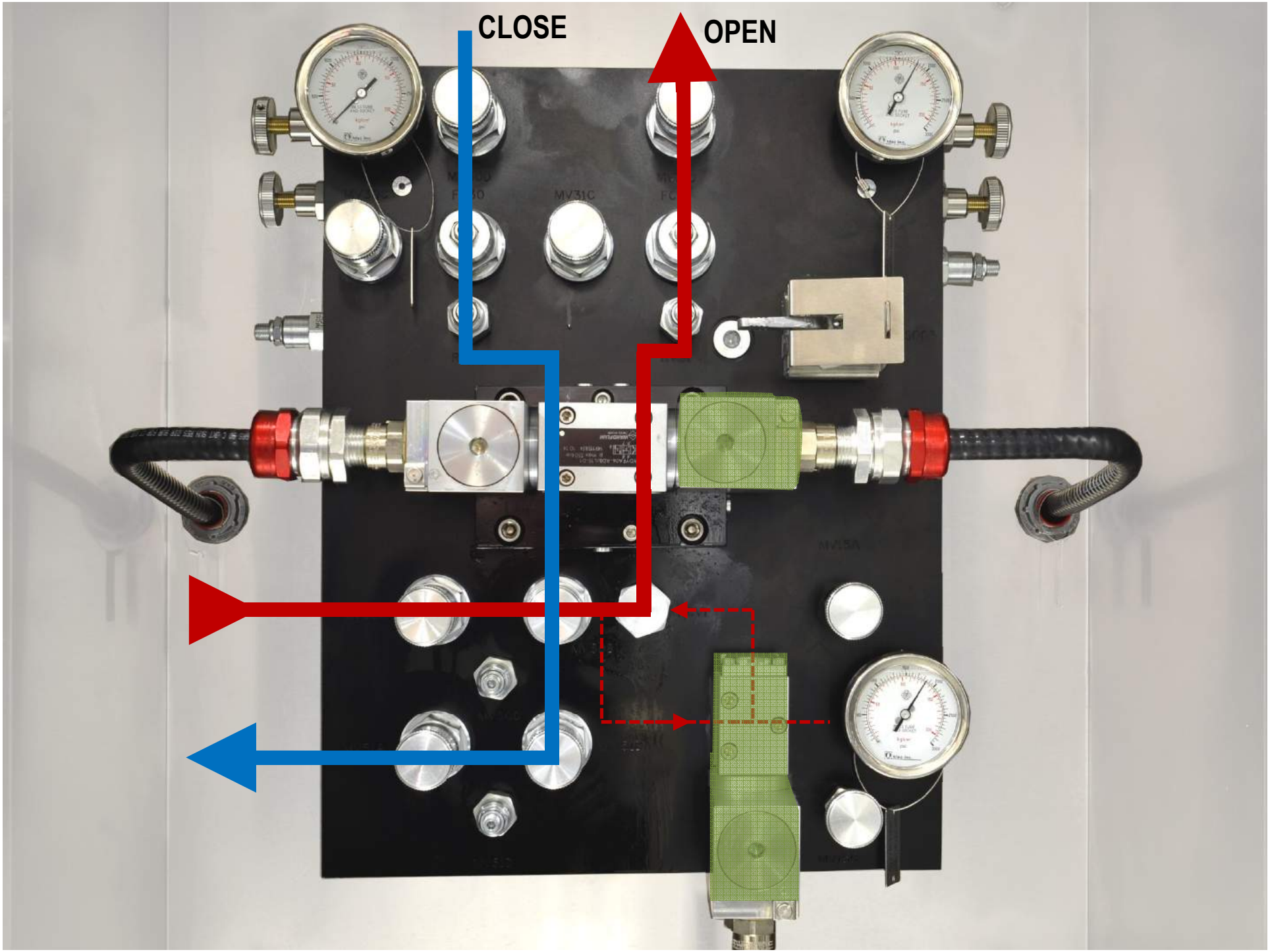
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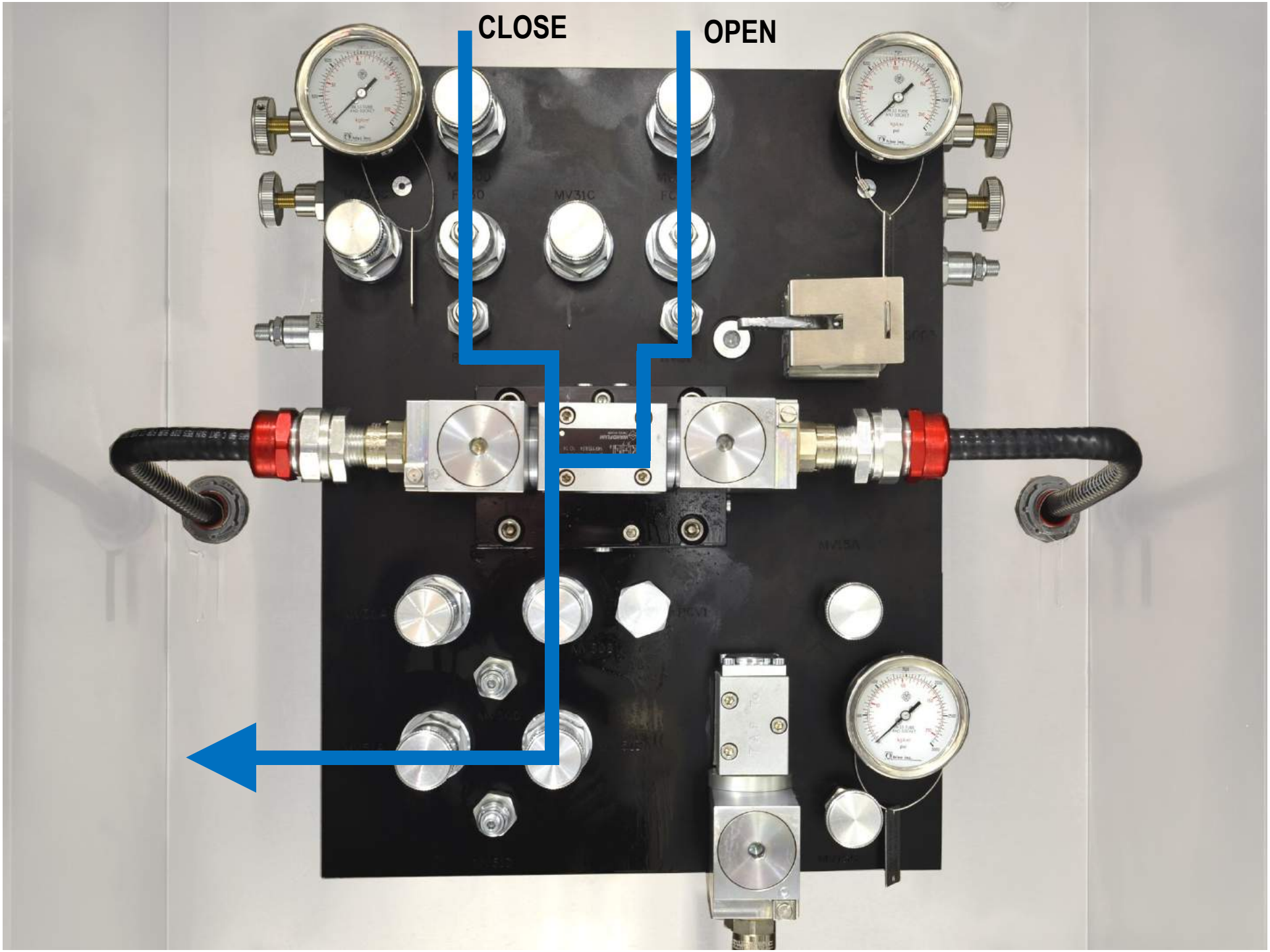
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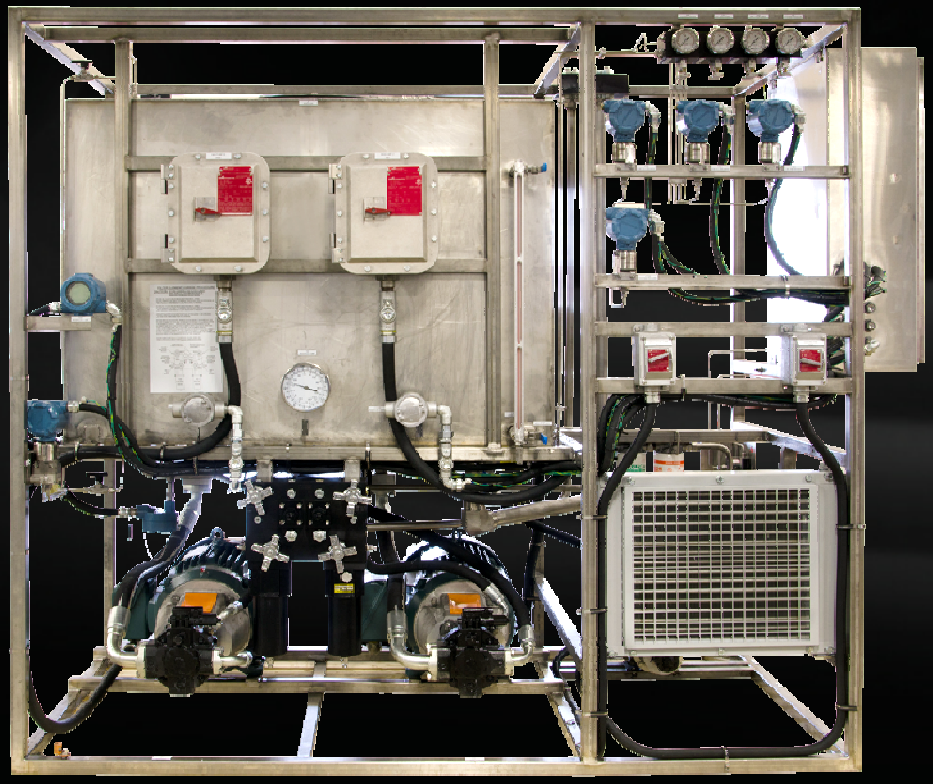
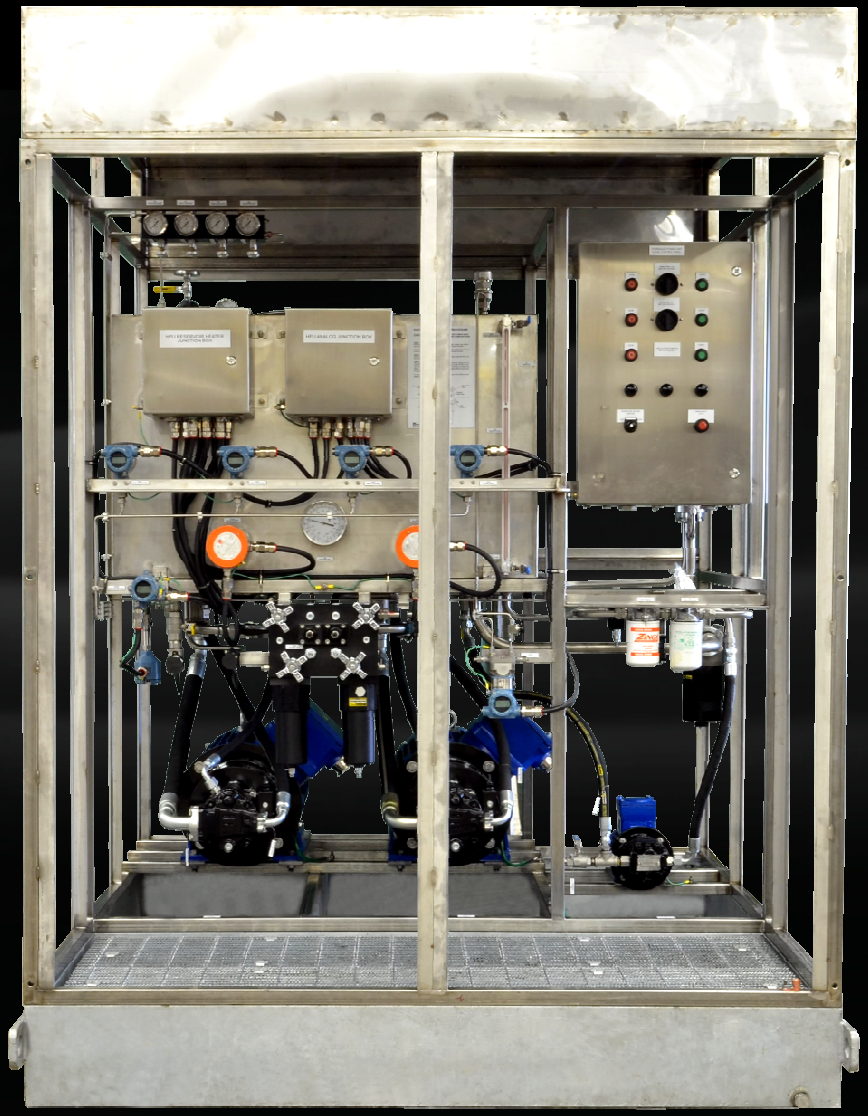
Recent project issues





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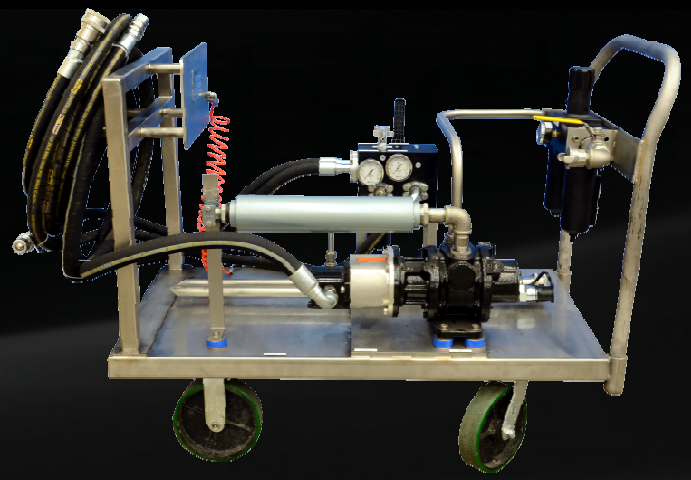
Recent 2 Drum Unheading Valve Project

- For this project, HPU only runs for 16 minutes every 24 hours (1.1% availability)
- Specs required SIL 2 rated “safety PLC” to operate HPU and HCU
  - Triconex, Honeywell Safety Manager, ICS Triplex
  - 2oo3 Voting for 3 level transmitters on reservoir
    - Individual transmitters rated SIL 3 (99.99% availability)
    - Low level only prevents pump from running
  - Required all electrical signal relays to be SIL 3 safety relays
    - SIL 3 relay to turn on lamps on local control panels

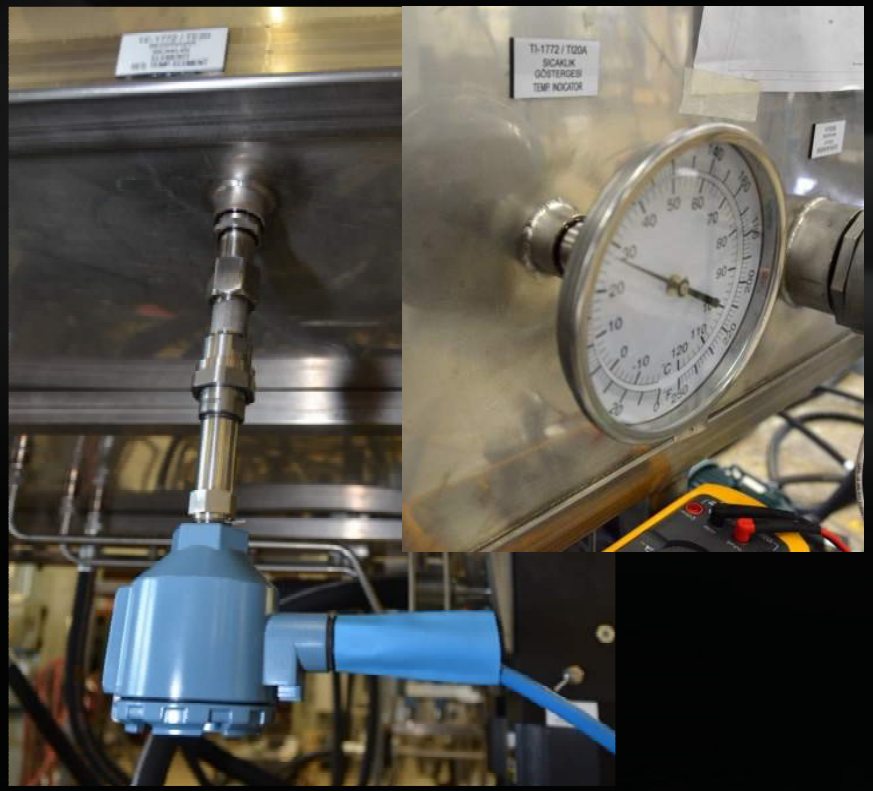
Some items in BUD/TUD Specs…

- Spare hydraulic cylinder
  - In 60+ yrs FCC experience, no refiner keeps spare cylinder
  - But…FCC actuators have handwheels
- Air operated portable HPCU cart
  - in case HPU is down
- Redundant PLC processors
  - redundant I/O
- "SIL rated" transmitters and electrical components
- Double block and bleed isolation valves for filter change
  - Pumps **not** operating for 22 hours each day
- Use of "process" specs for hydraulic equipment
  - Systems built to ISO 4413 hydraulic standards, not API



Details Matter

Some specs require 2” 300RF minimum flanges on all vessels for instruments



Reservoir fabricated from 3mm sheet 304SS

In conclusion

- FCC systems require 100% availability
- Coker systems require only 7% availability
  - System design should take this into account
  - System must NOT operate in order to be safe
- FCC unit operators have many years of experience with hydraulic actuators
  - Ask them to share their experiences, good and bad
- Excessive specification for Coker unheading valve actuator systems is leading to higher costs compared to FCC

Thank You!

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