# When Worlds Collide

## *FCC vs. Coker Unheading Valve ElectroHydraulic Actuator Systems*

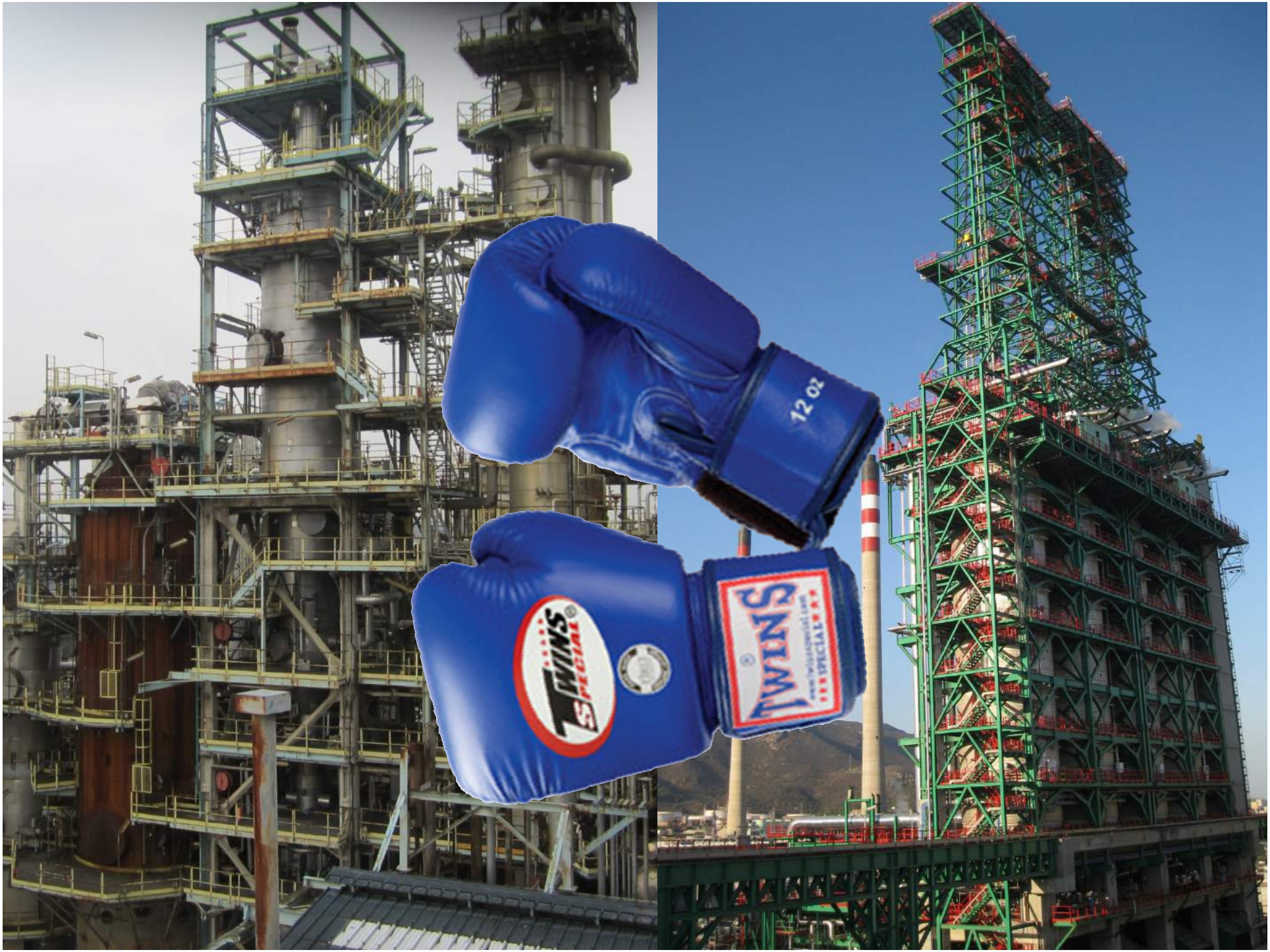
**Neal Cammy**

**Engineering Manager, BLAC INC.**

REFCOMM BAHRAIN
8-12 NOVEMBER 2015



blac inc.


12 oz
TWINS
TWINS SPECIAL

# Agenda

- Comparisons
- History
- System Design
- Cases

## FCC

- Continuously throttling 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 ~12-16 hrs
- Valve is process pressure boundary
- ESD function doesn't exist
- Redundant and back-up systems in spec

# FCC

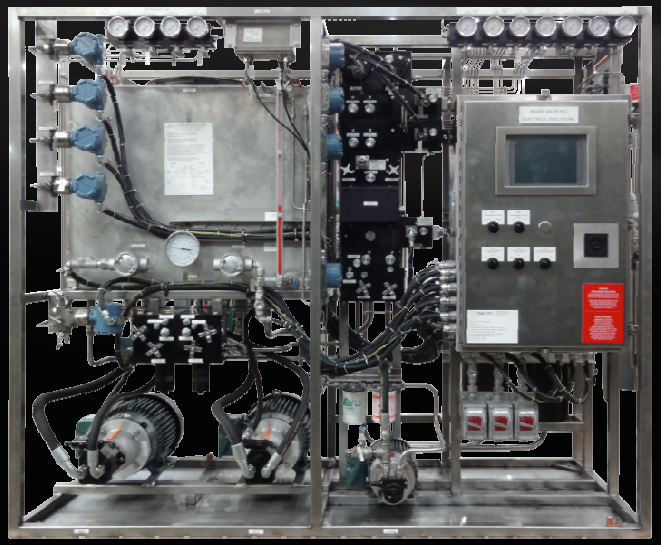
- 5 s throttling / 2 s ESD
- Failure to control properly causes process upset
  - lost profits
- Spurious ESD
  - process upset
  - lost profits
- Failure to ESD
  - possible equipment damage
  - lost profits

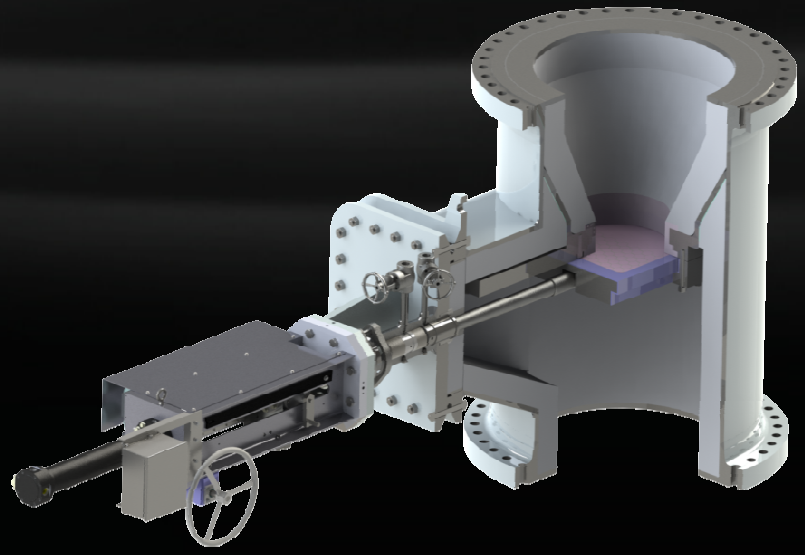
# Delayed Coker

- 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

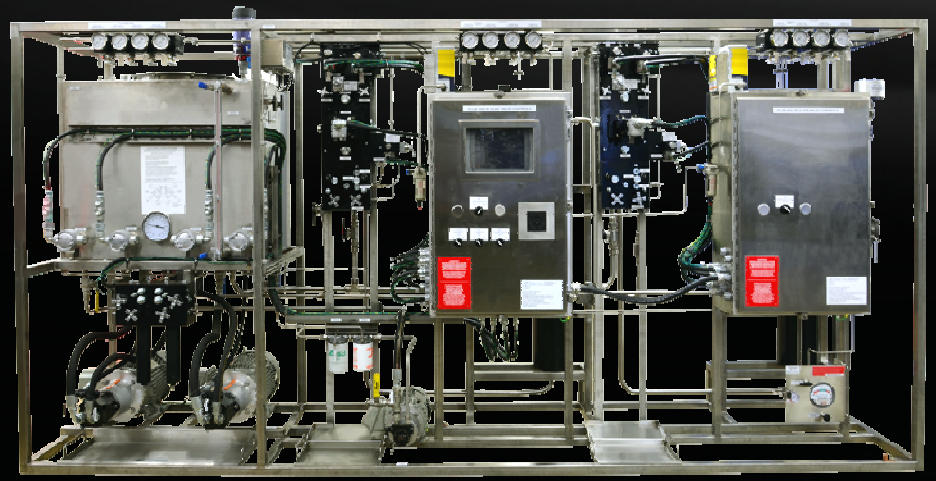


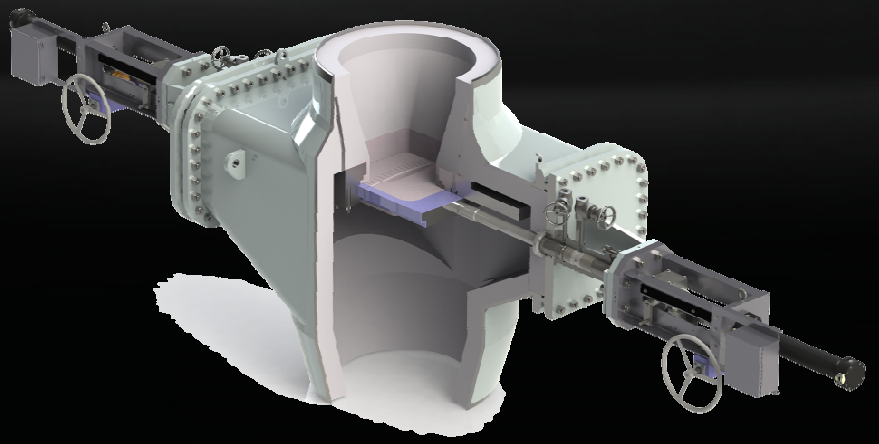


blac inc.

# FCC Slide Valve - Actuator History

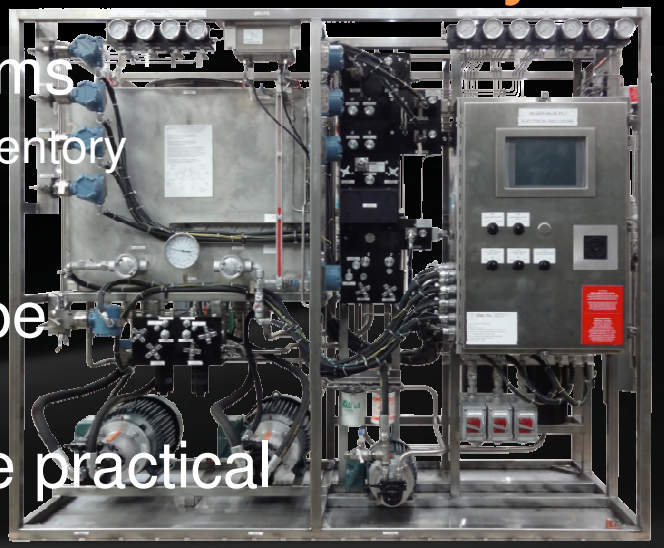
- Some Pneumatic
- Central, low pressure (~250psi) hydraulic) – 1945
- Central, med. pressure (~1000 psi) hydraulic – 60's & 70's
- Self-contained electro-hydraulic (1500-2000 psi) – 1979
- Split architecture electro-hydraulic – early 80's to now





blac inc.

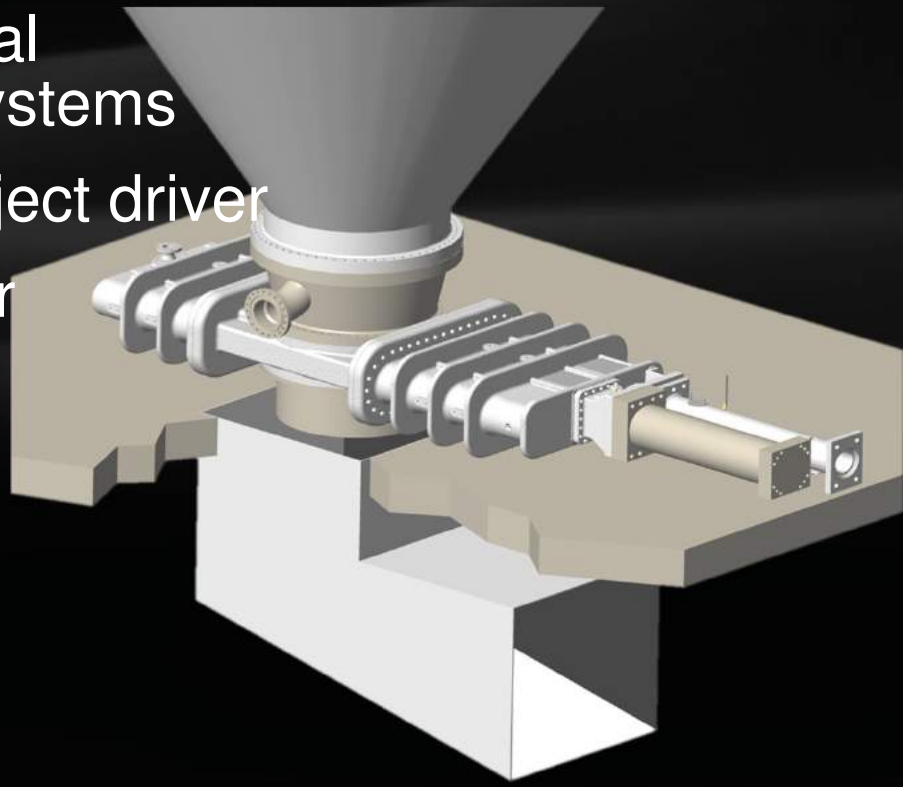
# FCC Reliability Improvements—80's to today



- Shift away from central hydraulic systems
  - Single point of failure, large hydraulic fluid inventory
- HPU/HCU unit for each valve
- Use of manifolds to minimize tubing/pipe
  - Reduce leak paths
- Provided redundant components where practical
  - Redundant feedback devices
  - Added redundant ESD functions
  - Added redundant limit switches for ESD trip initiation
- Provided back-up systems where necessary
  - Back-up "jog" control to move valve when servo is unavailable
- Added fluid conditioning systems
- Mid 90's begin use of PLC's for monitoring / diagnostics and control

# 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

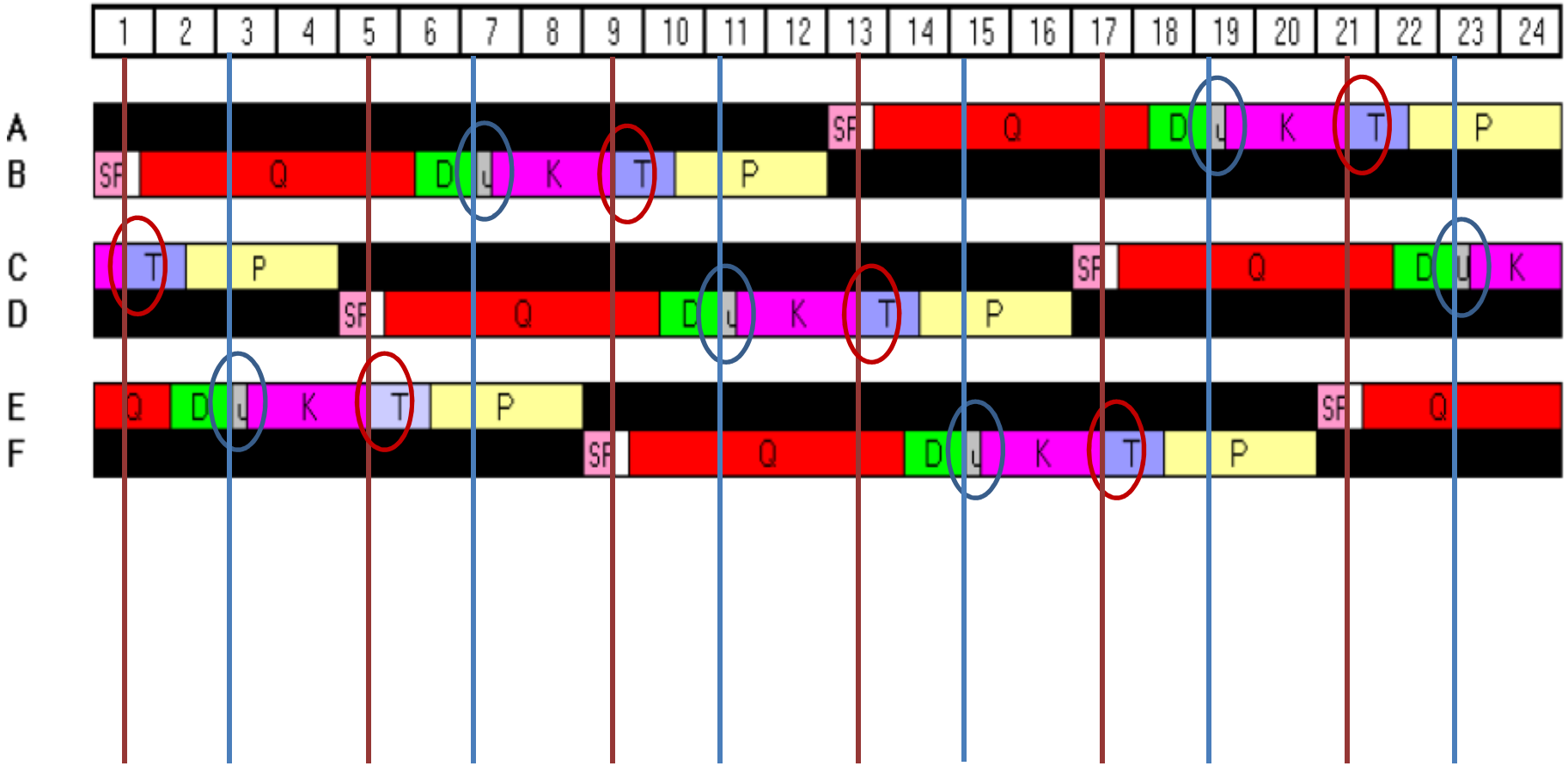


From DeltaValve, used with permission

blac inc.

# 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**

| LEGEND | HOURS | ACTIVITY |
|---|---|---|
| | 12 | COKING |
| SF | 0.5 | STEAMOUT TO FRACTIONATOR |
| | 0.25 | STEAMOUT TO BLOWDOWN |
| Q | 4.5 | QUENCH AND FILL |
| D | 1 | DRAINING |
| U | 0.25 | UNHEADING |
| K | 2 | DECOKING |
| T | 1 | REHEADING AND TESTING |
| P | 2.5 | PREHEATING |
| | 24 | TOTAL |

# 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…

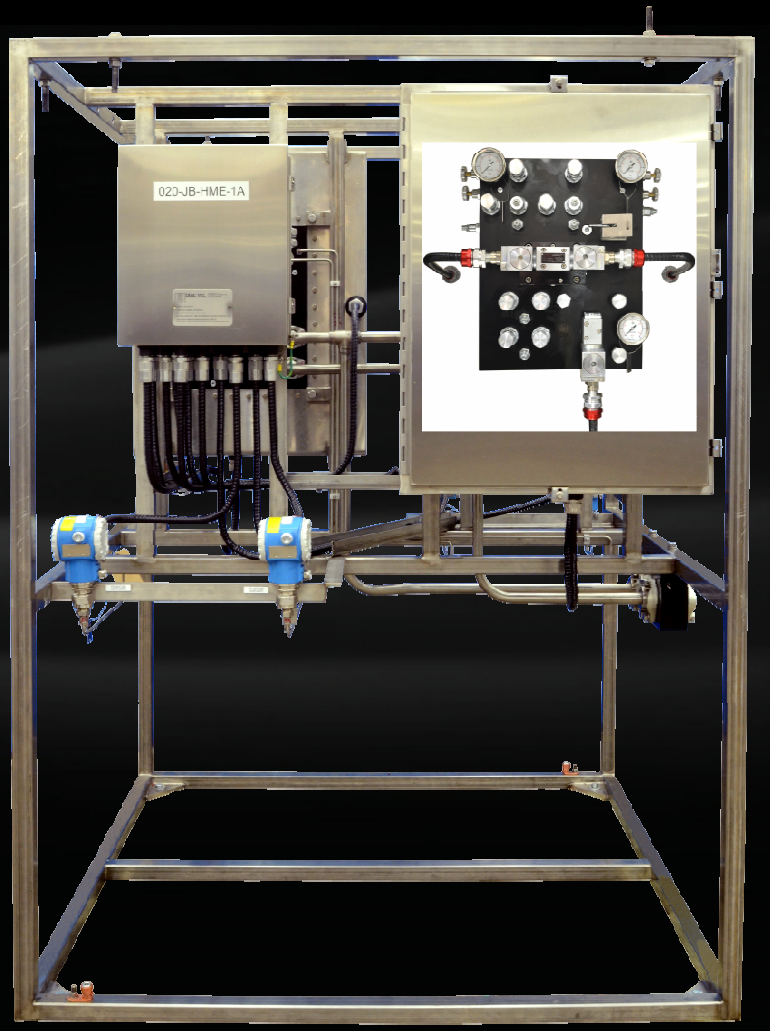
- Which system operates in a harsher environment – FCC or Coker?
- What backup systems are needed?
- What redundant systems are needed?
  - Redundant PLC control processors?
  - Redundant I/O?
- Do these systems require “SIL” rated instrumentation?
  - What does SIL mean anyway?
- What spare parts do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

# Why are we here?

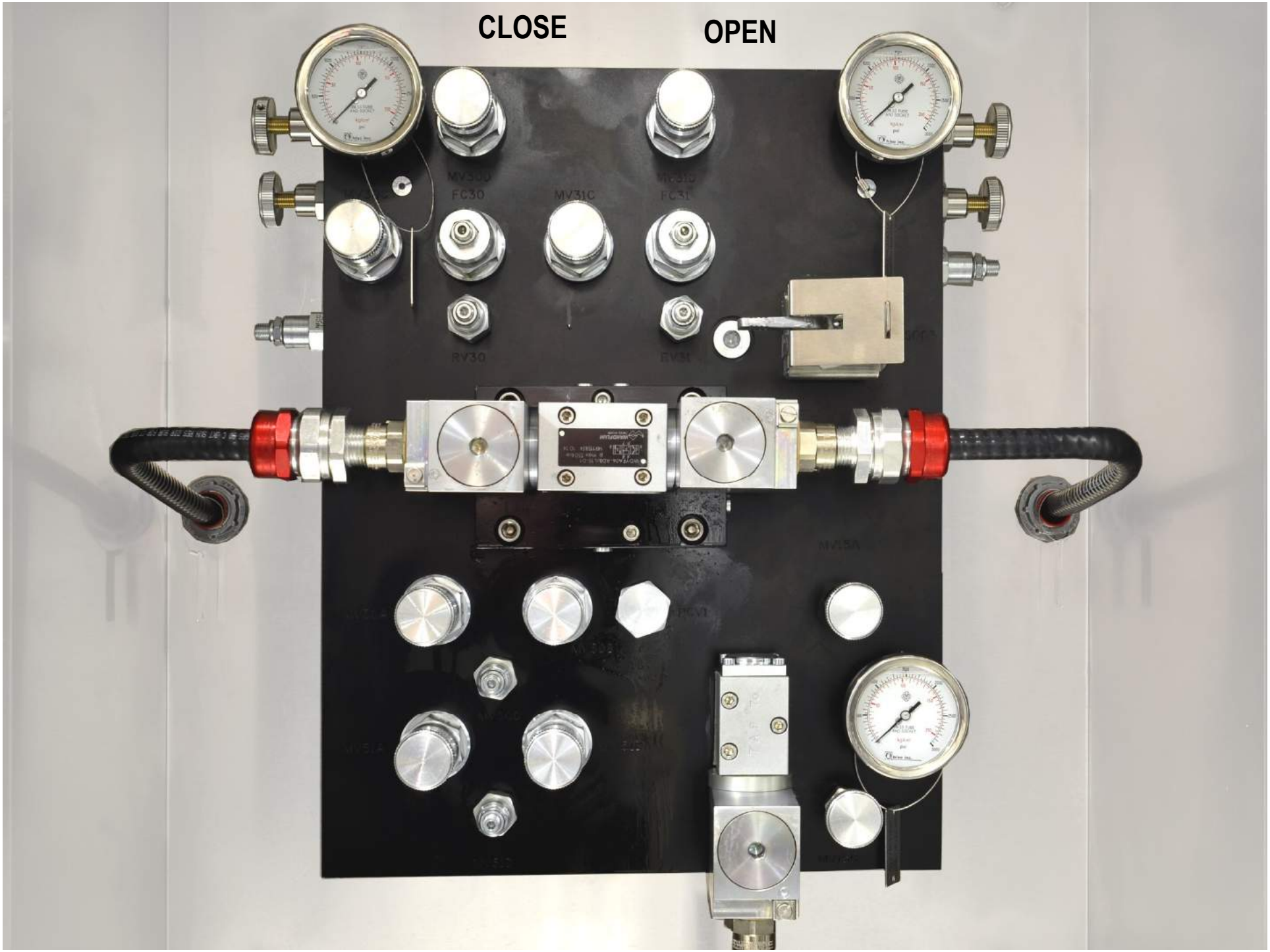
- 35 yrs of FCCU electro-hydraulic system experience
- Coker unheading projects should leverage that experience
- Projects should recognize intermittent nature of Coker operation (vs. FCCU)
  - However, many project specs seem to ignore that fact
- Excessive design requirements and over-specification causes project costs to skyrocket
  - We wish to supply safe and optimum designs
  - We really don't like wasting our customer's money

# 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

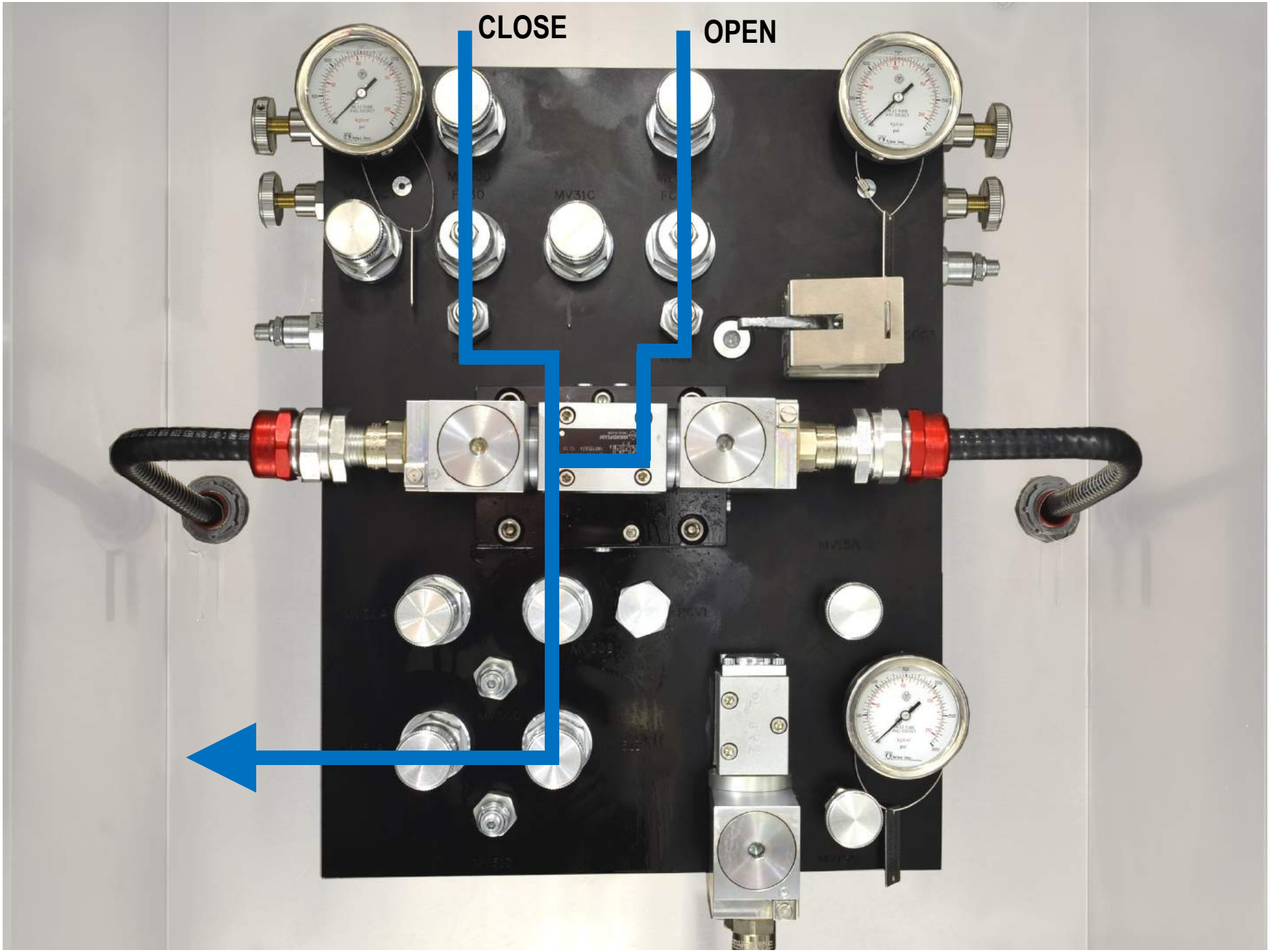


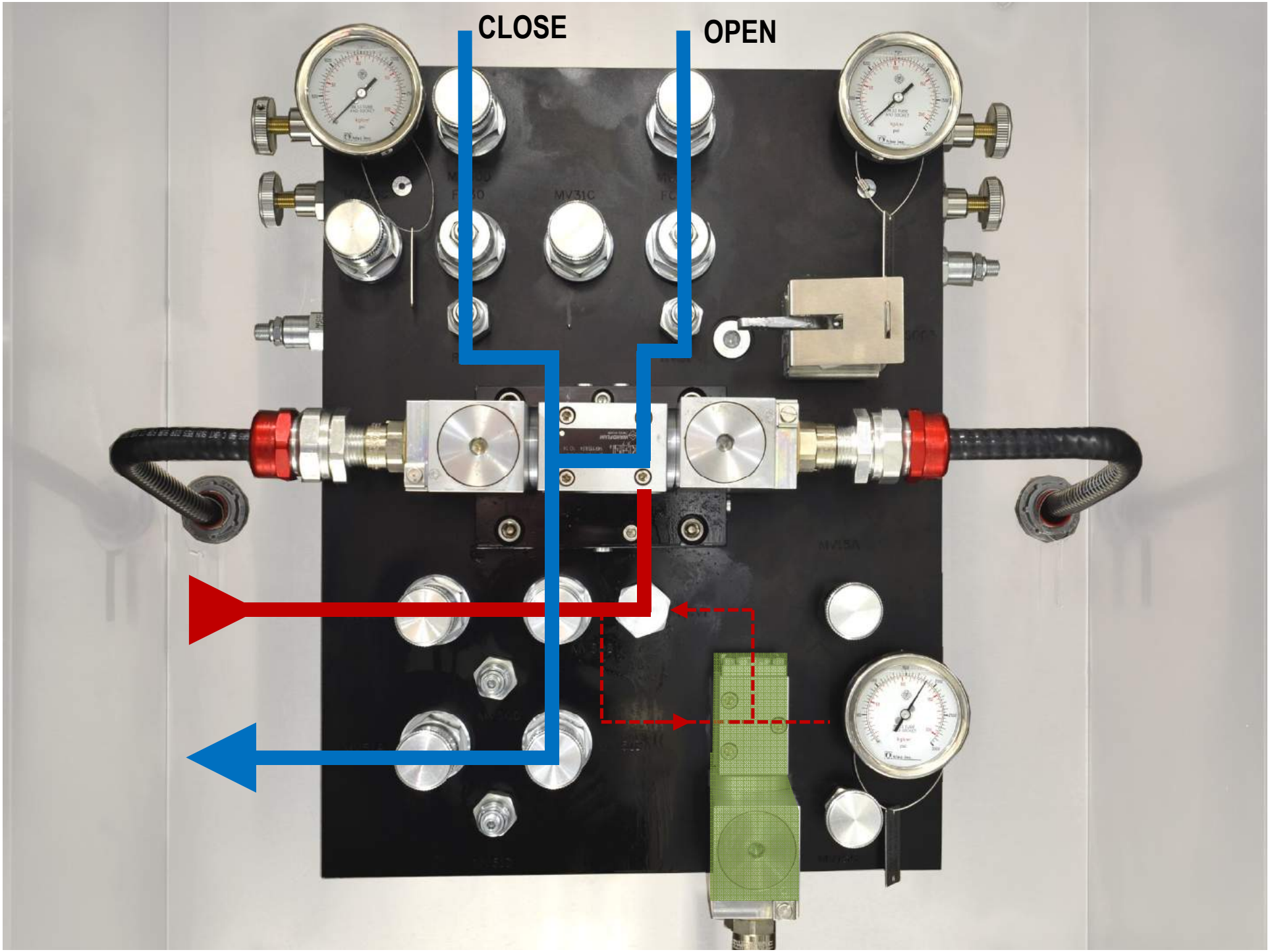
blac inc.

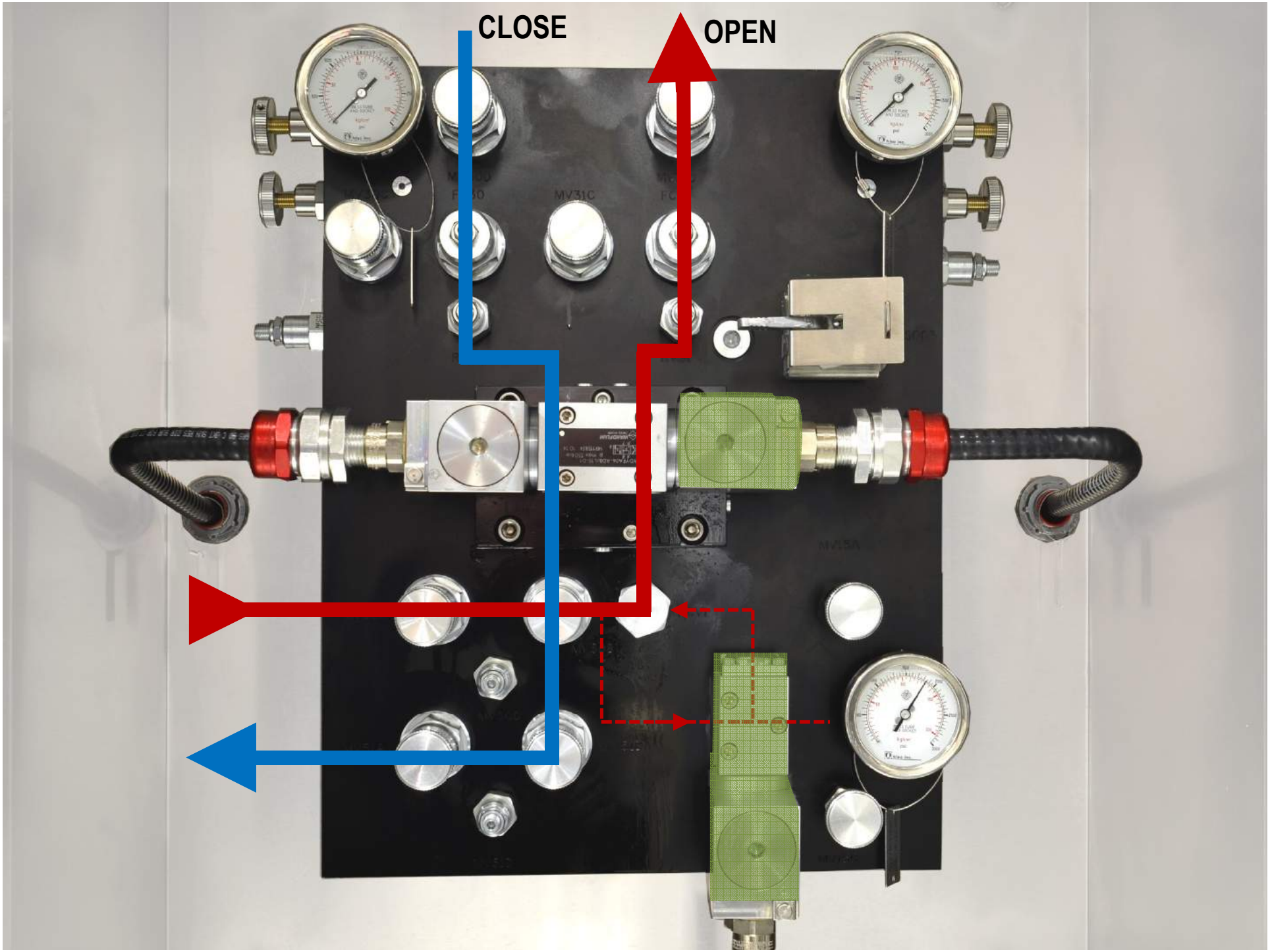

CLOSE
OPEN
MV30
FC30
MV31C
MV31O
FC31
RV30
RV31
PCV1

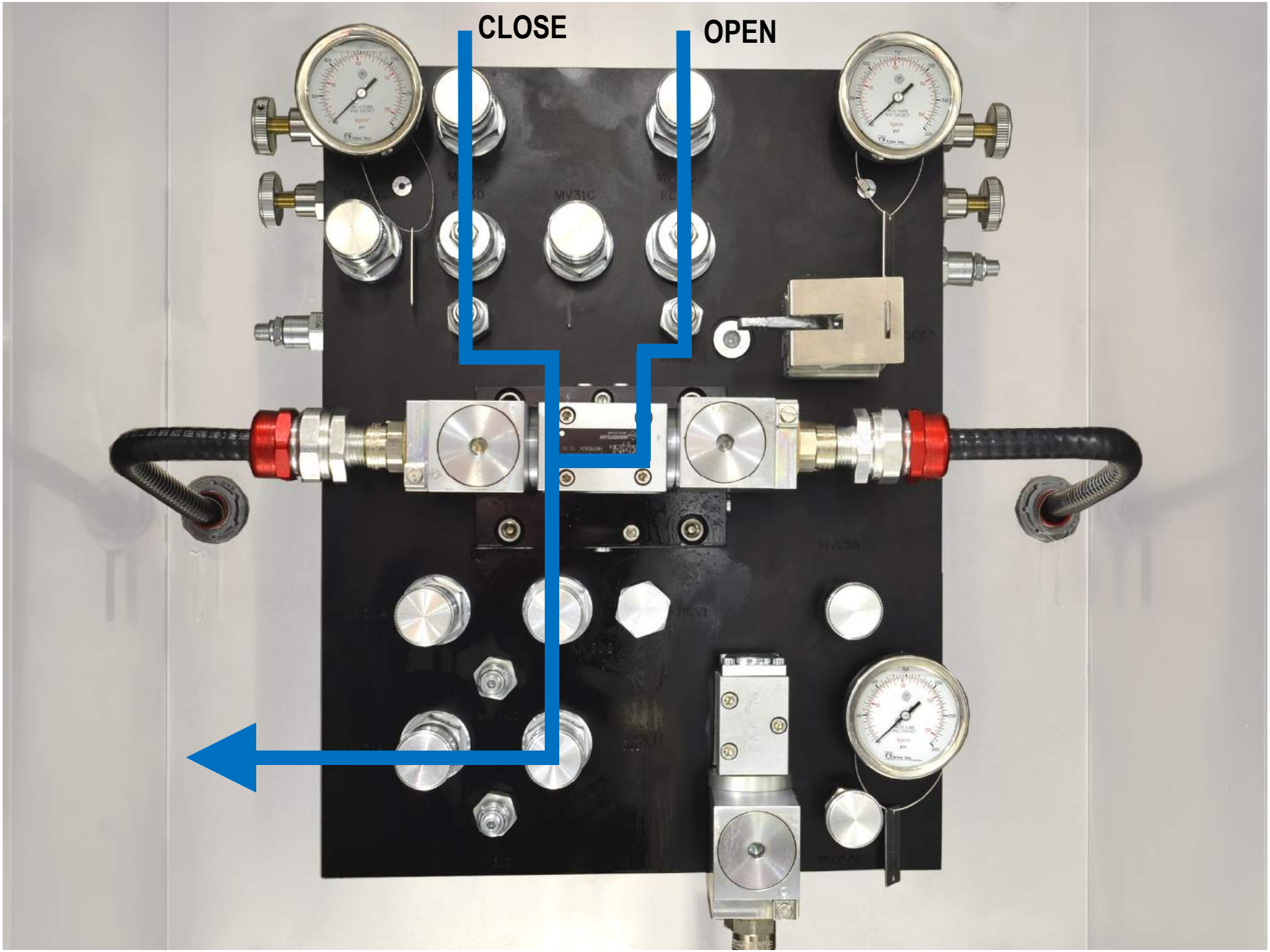
# BUD/TUD Hydraulic Control Circuit

- 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”

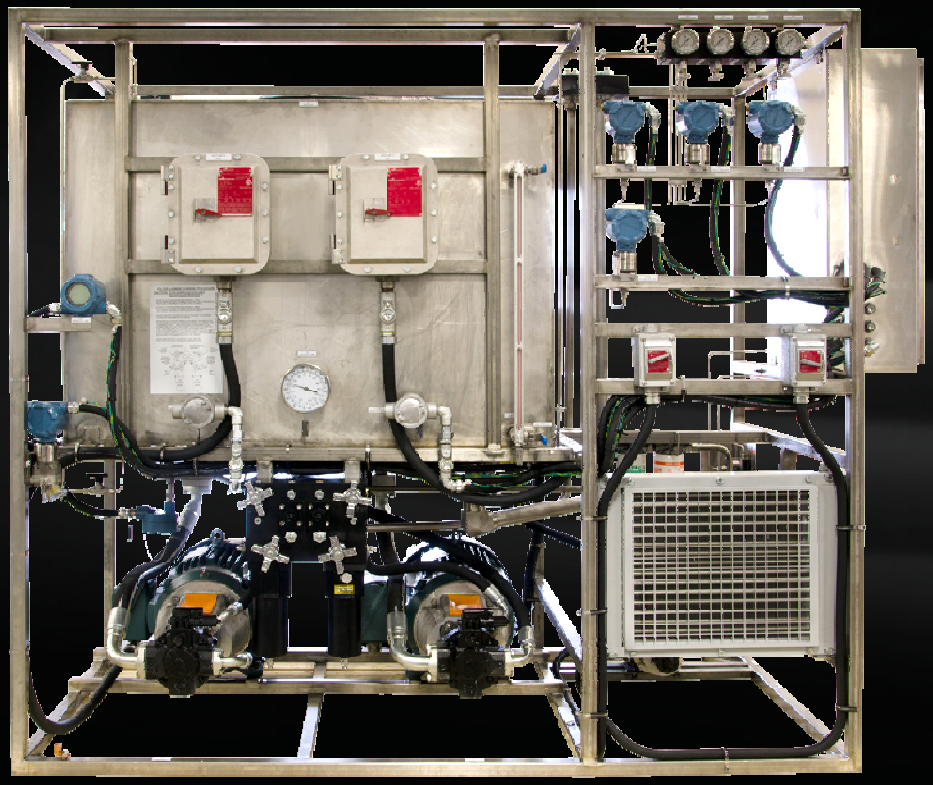

CLOSE
OPEN

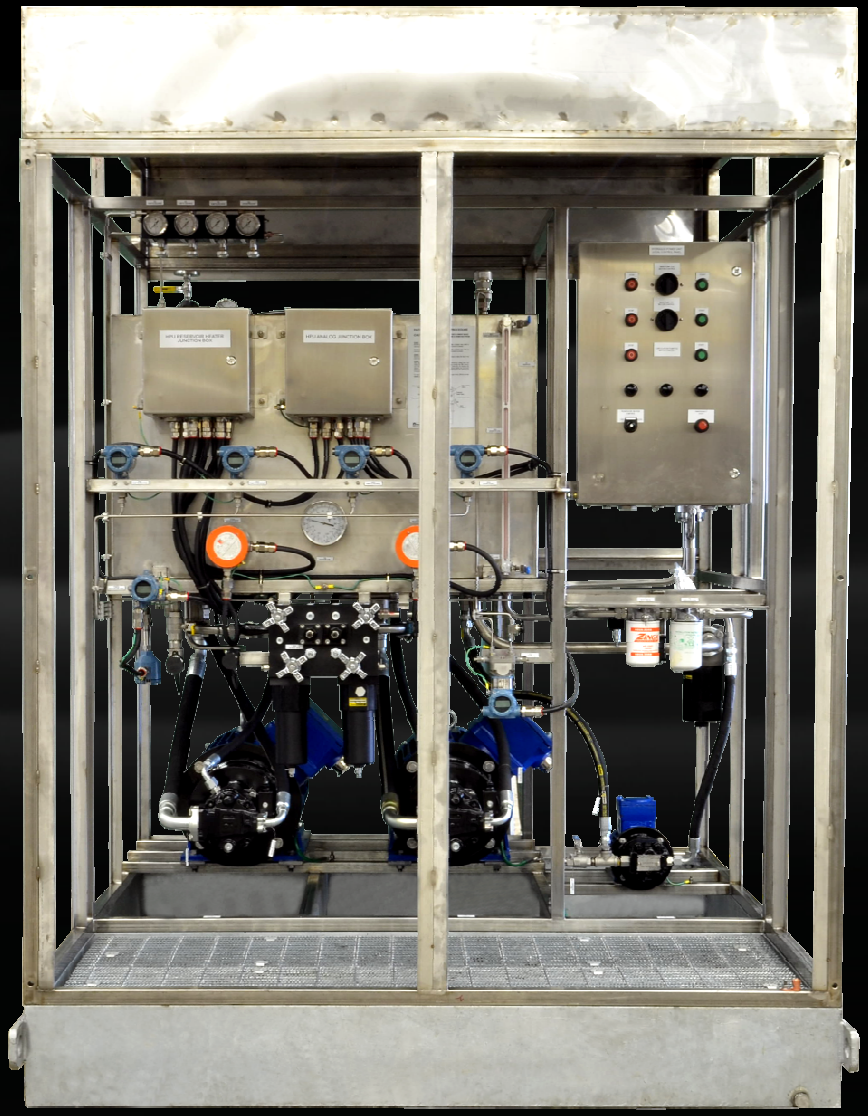

CLOSE
OPEN


CLOSE
OPEN


CLOSE
OPEN

# Recent project issues





blac inc.

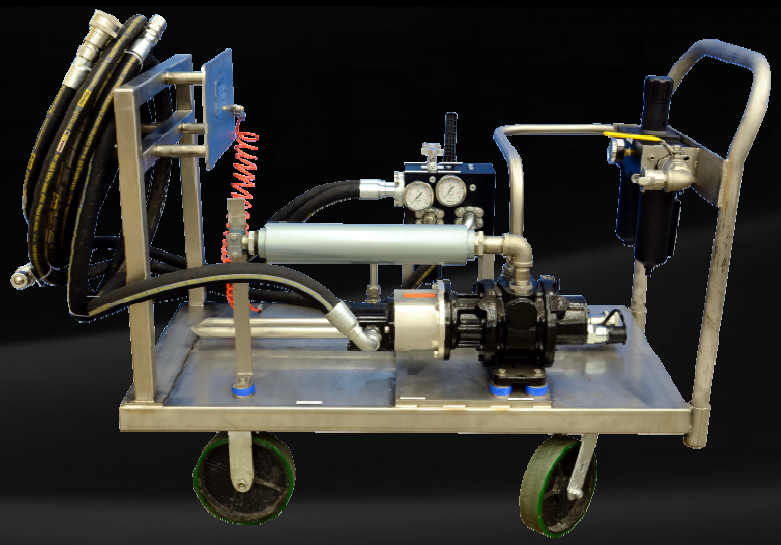
blac inc.

# 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
  - Honeywell Safety Manager
  - 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…

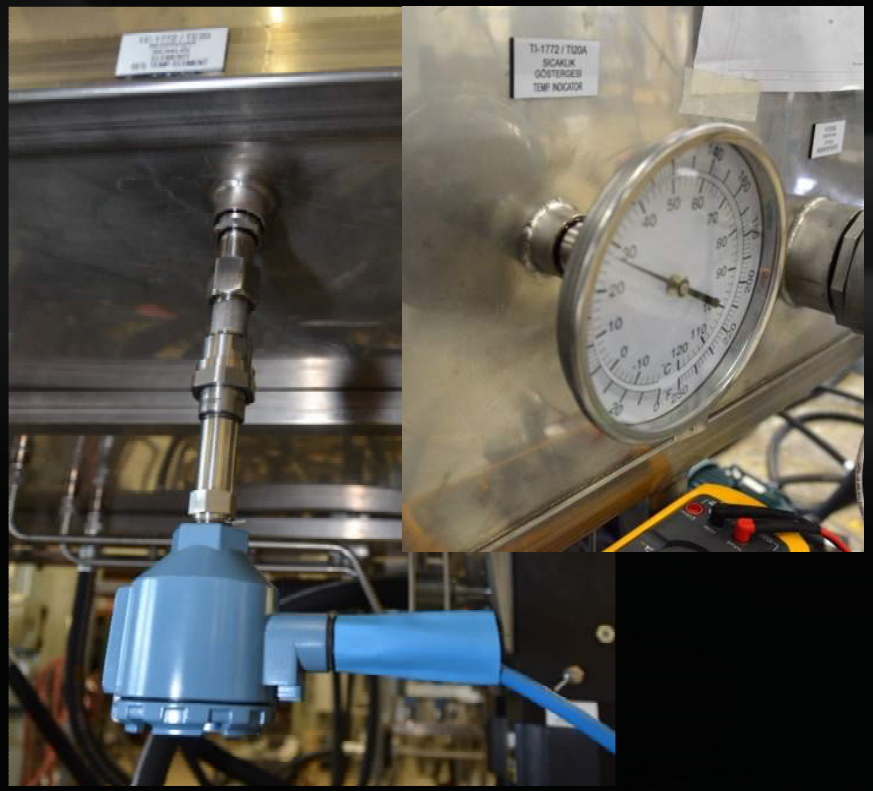
- Spare hydraulic cylinder
  - In 60+ yrs FCC experience, only one refiner keeps spare cylinder
  - But…FCC actuators have handwheels
- Air operated portable HPCU cart
  - in case HPU is down
- Redundant PLC processors
  - redundant I/O
- "SIL rated" transmitters and electrical components
- Double block 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



blac inc.

# Details Matter

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



Reservoir fabricated from 3mm sheet 304SS

blac inc.

# 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!

blac inc.