Octopus Online Solids Removal

Field Experience in the Permian Basin

OXY USA – Ziad Wardeh, Sabrina Watson

Wolf Process Technology – Mark Wolf

Grunt Oilfield Services – Jeff Lightsey

Cleaning a tank or separator is one of the energy industry's most dangerous jobs.

From 2011 to 2018, 1,030 workers died in the US from occupational injuries involving a confined space.[1]

1. US Bureau of Labor Statistics

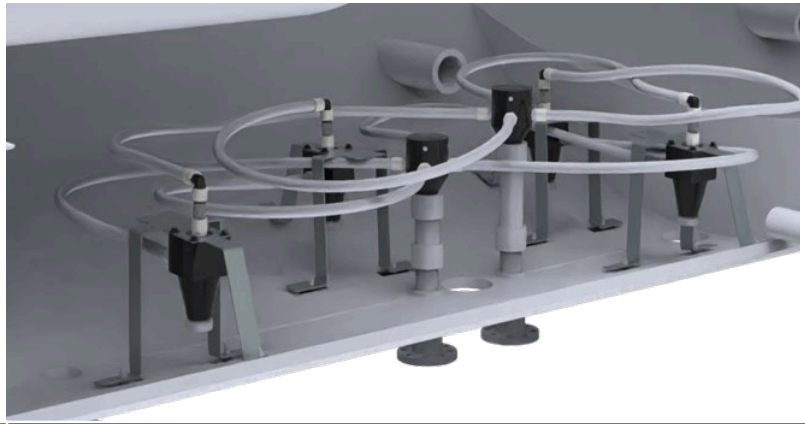
- Leading causes of death from CSE are lack of breathable air and engulfment

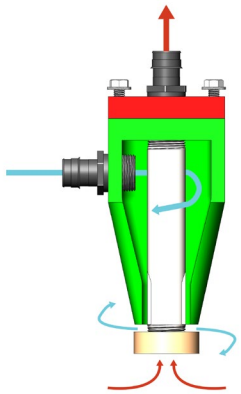
The Octopus online solids removal system eliminates the need to break containment for removal of sand and other materials from tanks and separators.

The Octopus System allow operators to:

- Mitigate Health and Safety Risk
- Minimize Damage to instruments and downstream equipment
- Reduce Methane Emissions
- Reduce Production Downtime
- Reduce solids carryover into water midstream system

In-Situ Sand Removal Types





	Linear Jetting	Cyclonic Jetting
Flush Water DP	80-100 PSIG	3-6 PSIG
Vessel Erosion Risk	High	Low
Sand Carryover Risk	High	Low
Emulsion Risk	High	Low
Effectiveness when buried	Ineffective	Very Effective

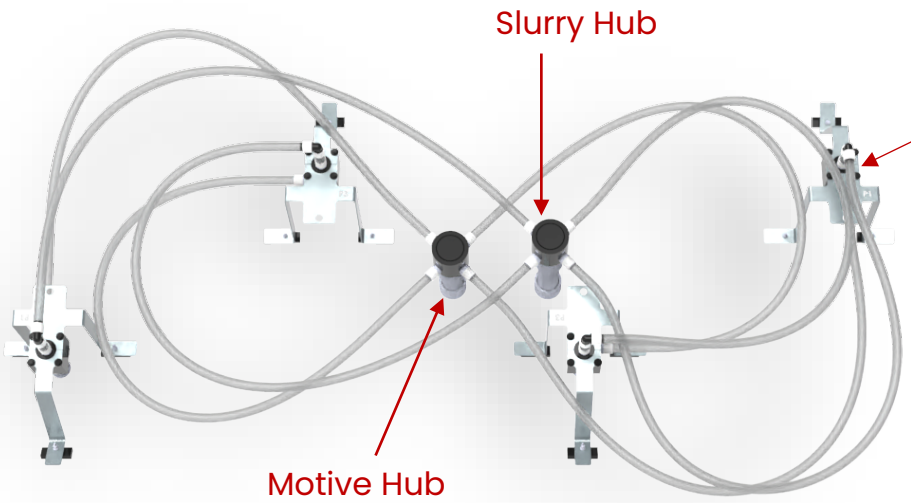
Advantages of Cyclonic Jetting

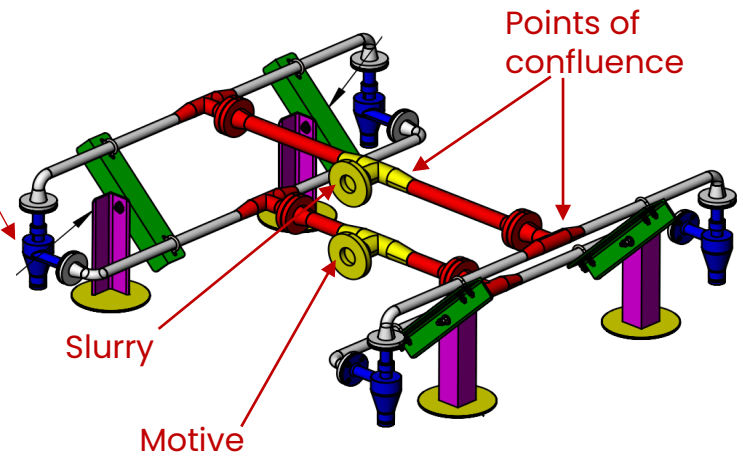
- No Upsets
- No Solids Carryover
- Low Operating Pressure
- No Vessel Wall Erosion
- Works when completely buried

HOW DOES THE OCTOPUS WORK?

OCTOPUS™
ONLINE SOLIDS REMOVAL SYSTEM

Advancements in Design





Octopus Hub + Flexible pipe

- Improved hydraulics
- Lower cost materials (HDPE/PEX)
- Retrofittable without welding
- Magnetic Supports
- **Lead time 48-72 hours**
- **Install time 2-4 hours/manifold**

Nested Tee Manifold

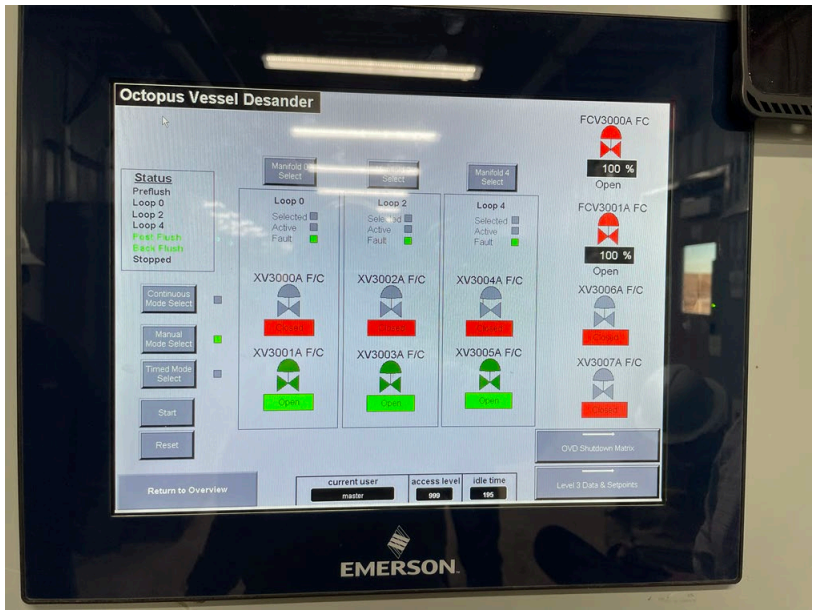
- Unequal flow distribution
- Custom welded stainless-steel construction
- Difficult to retrofit
- Welded supports
- **Lead Time 12-16 weeks**
- **Install time 8-12 hours/manifold**

Operating Methods

Services

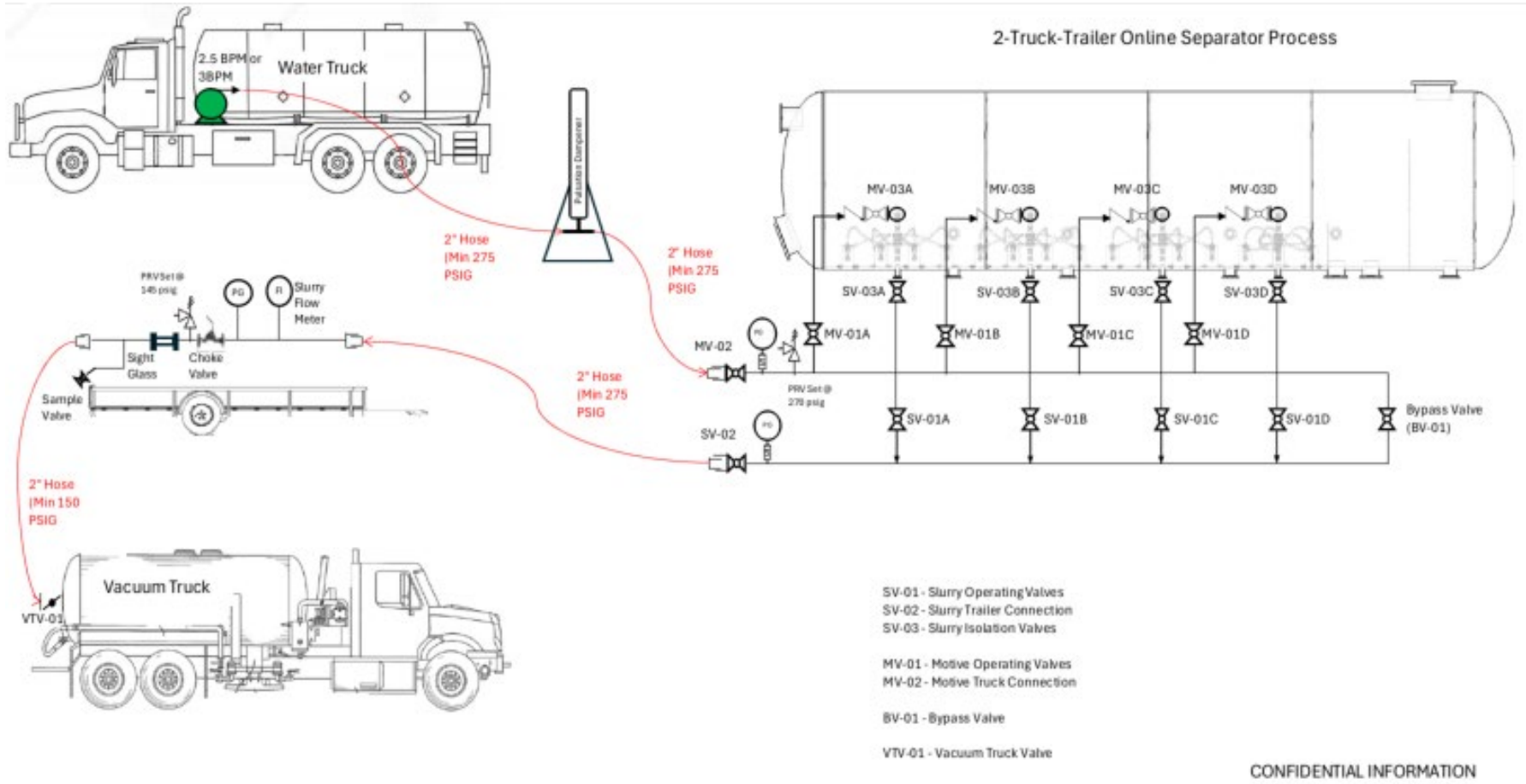
- No deployment lead time
- Low Capex
- Ideal for unconventional sand production profile
- Operating flexibility
- **>100 deployments and >200 vessel cleanings to date in Permian Basin**

Automation



- Requires integrated project team and longer deployment lead time
- Higher Capex
- Good for long life of field sand production profile

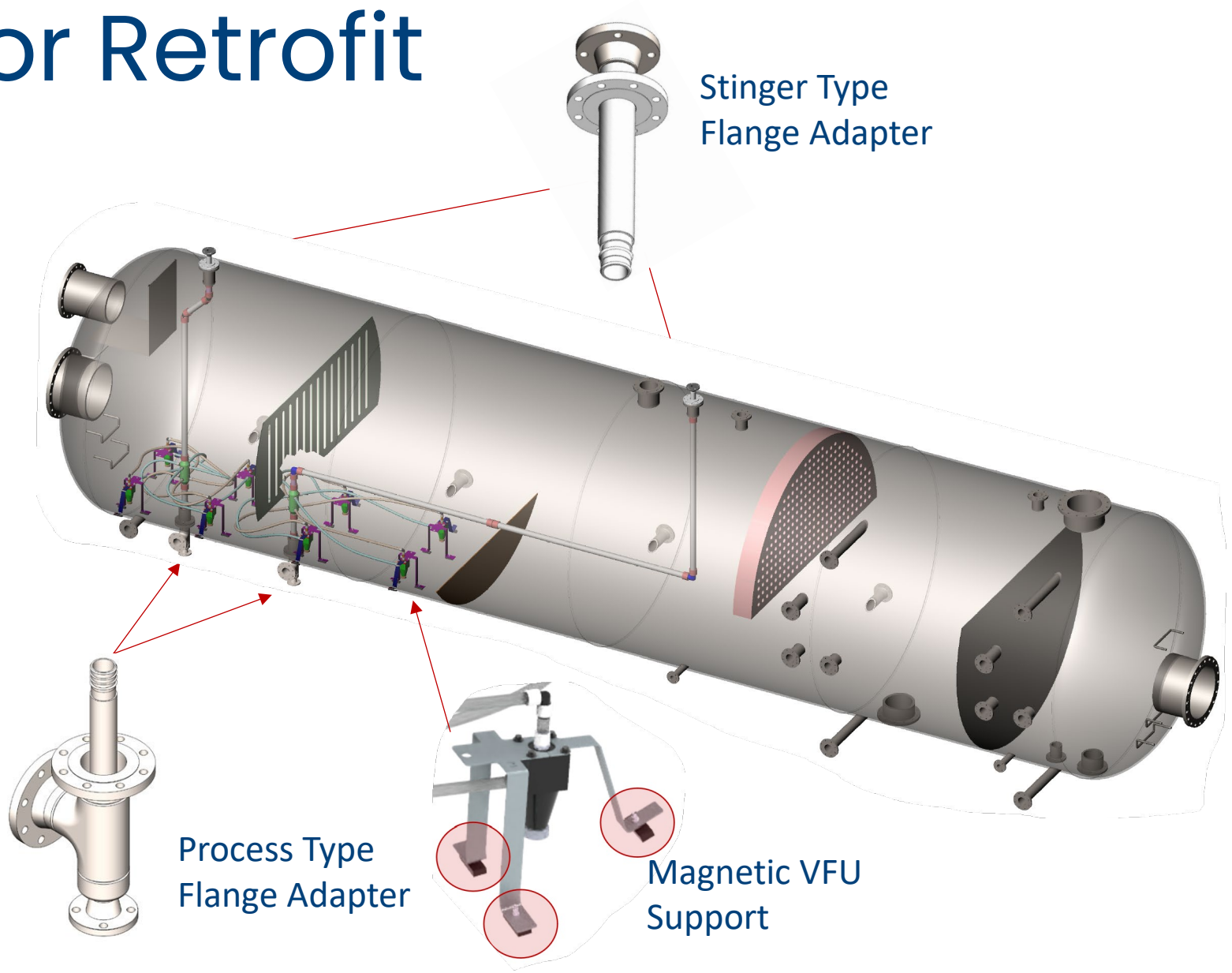
Typical P&ID – Service Based Operation



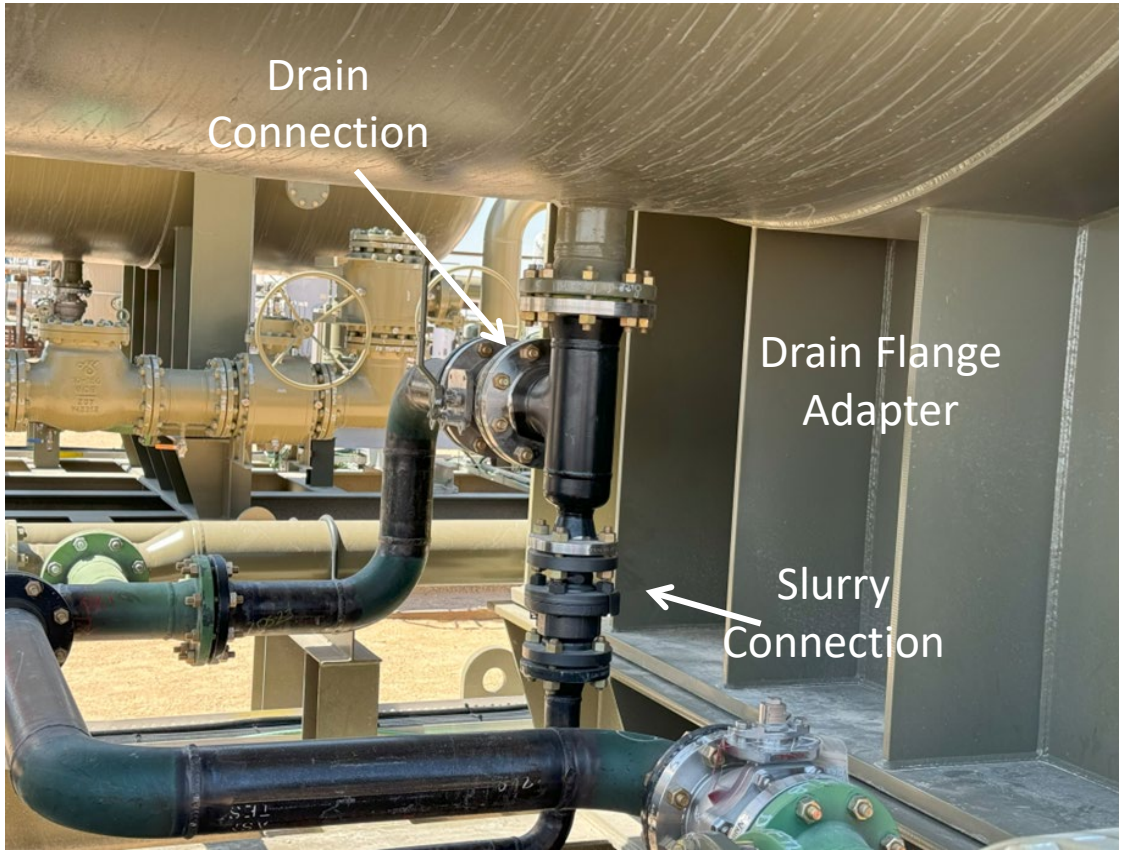
Bulk Separator Application

Bulk Separator Retrofit

- Two Octopus with Eight total VFUs
- Spare top nozzles fitted with stinger type flange adapters for motive water feed
- Drain nozzles fitted with process type flange adapters for slurry discharge and to retain drain capability
- VFUs attached to vessel shell with magnetic supports on top of coating

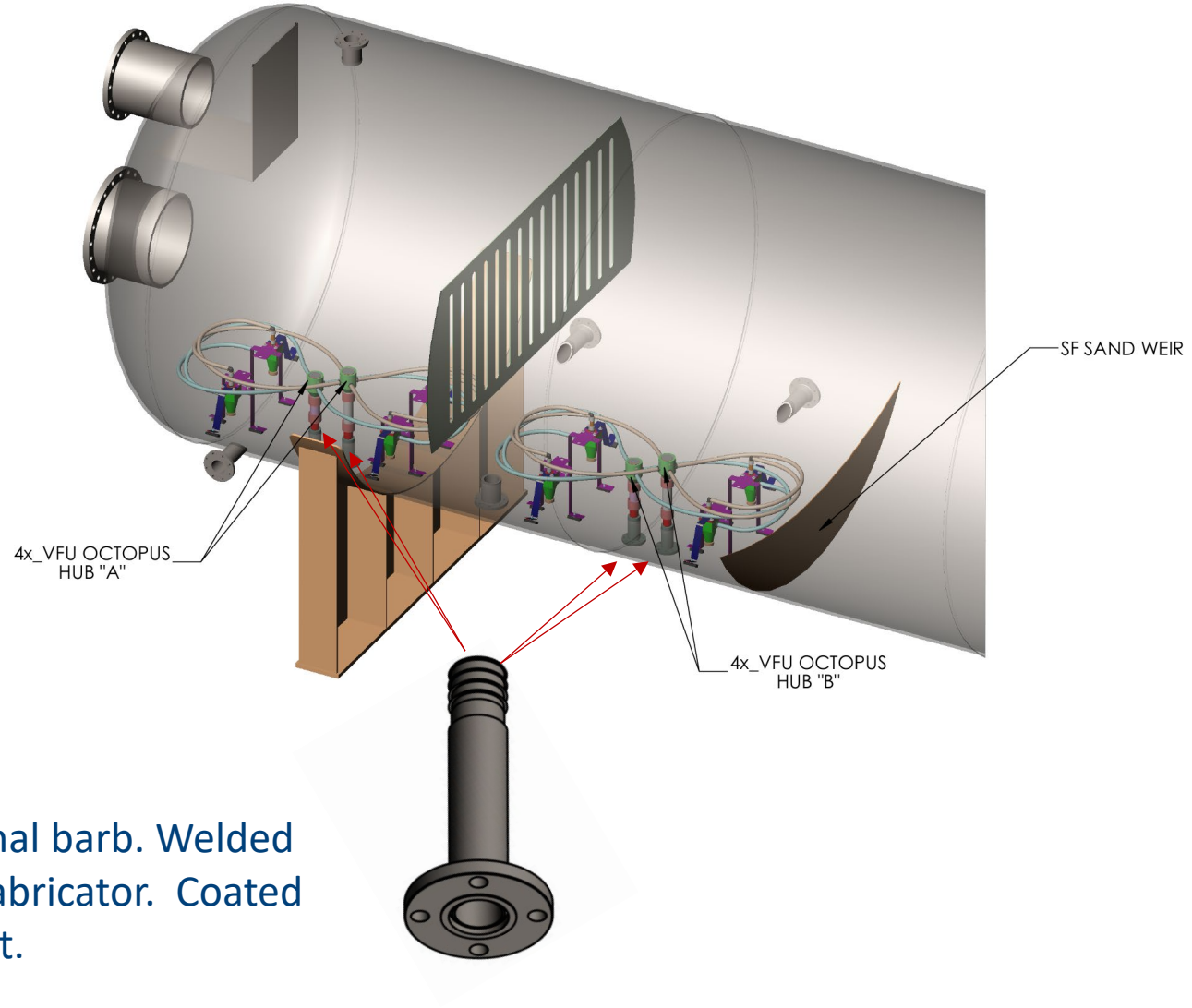


Retrofit Piping



Bulk Separator New Build

- Dedicated nozzles with PEX barb installed in bottom of vessel
- Double Half-hub design eliminates internal larger bore Piping
- Simplified external Piping integrated onto skid



CS Nozzle with internal barb. Welded into vessel shell by fabricator. Coated after vessel hydrotest.

Operating Experience

Experience with Octopus system

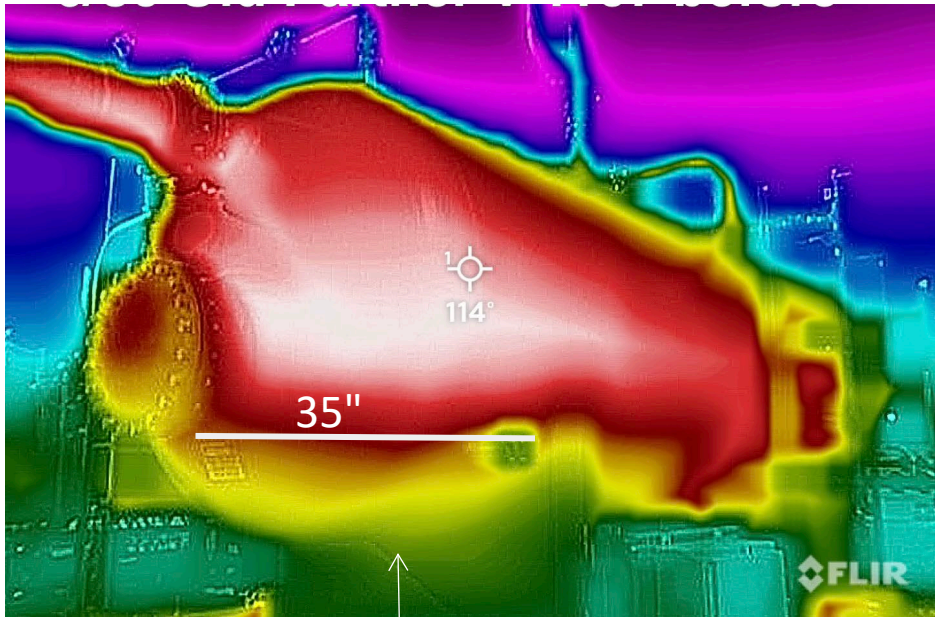
Installations

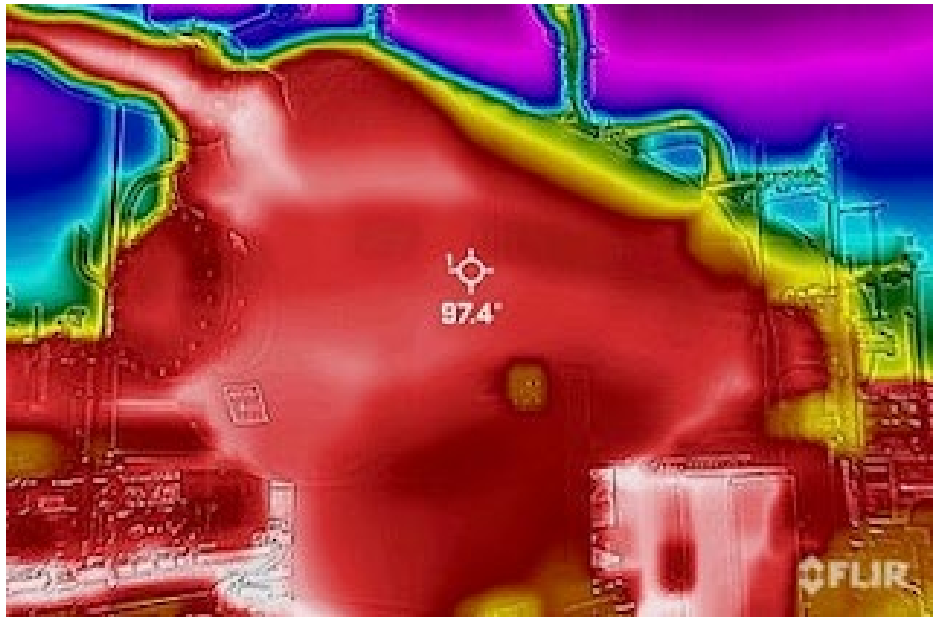
- 60+ vessel installations completed
  - Majority retrofits
- Installation requires 6-8 hours depending on design

Cleanouts

- Service Based Cleanout Frequency
  - AVG ~**8** weeks
  - High **2.5** weeks
  - Low **13** weeks
- Cleanout frequency is impacted by:
  - Vessel size
  - Incoming sand volumes

Before and After Thermal Images





10x40 Separator Cleanout performed in 1 hour **without**

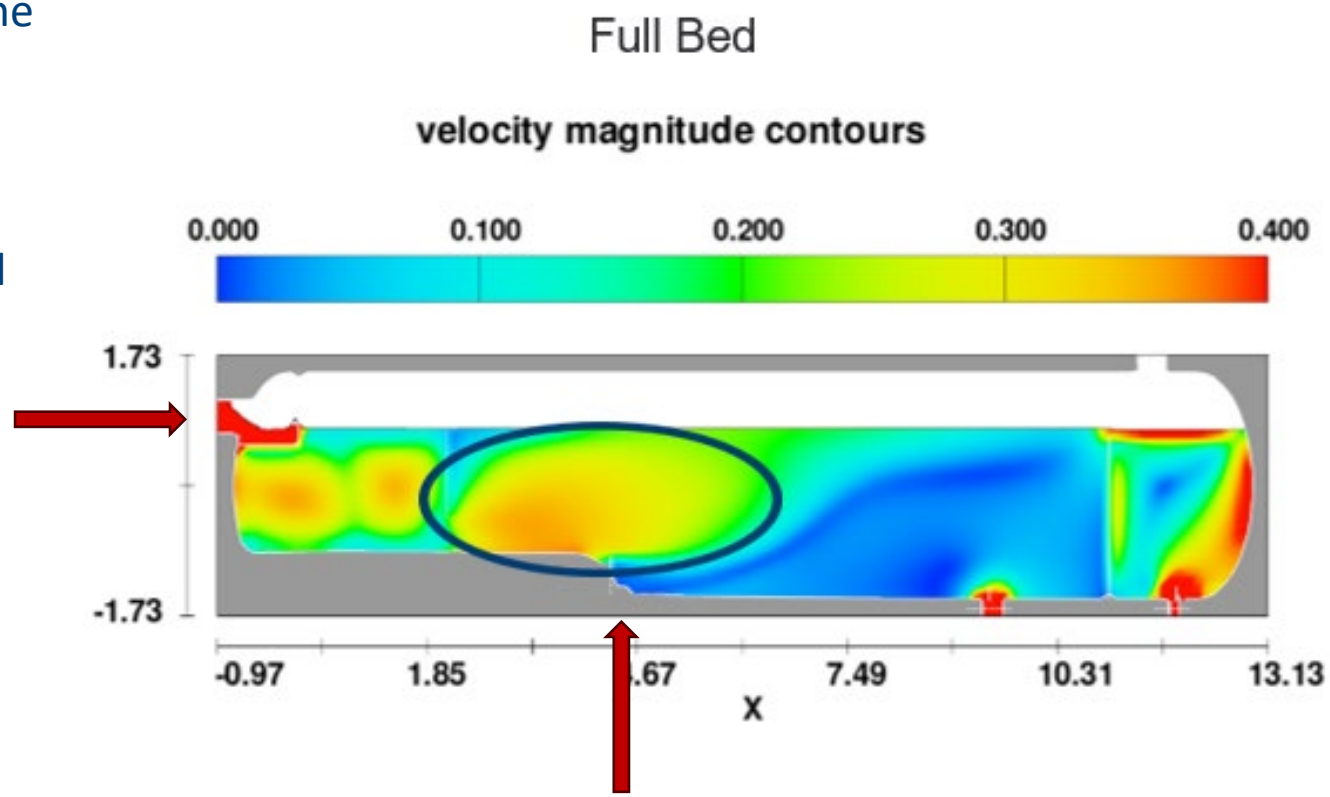
- Shutting in production
- Breaking containment

Cleanout Performance

- Removes ~80% of solids compared with traditional cleanout methods
- No impacts to instrument performance (guided wave radars) during cleanout process
- Typically scheduled 2-3 days in advance

Operational Improvements

- Reduced unplanned/planned production down time
- Improved sand management during flowback
  - Reduce time on flow back equipment
  - Prevent over-flowing sand weir with sand and reduce sand carryover to midstream
  - Improved separation efficiency due to larger retention volume
- Reduced sand erosion on dump valves
- Reduced GWR (guided wave radar) failures



HSE Improvements

- Reduce methane emissions from cleanout operations
  - Reduction of separator blowdowns
- Reduced risk from working at heights during vessel cleanouts
  - Octopus cleanout operation is completed at grade-level and eliminates the need for a manlift
- Reduced personnel exposure to hazardous atmospheres by eliminating blowdowns and work around an open separator

QUESTIONS ?

Durable Materials Suitable for a Wide Range of Operating Conditions

Standard Octopus materials are suitable for working temperatures up to 180°F (82°C).
The following higher temperature options are available:

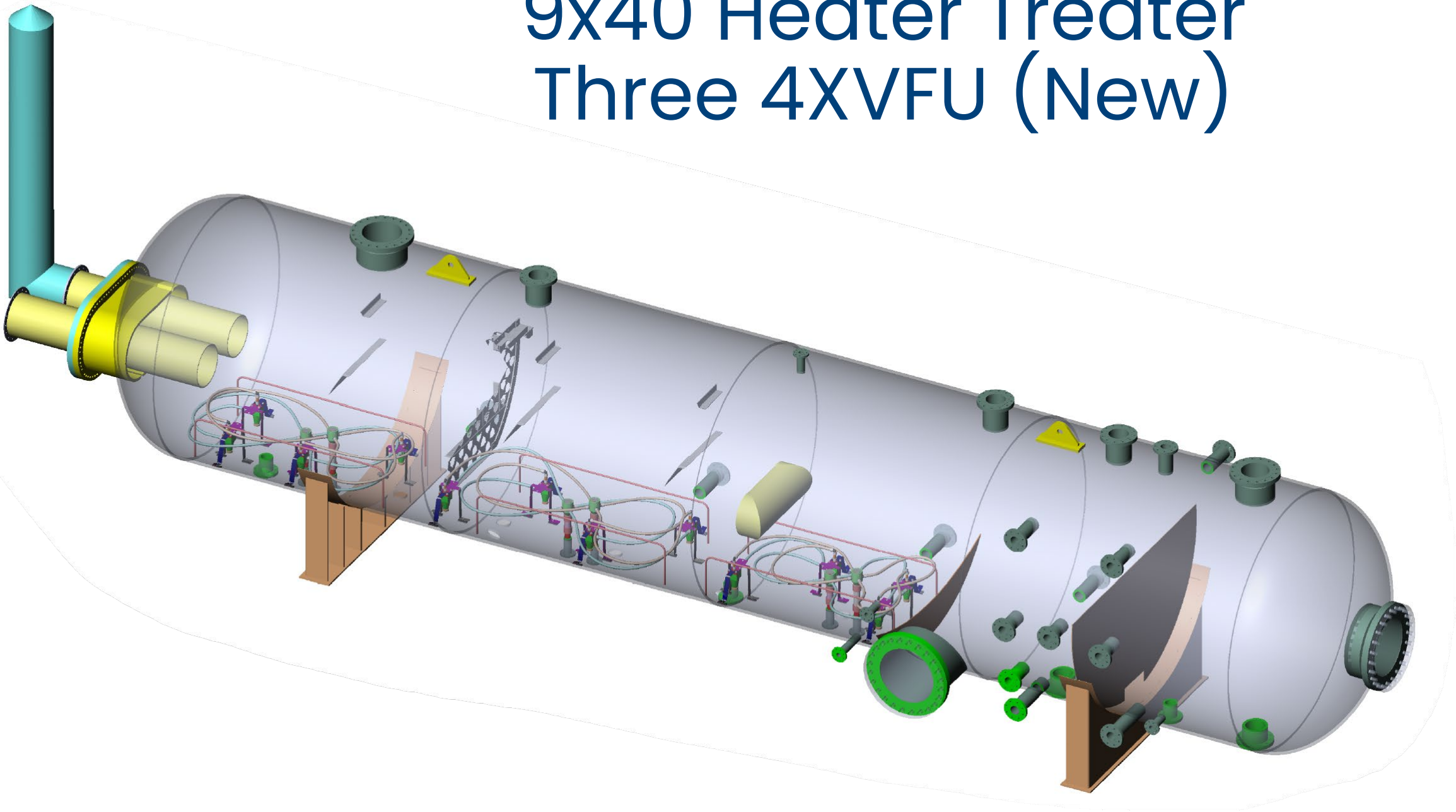
Component	< 180°F < 82°C	180-200°F 82-93°C	> 200°F > 93°C *See Note*
Distribution Hub	HDPE	Nylatron	316L SS (Standard)
Vortex Fluidizing Unit (VFU)	HDPE	Nylatron	316L SS (Standard)
Flexible Hoses	PEX-A	PEX-A	Convoluted 316 SS (Standard)

Note: Metallurgy for higher temperature applications can be customized to meet process conditions.

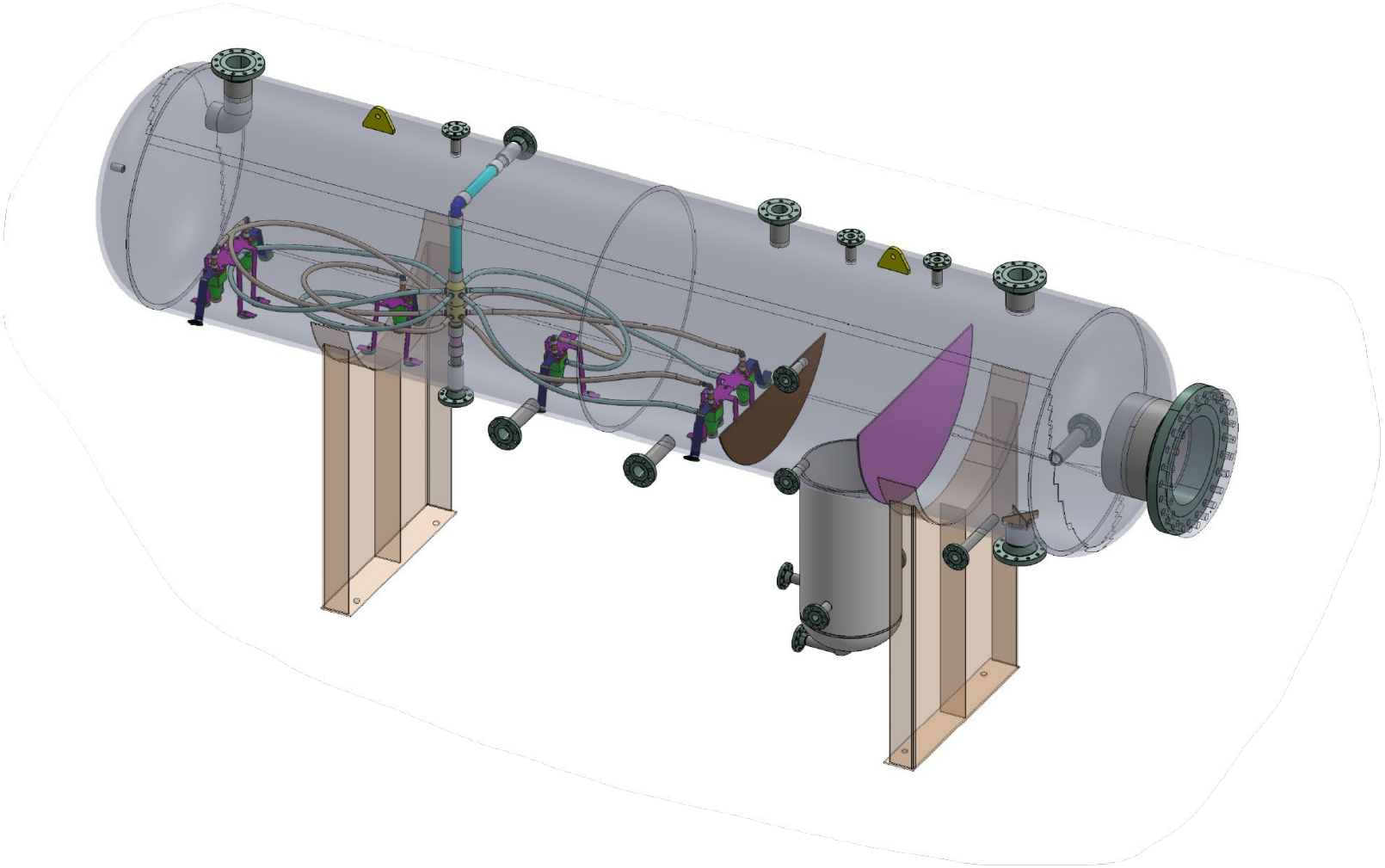
Variations of Bulk Separator

Other Vessels

9x40 Heater Treater Three 4XVFU (New)



5x20 300# Separator
One 4XVFU (New)



6’ VRT
One 4XVFU (New)