



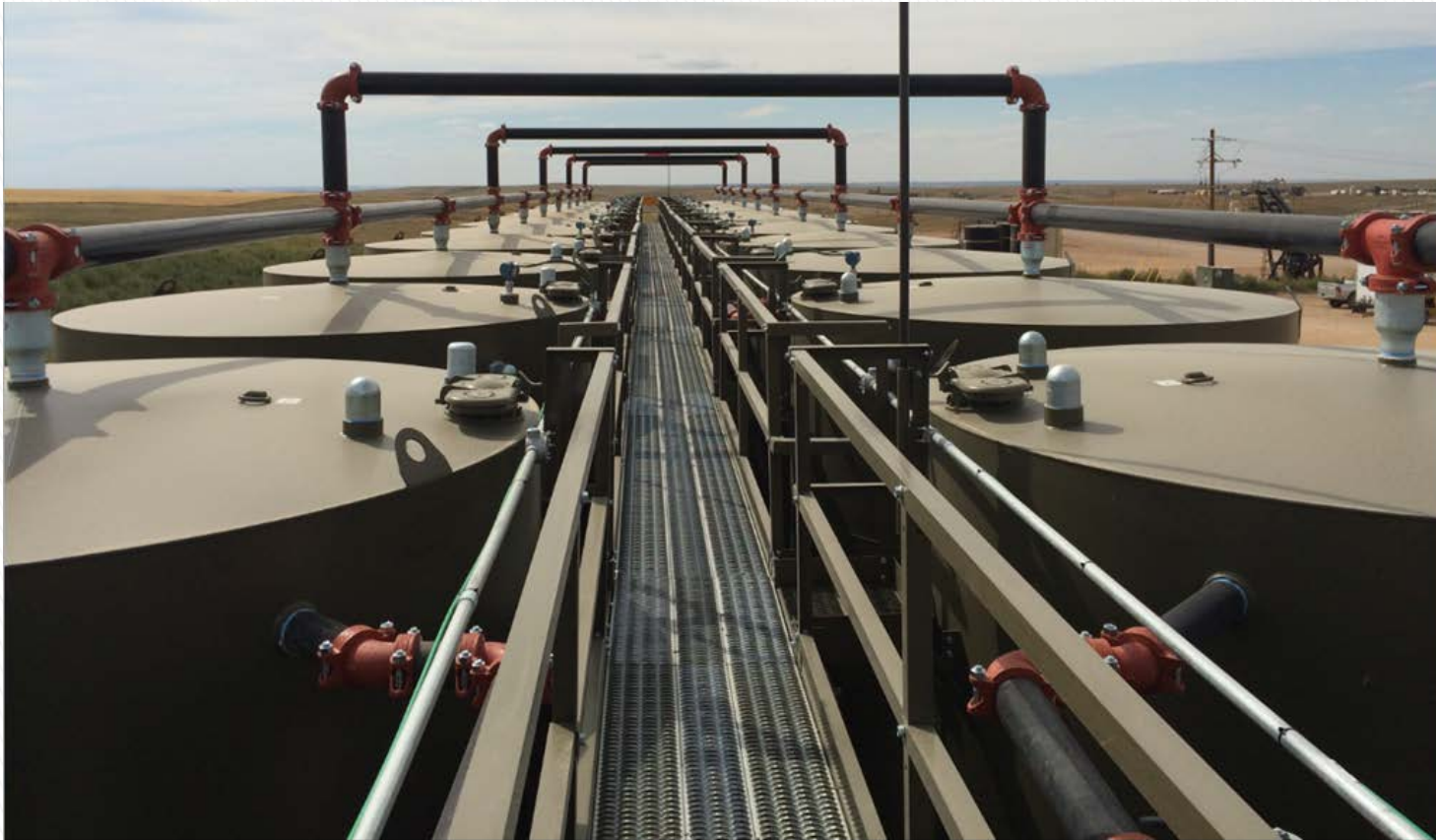
Life after the Thief Hatch

*Ryan Lunsford*

*5/22/18*



**WLL POWER**



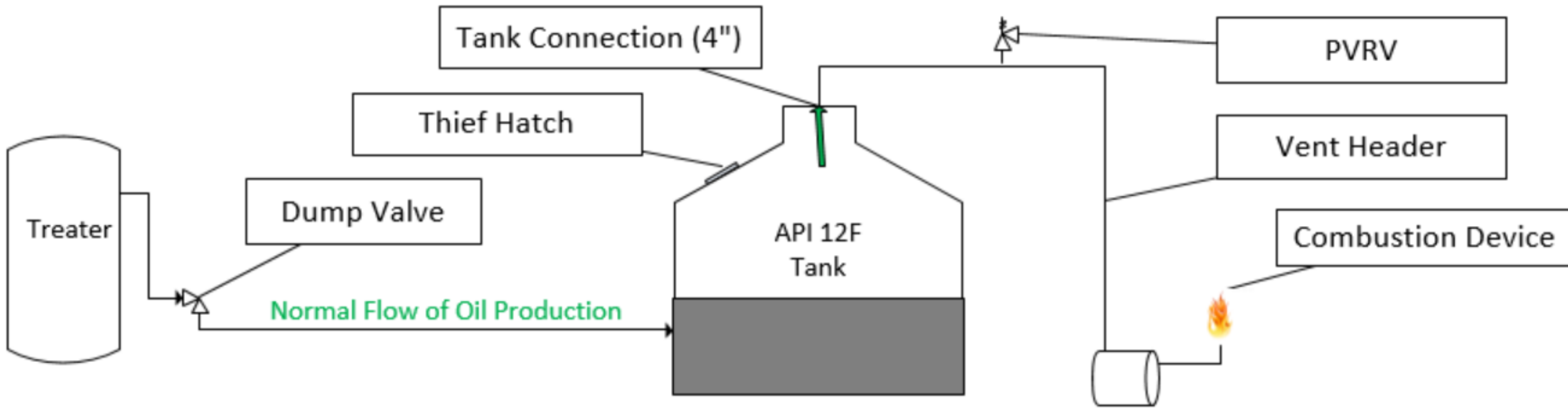
## VCS Design Goals

1. Route tank vapors to combustion device or VRU.
2. Size VCS for adequate capacity to maintain system pressure below relief device setpoints.

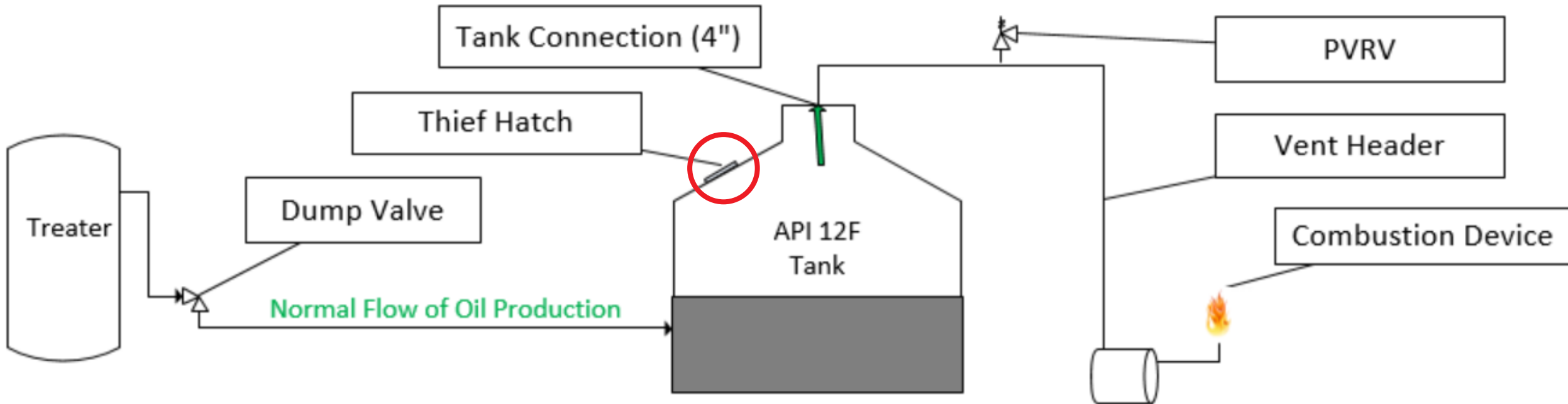
# Vapor Collection System: Normal Operation



During Normal Operation, tank vapors are routed through the VCS to a combustion device.



# Vapor Collection System: Normal Operation

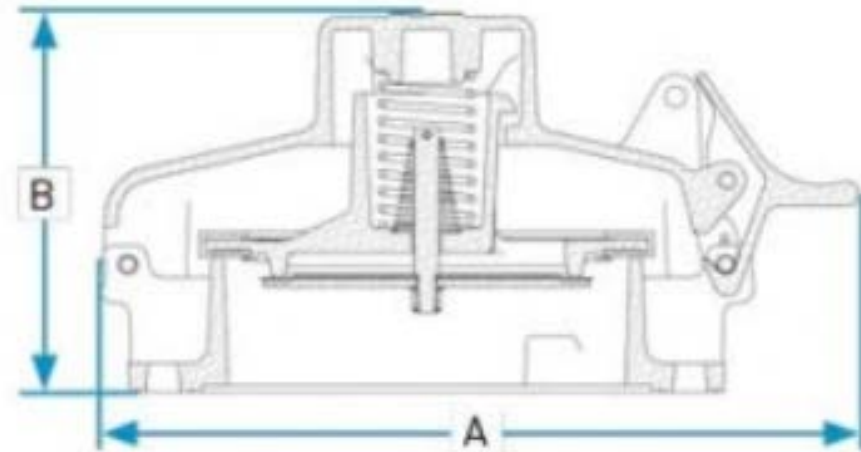
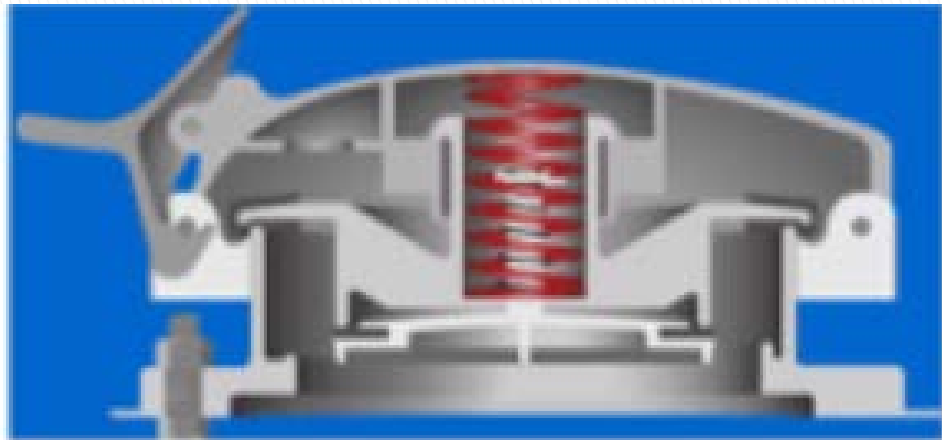


The thief hatch can still be a source of fugitive emissions no matter how well designed the rest of the VCS.

# Spring-Loaded Thief Hatch



- Pressure spring relieves at setpoint (typically 8-16 osig setting)
- Vacuum spring relieves at setpoint (-0.4 osig setting)
- Two 'leak points' per device

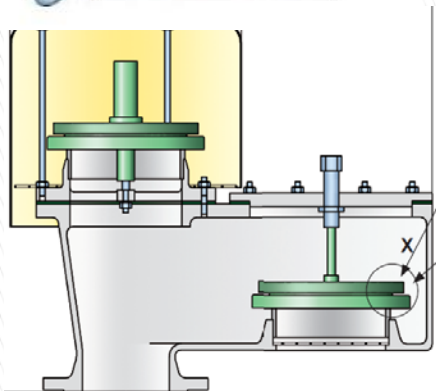
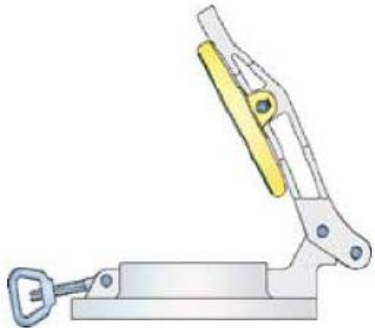


Can we replace spring-loaded thief hatch with lock-down hatch and:

- Reduce or eliminate fugitive emissions from tank components
- Reduce frequency of and cost associated with maintaining tank components
- Maintain adequate levels of pressure & vacuum relief for tank systems
- Maintain operability



# Tank Devices: Relief and Access

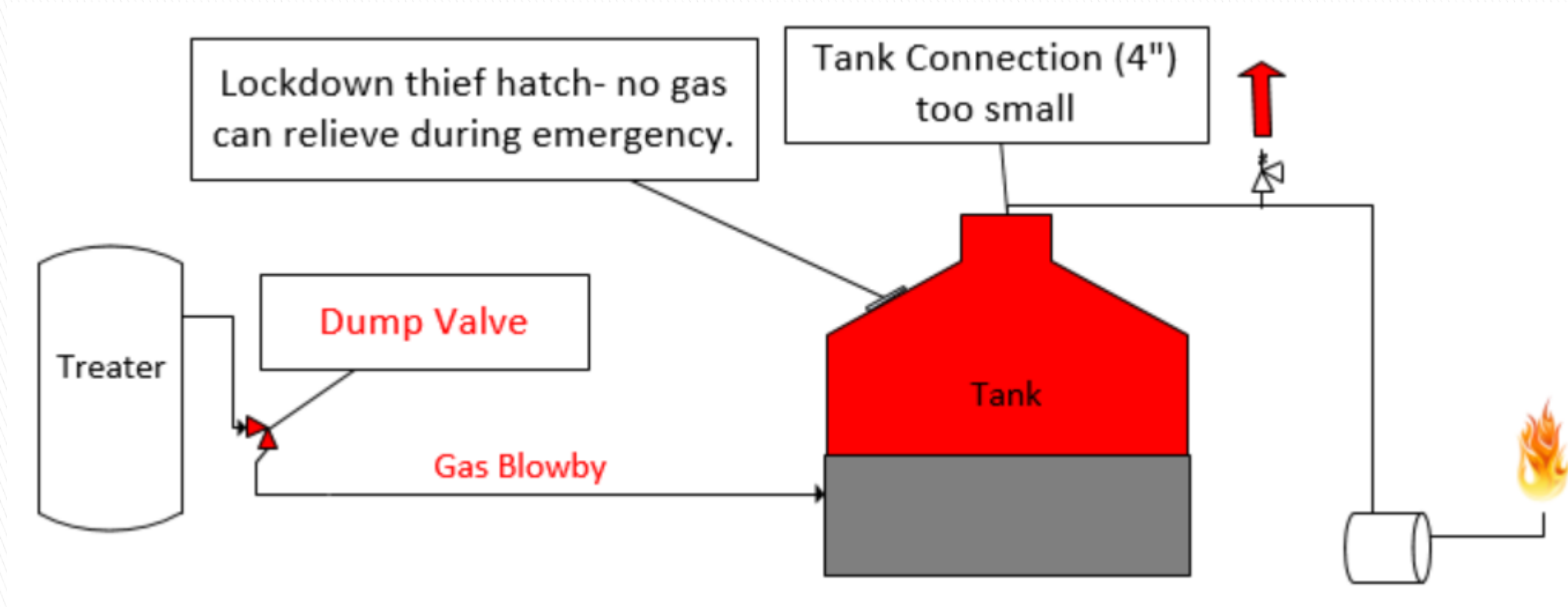


Device	Action	Pressure Relief	Vacuum Relief	Tank Access
Thief Hatch	Spring-loaded	Yes	Yes	Yes
Lock-Down Hatch	Manually Open/ Close; Screw Tight	No	No	Yes
Pressure-Vacuum Relief Valve (PVRV)	Weighted Pallet	Yes	Yes	No

# Vapor Collection System: Emergency Operation



During Emergency Operation, the standard 4" tank connection is too small to accommodate required relief capacity



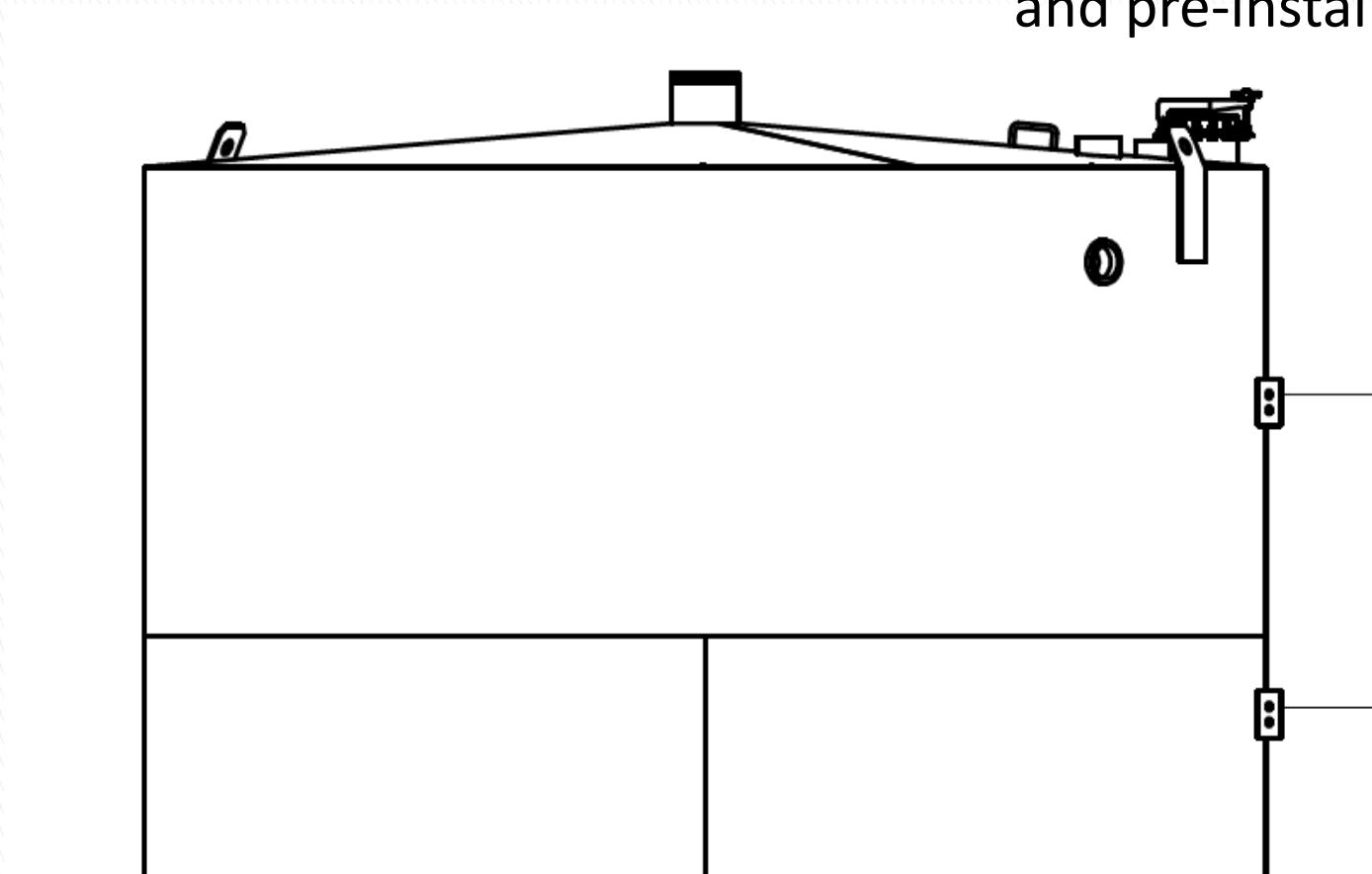


# Pilot Project: Tank Modification



Order new tanks with 8" vent connection...

and pre-installed Lock-Down hatch



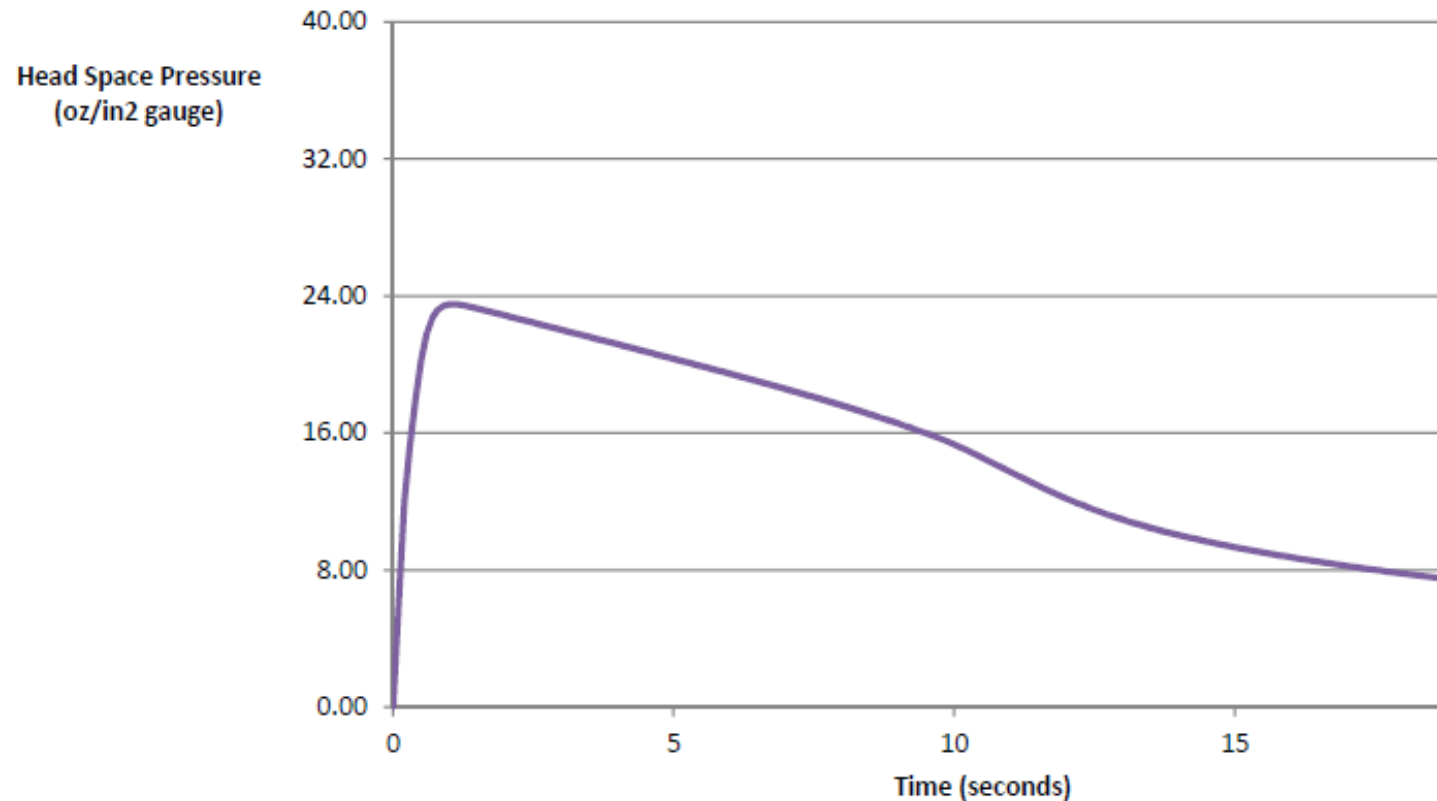
# Pilot Project: Tank Pressure Modeling



Modeled the egress of gas during emergency relief scenario to ensure tank pressure stayed within guidelines of API 2000.

Determined:

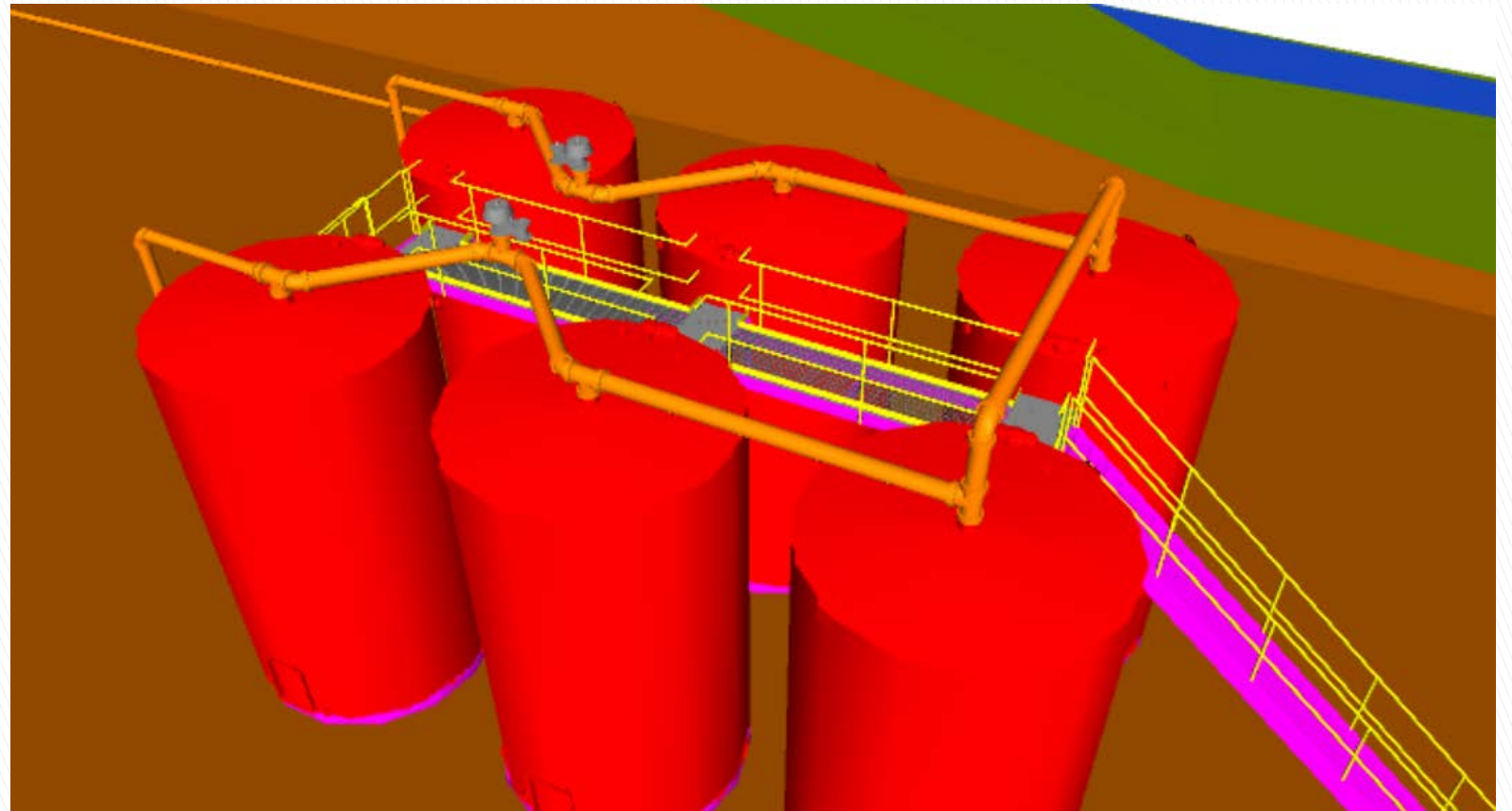
- PVRV Size
- PVRV Spacing
- Vent Pipe Sizing



# Pilot Project: Access & Winterization



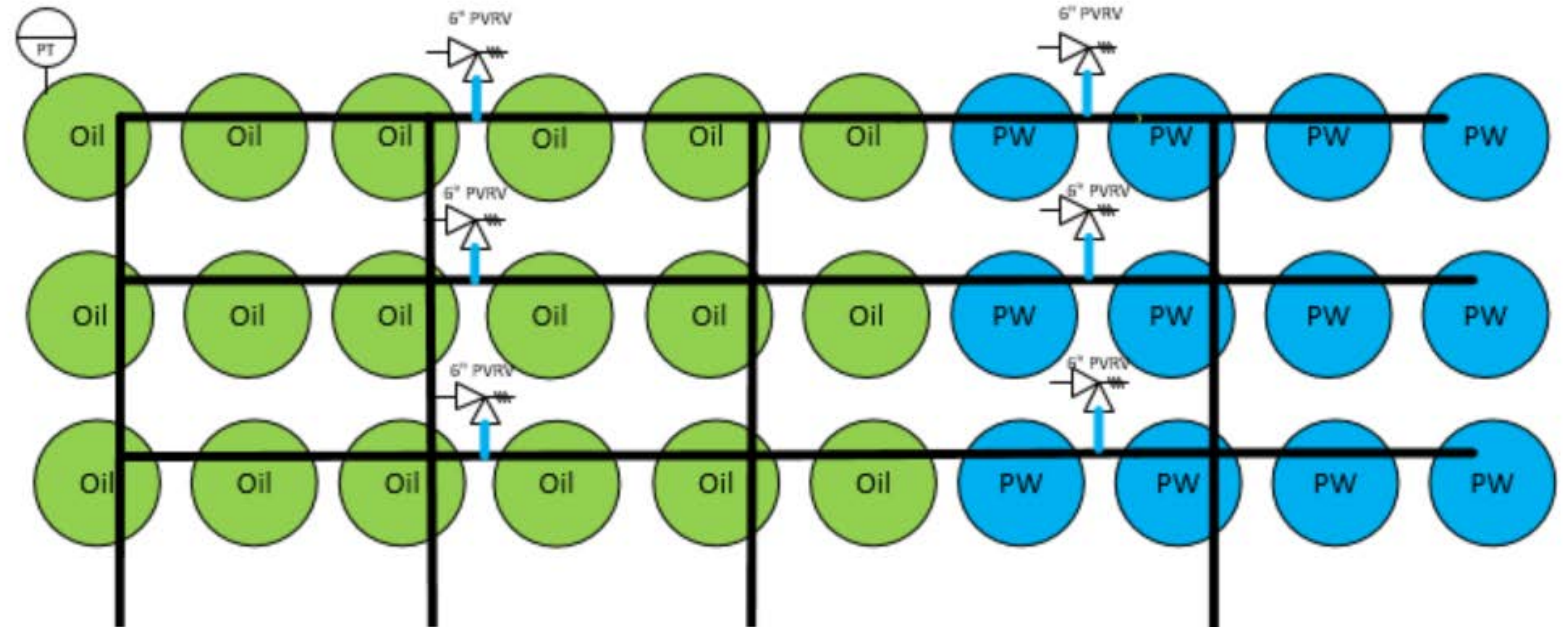
- Piping design to allow maintenance access to PVRV from catwalk
- All PVRVs were heat traced and insulated to protect from freezing
- Tank systems have at least two (2) relief devices



# Pilot Project: Layout



Pilot Project Q1 2017 – installed 30 lock-down hatches and 6 PVRVs. Eliminated 60 springs.



Device	Legacy Configuration	Pilot Lock-Down Configuration
Thief Hatch	30	0
Lock-Down Hatch	0	30
PVRV	3	6

Upon commissioning the facility, the following results were found:

- Initial inspection – corrected torque on lock-down hatch bolts
- Second inspection – no leaks on lock-down hatches
- Subsequent inspections – no leaks on lock-down hatches
- Winter observation – no freeze-ups on PVRVs

Project was deemed a SUCCESS and rolled out to all new installations.

Existing Locations: Economics do not support retrofit of existing locations due to extensive tank modifications

New batteries with Lock-Down configuration have experienced SIGNIFICANT reduction in work orders written to address fugitive emissions.

## Whiting Best Practices for New Tank Installations as of Q3'2017

- 100% Lock-Down Hatch Configuration on new tank installations
- All tanks ordered or installed with 8" vent connections
- All PVRVs heat traced & insulated
- No less than two (2) relief devices will be installed.