15 Sources of Methane Emissions in Oil Batteries and Recommended Mitigation Strategies

Methane emissions in oil batteries can arise from design limitations, operational practices, equipment failures, or maintenance procedures. The following are common sources and practical measures to minimize emissions.

1. **Operating Outside Design Parameters.**

   If upstream vessels operate at higher pressures or temperatures than intended, excessive vapors flash in storage tanks, overloading vapor recovery systems. This is especially common during initial production when liquid dumping is difficult, often due to sand accumulation.

   Mitigation:

   - Include sand filtration during early production phases.
   - Design vent systems for actual maximum operating pressures, and be sure to collaborate with Operations on this.
   - Provide independent backpressure control on each inlet vessel to isolate issues without raising backpressure across the facility.

2. **Restrictive Vent Systems or PRV Setpoints**

   A restrictive tank vent header or an overly high PRV setting can cause tank venting. While higher tank pressures reduce flash losses, improve VRU performance and vent header hydraulics and provide for increased VRU setpoint bandwidth, PRV setpoints must remain safely above normal operating pressures.

   Mitigation:

   - Monitor and adjust pressures frequently.
   - Conduct a Closed Vent System study to determine optimal PRV and operating setpoints.

3. **Detonation Arrestor Maintenance Issues**

   Clogged detonation arrestors frequently cause tank venting. Poor installation that prevents in-service cleaning exacerbates the problem.

   Mitigation:

   - Install bypasses and differential pressure transmitters for safe isolation and cleaning.
   - Consider purge gas systems to prevent oxygen ingress during maintenance.

4. **Corrosion in Vent Headers**

   Internal corrosion can rapidly clog detonation arrestors and force tank PRVs to lift.

   Mitigation:

   - Use corrosion-resistant materials (fiberglass, stainless steel) or internal coatings.

5. **Snap-Acting vs. Throttling Level Controllers**
   Snap-acting liquid level controllers cause intermittent flash rate spikes that may overwhelm vent headers.

   Mitigation:

   - Use throttling controllers to stabilize flows and reduce peak vapor loads.

6. **Compressor Liquids Dumping to Atmospheric Tanks**
   Compressor liquids often contain volatile hydrocarbons that re-gas when dumped to atmospheric tanks, creating pressure spikes. The rich density of the flash gas can seize liquid filled screw compressors, and this high-valued product should not be sent to the flare.

   Mitigation:

   - Route liquids to stabilization systems, blowcases, NGL tanks, or pipelines.
   - Avoid liquid-filled screw compressors in wet gas service

7. **Undersized Equipment or Higher-than-Expected Rates**
   Insufficient retention time in VRTs and heater treaters can increase flashing.

   Mitigation:

   - Design for 30-minute retention in VRTs.
   - Use modular, re-deployable flush production equipment during high-rate phases.

8. **Liquid Level Blowby and Blanketing Failures**
   Blowby or regulator failure can send large gas surges to tanks, lifting thief hatches for extended periods until Operator intervention. Perhaps not a "normal operating condition", this happens often, and especially if not separating sand from the production stream prior to separation, or there are paraffins, asphaltenes or other compromising particulates.

   Mitigation:

   - Install low-level switches to shut in production during blowby events.
   - Use restriction orifices to limit blowby rates, if valve terminal flow rate exceeds venting capacity.
   - Cascade higher-stage compressor dumps into lower-pressure vessels

9. **Ineffective Gas Blanketing Systems**
   Undersized or misconfigured blanketing systems allow oxygen ingress, risking shutdowns and requiring purges.

   Mitigation:

   - Size systems for peak SCFH demand with all pumps running and no incoming production.
   - Ensure proper blanket valve and 1st stage regulator selection and installation, regulator supply pressure is adequate and liquid traps are not present.

10. Flare/Combustor Pilot Failures

Unmonitored pilots can cause extended uncombusted venting.

Mitigation:

- Install pilot status monitoring and alarms.

11. Fugitive Emissions from Connections and Seals

Leaks can develop over time in thief hatches, PRVs, piping, and tubing.

Mitigation:

- Perform routine methane detection scans to verify integrity.

12. Glycol Regenerator Still Vents

These continuously emit methane.

Mitigation:

- Add condensers to recover heavier hydrocarbons.
- Install a combustor or thermal oxidizer for remaining vapors.

13. Manual Tank Gauging and Sampling

Opening thief hatches releases methane and may prompt operators to disable blanketing systems.

Mitigation:

- Use level transmitters and alternate sampling points.
- Install floating skimmers to recycle oil without opening hatches and without incurring vac truck costs

14. Pneumatic Instrument Gas

Methane-venting pneumatics remain a major emission source.

Mitigation:

- Route instrument vents to flare.
- Use low- or no-bleed devices.
- Convert to compressed air or nitrogen where economical.

15. Pigging and Vessel Maintenance

Depressuring vessels directly to atmosphere releases significant methane.

Mitigation:

- Route depressuring to existing flare systems.
- Use pig-sending/receiving valves to minimize vented volumes.

Closed Vent System Studies – A Holistic Approach

We recommend performing a Closed Vent Study for all new designs, expansions, and existing systems of concern. At CUE EPCM, our approach incorporates a safeguarding analysis to identify risks during both routine and upset conditions.

Our evaluation includes:

- Peak instantaneous vapor/liquid rates and corresponding flash, working, and thermal outbreathing rates.
- Hydraulic performance from tank outlet to flare tip, including BPCVs and detonation arrestors.
- PRV, PVRV, and thief hatch throughput capacity.
- LP flare and combustor throughput.
- VRU sizing, throughput, and turndown capabilities.
- Tank venting under pool fire conditions at various fill levels.
- Gas blowby scenarios from regulator or dump valve failures.
- Pressure/vacuum potential under maximum pump throughput conditions.

We then provide targeted recommendations on:

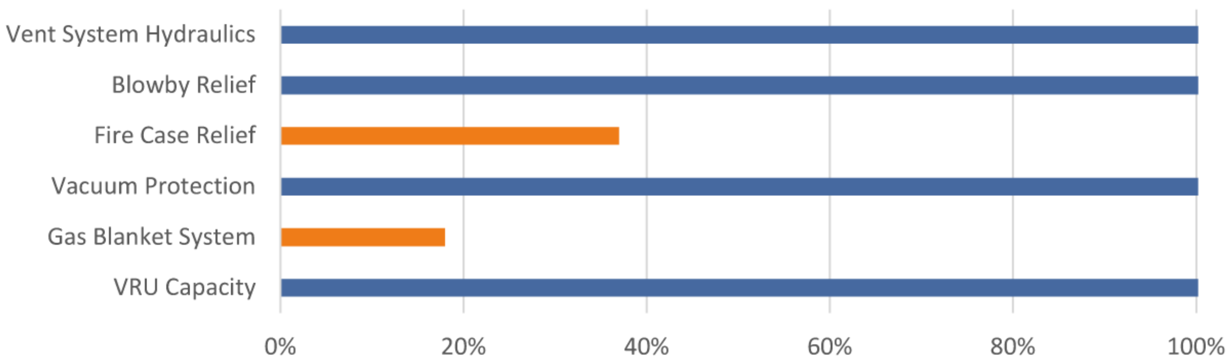
- Tank BPCV optimal set pressure
- Relief valve and hatch selection, additions or setpoint changes.
- Vent header and appurtenance modifications; PRV, D.A., LP flare/combustor
- Gas blanket system capacity, valve specification and configuration.
- VRU operating setpoints.
- Optimal tank liquid heights to reduce pool fire vent rates.
- Restriction orifice sizing and specification, while ensuring adequate dump rates.
- Pump operating pressures to achieve best efficiency points considering available NPSH.

By addressing these factors proactively, methane emissions can be minimized while maintaining safe, efficient operations.

Partner with Us to Reduce Methane Emissions

If you’re looking to meet or exceed your methane reduction targets, CUE EPCM can help. Our Closed Vent System and operations analysis identifies both routine and non-routine emission sources, and provides practical, cost-effective solutions tailored to your facility. Contact us to discuss how we can support your environmental and operational goals.

Study Excerpt: Snapshot of Existing System Performance



Study Excerpt: Pressure/Vacuum Relief Device Recommended Modifications

Storage Tanks PRD Capacity Requirements

				PRESSURE CAPACITY				VACUUM CAPACITY		
Location		**PRD**	**Details**	**Set Point**	**Rated Capacity**		**Required Capacity**	**Set Point**	**Rated Capacity**	**Required Capacity**
				oz	scfh AIR	scfh	scfh	oz	scfh AIR	scfh AIR
T-100A	Oil Tank	Thief Hatch	8" Enardo 665	16	16,670	10,523	254,400	0.4	20,057	
		PRV-100A	4" Enardo 951	15.5	112,306	70,892				
T-100B	Oil Tank	Thief Hatch	8" Enardo 665	16	16,670	10,523	254,400	0.4	20,057	
T-100C	Oil Tank	Thief Hatch	8" Enardo 665	16	16,670	10,523	254,400	0.4	20,057	
Vent header	common	PVRV-200*	NOT INSTALLED	14	N/A	N/A			N/A	
T-200	Skim tank	Thief Hatch	8" Enardo 665	16	16,670	21,074	203,950			46,754
		PRV-200	4" Enardo 951	15.5	112,306	141,979				
T-300A	PW Tank	Thief Hatch	8" Enardo 665	16	16,670	21,074	171,965	0.4	20,057	
		PRV-300A	4" Enardo 951	15.5	112,306	141,979				
T-300B	PW Tank	Thief Hatch	8" Enardo 665	16	16,670	21,074	171,965	0.4	20,057	
T-300C	PW Tank	Thief Hatch	8" Enardo 665	16	16,670	21,074	171,965	0.4	20,057	
			Total		453,608	**470,715**	**1,483,045**		**120,342**	**46,754**
			PRESSURE CAPACITY IS BELOW REQUIRED BY:				**1,012,330**	**VACUUM CAPACITY IS ACCEPTABLE**		
			COMBINED MW	45.5	1,012,330	GAS				
			COMBINED S.G.	1.5711	1,268,904	AIR	REQUIRED ADDT'L			

				PRESSURE CAPACITY				VACUUM CAPACITY		
Location		**PRD**	**Details**	**Set Point**	**Rated Capacity**		**Required Capacity**	**Set Point**	**Rated Capacity**	**Required Capacity**
				oz	scfh AIR	scfh	scfh	oz	scfh AIR	scfh AIR
T-100A	Oil Tank	Thief Hatch	Enardo ES-660 HF	16	100,013	63,132	254,400	0.4	20,057	
		PRV-100A	4" Enardo 951	15.5	112,306	70,892				
T-100B	Oil Tank	Thief Hatch	Enardo ES-660 HF	16	100,013	63,132	254,400	0.4	20,057	
T-100C	Oil Tank	Thief Hatch	8" EPRV SERIES 5000	16	470,000	296,681	254,400			
VENT HDR	COMMON	PVRV-200	not installed	14	n/a	n/a				
T-200	Skim tank	PRV-200	8" EPRV SERIES 5000	16	470,000	296,681	203,950			46,754
			4" Enardo 951	15.5	112,306	141,979				
T-300A	PW Tank	Thief Hatch	Enardo ES-660 HF	16	100,013	126,438	171,965	0.4	20,057	
		PRV-300A	4" Enardo 951	15.5	112,306	141,979				
T-300B	PW Tank	Thief Hatch	Enardo ES-660 HF	16	100,013	126,438	171,965	0.4	20,057	
T-300C	PW Tank	Thief Hatch	8" EPRV SERIES 5000	16	470,000	296,681	171,965			
		Blanket valve	2" Bel Gas PCV-300						8,400	
			Total		2,146,970	**1,624,031**	**1,483,045**		**88,628**	**46,754**
			PRESSURE CAPACITY EXCEEDS REQUIREMENTS BY:				**140,986**	**VACUUM CAPACITY IS ACCEPTABLE**		

NB: all tanks at 50% LL *Required capacity based on Pool Fire*

Enardo 665 hatches have utilized the flow capacities of ES-660 thief hatches per Emerson

Referenced recommended valves are Hawkeye PVRV and EPRV's and Enardo ES-660 HF