Tank Emissions from Controlled Tanks

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Tanks Emissions: overview

- Tanks can be a significant source of methane & VOC
  - flash emissions, working and breathing emissions, and emissions resulting from upstream problems (stuck dump valves or problems resulting from undersized separators)
- Current emissions estimate: 104 ktonne CH_4

  (crude oil tanks + condensate tanks)
- Previous estimates were ~4x higher
- Inventory calculates that 70-80% of oil and condensate are stored in *controlled* tanks, but ~90% of emissions are from *uncontrolled* tanks.
- Most new tanks (installed since August 2011) are covered by NSPS Subpart OOOO / OOOOa, requiring control if VOC PTE is over 6 tons per year

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Do tank emission controls work?

- Some top-down research has indicated high emissions **from VOC-heavy sources**
  - Petron et al 2014: high benzene in Weld County in 2012
  - Roest and Schade 2017: high VOC emissions in Eagle Ford 2013-2015
- Consent decrees between USEPA and operators in Colorado and North Dakota, focused on high emissions from tanks with controls installed.

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Causes of failure for tank control systems

- Design Flaws
  - VRUs undersized
  - Separators undersized / dumping very frequently
  - Separator dump valve leakage**
  - Liquid pooling
- Mechanical Failures
  - Thief hatch mechanical failure
    - gasket failure, weak or defective sealing mechanisms, etc.
  - Pilot flame fuel supply and igniter failures
  - Incomplete combustion
- Operational Failures / Errors
  - Thief hatches open
  - Other issues – intentional bypass, flares unlit
- Leaks in the system

**2017 GHG Inventory includes a line item for Malfunctioning Separator Dump Valves, but not any of the other forms of tank control malfunction.

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Estimating Emissions from tanks with malfunctioning controls

Lyon et al (2016) "Aerial Surveys of Elevated Hydrocarbon Emissions from Oil and Gas Production Sites"

- Helicopter survey of 8,000+ wellpads in Bakken, Barnett, Eagle Ford, Fayetteville, Marcellus, Power River, and Uinta basins (23 counties)
- Observed emissions from 453 tanks
- Largely qualitative (emissions observed? Y/N)
  - Lower detection limit 1-3 g/s (1.5 – 4 tpy)
- Most likely, many of these tanks are "uncontrolled" – ***so we would expect to see emissions from them.***
- **But, did they see emissions from any tanks that should have been controlled with either a flare or VRU?** If so, this would point to a malfunction. ***How often does this occur?***

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Reviewing “controlled” tanks (Method 1-Subpart W)

- Look at subset of pads from Lyon study that are 100% controlled, **at sub-basin level**, according to operator reports to Subpart W
- For each sub-basin (i.e. county), operators report total number of large tanks and total number of “controlled” large tanks.
- In the areas of the Lyon study, we found 14 operator-county combinations where all tanks are reported to be controlled. (Matched with pads surveyed in Lyon study based on lat/long.)
- **This accounts for 538 well pads in Lyon study.**

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Reviewing “controlled” tanks (Method 1-Subpart W cont.)

- 538 pads measured in Lyon study that report 100% tank control to Subpart W.
  - Remove 1 pad that was fully controlled in 2014, but not in 2013, in case controls were installed halfway through 2014.
- 60 tank emissions sources at these pads
  - Adjustment to only consider wells with date of first production at least 60 days at time of Lyon survey to account for Subpart W rules
- 1,825 tanks based on Google Earth review
  - Google Earth caveats:
    - Where possible, look at Google Earth images from 2014 (year of survey), infer in cases where this is not available.
    - Not always straightforward to know which tanks for with which pads based on Google Earth alone.

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Google Earth images:

1 tank, 1 well:

4 tank,
3 wells:

40 tanks,
5 wells:

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Reviewing “controlled” tanks (Method 1-Subpart W cont.)

- In this subset of tanks that should be 100% controlled, **3.2%** are found to be venting.
- Double checks:
  - We ran these pads through E&P tanks to see if properly controlled tank emissions (assuming 95% control or similar) would still be high enough to be observed by helicopter equipment (1 g/s)—and none were.
  - Checked to see if emissions could be from “small tanks” or malfunctioning/dump valves which are reported separately in Subpart W—and none were.

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Reviewing “controlled” tanks (Method 2-OOOO)

- Tanks on pads with first production (from first well) after OOOO effective date and at least 60 days before Lyon survey date, should be fully controlled.
  - Since the Lyon study was conducted in 2014, these were actually “Group 2” tanks with the earliest FDOP on the pad after 4/12/13.
- Due to the availability of data, we initially confine our review to pads in ND.
- 67 pads measured in Lyon study should be fully controlled under OOOO.
- 38 tank emissions sources at these pads
- 529 tanks based on Google Earth review
- In this subset of tanks that should be fully controlled, **7.2%** are found to be venting.

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Findings

- These **preliminary** analyses find that 3-7% of these sets of tanks, which should be 100% controlled tanks, are venting significant hydrocarbons
- We plan to expand the Method 2-OOOO analysis from the Bakken to other basins in the Lyon et al survey dataset.

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Roughly estimating impact

- Surveys did not quantify emissions.
- As an estimate of the impact **of observed leaks**, we can estimate emissions impact if 3-7% of controlled tanks are venting **all** flash gas.
  - This may be a reasonable assumption: once a thief hatch opens or a PRV cracks, pressure in the tank is lost and essentially all vapors may take the "path of least resistance" and vent.
  - At the same time, this impact does not include smaller leaks. Some pads could vent 100% and not be detectable, and any pad can have a smaller leak not detectable from the helicopter.
  - *If a pad has a stuck dump valve, or an undersized separator is not properly separating liquids,* ***emissions can be much higher than flash potential emissions****.*
  - Surveys were from 2014, before LDAR was required by OOOOa. If pads have wells drilled after 9/2015, LDAR will be required.
- If 3-7% of "controlled" tanks are venting flash, overall tank emissions methane should be 10-20% higher (10-20 ktonne).

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Questions?

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