
http://blogs.dailybreeze.com/history/files/import/27572-chevronaerial-thumb-400x262.jpg


https://media.gettyimages.com/videos/oil-refinery-at-dusk-drone-shot-video-id1058837302?s=640x640

Proposed Amended Rule 1178 – Further Reductions of VOC Emissions from Storage Tanks at Petroleum Facilities

WORKING GROUP MEETING 5
JULY 14, 2022

JOIN ZOOM MEETING
HTTPS://SCAQMD.ZOOM.US/J/93814044899
MEETING ID: 938 1404 4899
TELECONFERENCE DIAL-IN: 1-669-900-6833

Agenda

- Summary of Working Group Meeting #4
- Public Comment and Responses
- Rules 463 and 1178 Deficiencies
- Cost-effectiveness
- Next Steps

Summary of Working Group Meeting #4

- During Working Group meeting #4, staff responded to a comment letter received from a coalition of environmental groups and included information on:
    - Control and leak detection technology costs
    - Enhanced leak detection methods
    - Methods for calculating emission reductions

- Technologies not included in last Working Group meeting will be presented today
    - Vapor recovery
    - Secondary seals
    - Gap requirements

PUBLIC COMMENT AND RESPONSES

Control Technology Assessment

Comments

- What controls were assumed to calculate reduction from installing cable suspension floating roofs
- Unionized labor costs must be considered for installation of cable suspended floating roof systems

Staff Responses

- TanksESP emission calculating program used
- Default option for internal floating roof leg control fittings used (“IFR- type”)
- Staff revised costs to reflect additional labor costs

Control Technology Assessment *(continued)*

Comments

- What types of sample hatches and pressure vacuum vents can be retrofit with proximity switches?

- Costs to install proximity switches does not include the cost to install electricity network/power supply

Staff Responses

- Typical sample hatches and pressure vacuum vents installed on tanks are compatible with proximity switches
- Staff is not proposing to require installation of proximity switches (slide 22)

- Proximity switches have power source options such as batteries and solar panels that do not require electricity to be hard wired to devices

Third Party Inspection Method

Comments

- What training/certification is required at South Coast AQMD for third party inspections

Staff Responses

- Third party inspections required to follow protocol EPA's Method 21 – Determination of VOC Leaks

RULES 463 AND 1178 DEFICIENCIES

REVISED SLIDE

EPA Identified Deficiencies in Rules 463 and 1178

- EPA proposing partial disapproval of CARB RACT demonstration in oil and gas VOC sources partly relying on Rules 463 and 1178

Deficiency

- It is not clear if Rules 463 and 1178 meet or exceed EPA's 2016 Control Technology Guidelines for Oil and Natural Gas Industry (CTG) Potential-to-Emit (PTE) threshold

CTG vs Rules 463 & 1178 Thresholds

- 2016 CTG contains requirements for tanks to meet continuous 95% emission control*
  - Applies to tanks with potential to emit (PTE) of 6 tons per year
- Rules 463 and 1178 contain requirements for continuous 95% emission control
  - Applies to tanks with capacity 19,815 gallons and greater with minimum TVP
    - Rule 463 also applies to tanks 251 – 19,815 gallons used for gasoline

* Considered reasonable available control technology (RACT) and Federally required for existing sources in non-attainment areas

REVISED SLIDE

EPA Recommendation

- Rules be amended to apply to all storage tanks covered by 2016 Oil and Gas CTG
- Alternative:
  - CARB demonstrates how emissions from all storage tank vessels at oil and as facilities, other than the “separator and tank systems,” as defined, are significantly less than the CTG’s applicability threshold for storage vessels, and therefore not required to have RACT-level control for VOC emissions
- Staff working with CARB to resolve EPA’s partial disapprovals

CONTROL TECHNOLOGY COST EFFECTIVENESS

Cost-Effectiveness

- Cost-effectiveness calculated for controls and leak detection methods with potential to reduce emissions
- Threshold of $30,000 per ton of VOC reduced established in 2016 Air Quality Management Plan
- Staff calculated cost-effectiveness for:
  - Vapor recovery
  - Secondary seals
  - Gap requirements
  - Doming
  - Cable suspended internal floating roofs
  - Proximity switches
  - Continuous monitoring
  - Third-party monitoring with optical gas imaging cameras

Vapor Recovery Systems

- Fixed roof tanks required to vent to a fuel gas system or an emissions control system with at least 95% efficiency

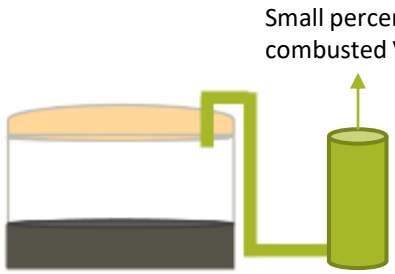
Fuel gas system

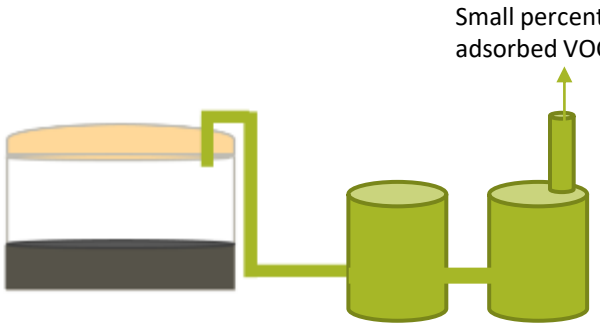
- Collected vapors transported for sale or for use in other process equipment (closed system)

Heater covered by Rule 1109.1

Emission control systems

- Combustion
  - Collected vapors combusted to prevent VOC to atmosphere – 98% control efficiency
- Non-combustion
  - Collected vapors processed through carbon adsorption to prevent VOC to atmosphere – 95% control efficiency





Vapor Recovery Systems *(continued)*

- 9 refineries, 185 fixed roof tanks connected to fuel gas systems
- 5 facilities, 82 fixed roof tanks connected to vapor recovery

Performance Tests

- Annual performance testing for one facility shows greater than 99% efficiency for combustion vapor recovery unit
  - Other records of performance testing show compliance – efficiency not specified
- Initial performance testing shows greater than 99% efficiency

Cost Effectiveness

- Not evaluated – units already meeting 98% emission control efficiency

Staff Recommendation

- Require overall control efficiency of at least 98% by weight for combustion emission control systems

Secondary Seals for Internal Floating Roof Tanks

- Secondary seals not required on internal floating roof tanks
- Most internal floating roof tanks equipped with secondary seals
  - 31 tanks with no secondary seal

Costs

- Obtained from 2001 Rule 1178 adoption – adjusted to 2022 dollars

Reductions

- Based on Tank ESP calculations for adding secondary seal to internal floating roof tanks storing various liquids including gasoline, jet kerosene, crude RVP 5, and fuel oil #2

Cost Effectiveness

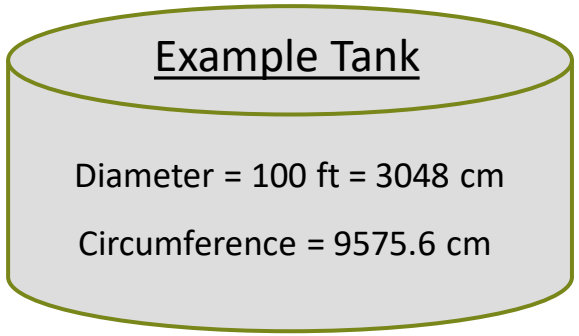
- $197,500 per ton of VOC reduced*

Staff Recommendation

- Retain current requirements for seals
- Add provision to prohibit modification of internal floating tanks with existing secondary seals if modification results in tank having only primary seal, unless equivalent or greater control efficiency can be demonstrated

* Based on 20-year equipment life

Gap Requirements



- EPA has requirements for seals contained in 40 CFR 60 Subpart Kb
  - Applies to tanks ≥75,000L constructed, reconstructed or modified after July 23, 1984
  - Does not apply to tanks:
    - 151,000L or larger storing liquid with maximum TVP <0.5 psia
    - 75,000L to <151,000L storing liquid with maximum TVP of 2.18 psia
- EPA requirement for primary seal more stringent than South Coast AQMD for certain tanks

EPA	South Coast AQMD	SJVAPCD
• No gap >3.81cm • Primary seal gaps not to exceed $\frac{212\ cm^2}{meter\ of\ tank\ diamter}$ • Maximum gap area = 6,461.8 cm^2	• No gap >3.8cm • Gaps >1.3cm not to exceed 30% of circumference • Gaps >0.32cm not to exceed 60% of circumference • Maximum gap area = 12,812.2 cm^2	• No gap >3.8cm • Gaps >1.3cm not to exceed 10% of circumference • Gaps >0.32cm not to exceed 30% of circumference • Maximum gap area = 5,266.9 cm^2

- Staff examined gap measurement inspection reports to identify tanks potentially affected by more stringent gap requirements
  - Staff examined statistically significant percentage (10%) of floating roof tanks

Gap Requirements *(continued)*

- 780 floating roof tanks subject to gap inspections
- Staff examined most recent inspection reports for 10% random sample of tanks (84 tanks)
  - Gaps reported for 48 out of 84 tanks (all tanks incompliance)
  - All tanks would remain in compliance with more stringent gap requirements

Cost Effectiveness

- Not evaluated – tanks in compliance with proposed requirements

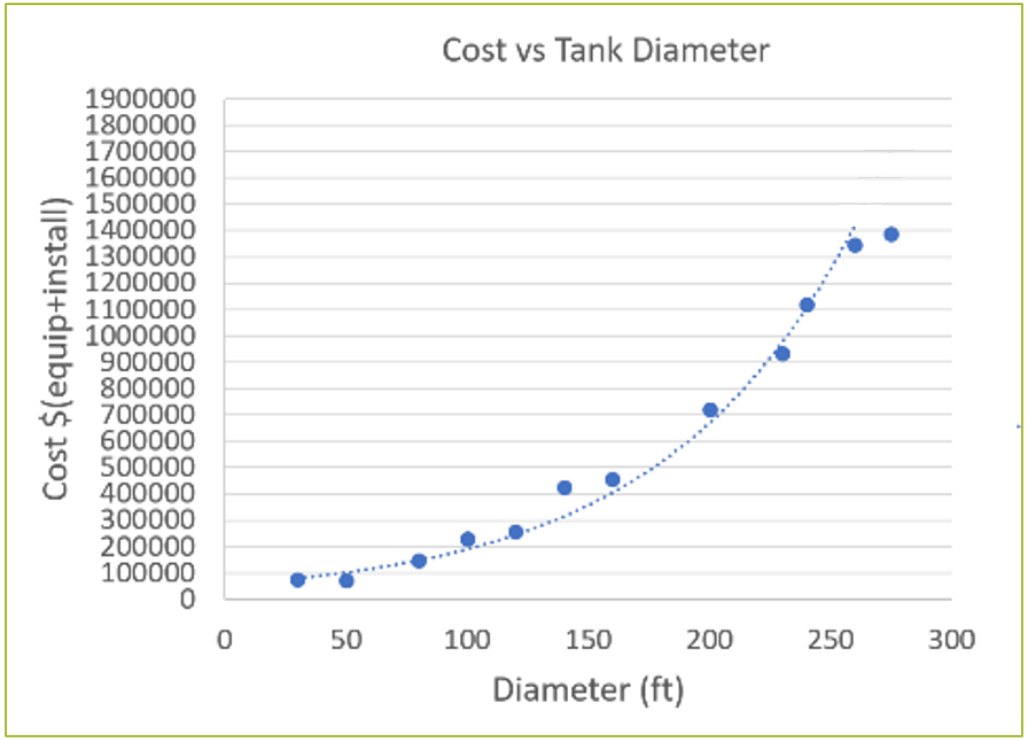
Staff Recommendation

- Revise gap requirements to reflect stringency of 40 CFR 60 Subpart Kb for all floating roof tanks
  - Gaps >1.3 cm not to exceed 10% of circumference and gaps >0.32 cm not to exceed 30% of circumference

Doming Crude Oil External Floating Roof Tanks

Revised costs

- Staff included additional costs for unionized labor, crane rental and creating space for dome assembly
  - 20% increase in labor costs for unionized labor
  - $10,000 per tank to create space for dome assembly and crane mobility, and crane rental
- More costly to dome larger tanks



Reductions

- 2020 Annual Emissions Reports (AER) used for baseline emissions
  - Data obtained for 43 external floating roof tanks storing crude oil with reported emissions in 2020
- Reductions calculated using Tank ESP*
  - Used average reported RVP for crude within 2 standard deviations (RVP 8.19)
  - Used throughputs reported in 2020 AER

* Based on TankESP PRO program calculation for doming an external floating roof tank of various diameters, storing crude at 80 °F, located in Los Angeles County, with standard deck fittings and seals.

Doming Crude Oil External Floating Roof Tanks *(continued)*

Cost Effectiveness

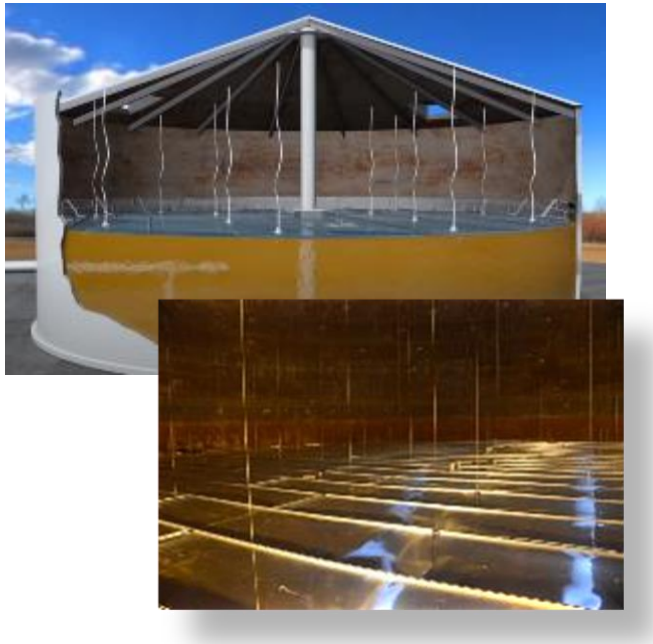
Tank Diameter (ft)	Cost-effectiveness* ($/ton)	# of Affected Tanks
All	$43,100	43
< 260	$37,200	39
< 200	$31,000	32
< 180	$29,900	31

Staff Recommendation

- Require domes on tanks with diameter less than 180 ft storing crude oil with TVP greater than 3 psia

* Based on 25-year equipment life.

Retrofitting Internal Floating Roofs with Cable Suspension Systems



Revised costs

- Revised costs to include shipping, demolition, roof modification and labor
  - Total costs range from $120,000 – $670,000 depending on tank size

Reductions

- Calculated percent reductions for tanks storing product with high TVP*
- Baseline emissions from 2020 AER reports

Cost Effectiveness

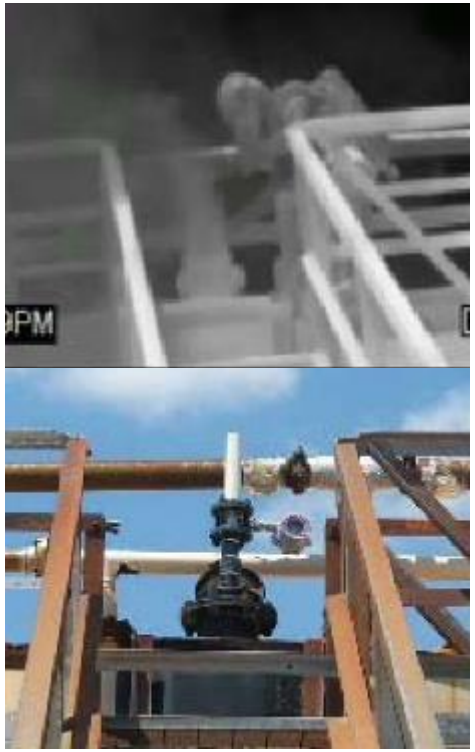
- Cost-effectiveness = $39,800 per ton of VOC reduced for tank with high TVP product
  - Cost-effectiveness for retrofitting all internal floating roof tanks exceed $39,800 per ton of VOC reduced

Staff Recommendation

- Implement protocol for enhanced monitoring to effectively identify potential leaks from internal floating roof tanks

* Based on TankESP PRO program calculation for an internal floating roof with no roof leg penetrations storing gasoline with RVP 10 at 80 °F, located in Los Angeles County, with standard deck fittings and seals, and 25-year equipment life

Installing Proximity Switches on Fixed Roof Tanks



Revised costs

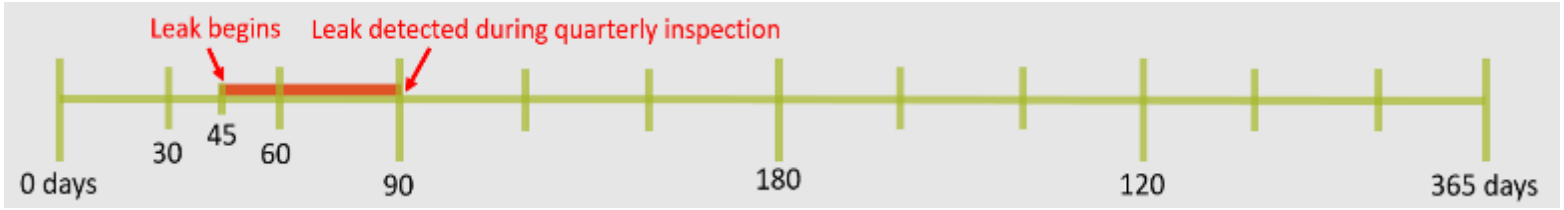
- Total cost to install switches is $4,000 per tank
  - Includes sensor, transmitter, receiver, cellular, and power

Reductions

- Reductions estimated using EPA's 2016 Control Technologies Guidelines (CTG) for the Oil and Gas Industry estimates for uncontrolled emissions from tanks
  - Emission estimates provided in tons of VOC per barrel of oil per day
- Staff based assumption on enforcement action taken for open sample hatch covers

➢ Assumptions:

➢ 1 open hatch undetected for ½ the time between quarterly inspections (45 days)



➢ Average throughput of fixed roof tanks storing crude oil in 2021 used

Average Throughput 115,542.9 Mgal/yr → 7,537 barrels per day → Table 4-2 in CTG: 1,464 tpy → 4.0 tons each day hatch left open → 180 tons emitted over 45 days

Installing Proximity Switches on Fixed Roof Tanks *(continued)*

Cost Effectiveness

- Less than $1,000 per ton of VOC reduced*

Staff Considerations

- Leaks from hatches may be result of other factors (i.e., worn/missing gaskets)
  - Proximity switches not useful for detecting all leaks
- Leak detection may be more useful for identifying leaks
  - Can identify leaks from worn/missing gaskets or malfunction

Staff Recommendation

- Explore how monitoring recommendation can identify potential leaks from hatches and PRDs
- Implement protocol for enhanced monitoring to effectively identify potential leaks from all components

* Based on 15-year life

ENHANCED LEAK DETECTION COST EFFECTIVENESS

Identified Emissions

- All identified leaks not detectable with audio, visual, olfactory (AVO) inspections
- Leak reports suggest leak detection technology most useful for identifying leaks*
  - TVA inspections made up 67% of total inspections and identified 98% of leaks
  - AVO inspections made up 33% of total inspections and identified 2% of leaks

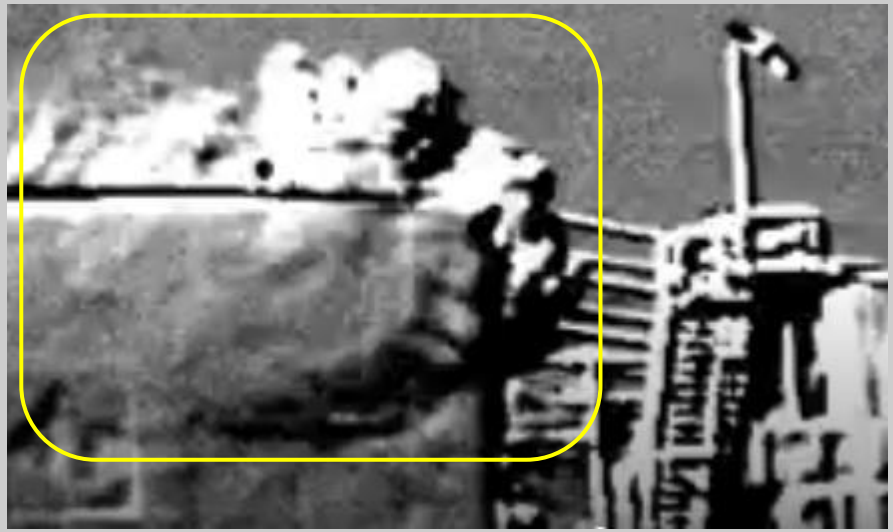
Type of Inspections	# of Tanks	# of Inspections	# identified leaks
TVA inspections (fixed)	119	464	178
AVO inspections as required by rule 1178 (domed/internal)	116	229	4

- Newer leak detection technologies effective at identifying large leaks sooner - may be more efficient than using TVAs
- Facilities and South Coast AQMD compliance staff use other technologies to identify leaks
- Compliance staff have identified several leaks from floating and fixed roof tanks using optical gas imaging (OGI) cameras

* Data from 2021 leaks reports from 5 refineries, 1 bulk storage facility, and 1 terminal

Emissions Identified Using OGI

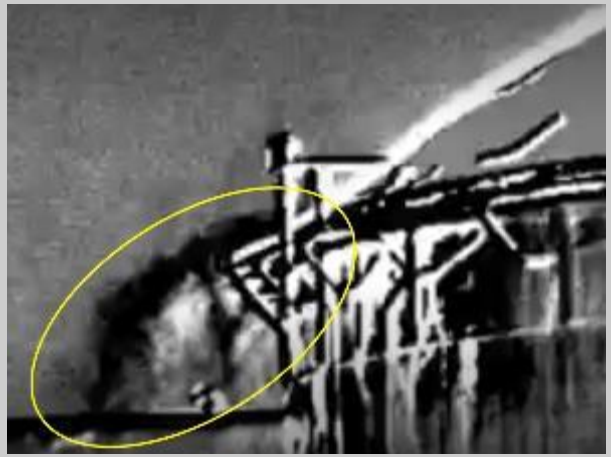
Fixed roof tank

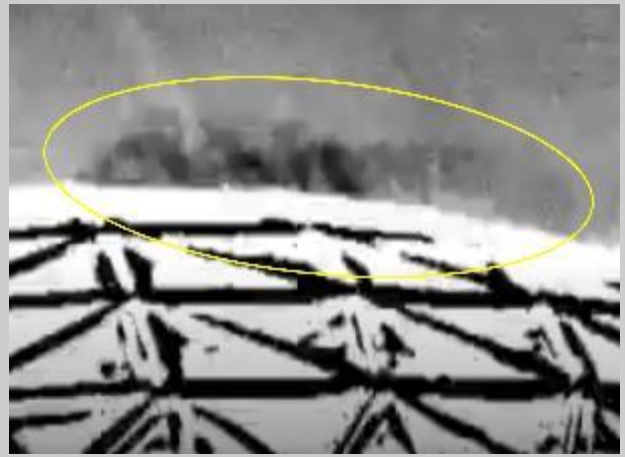


Fixed roof tank

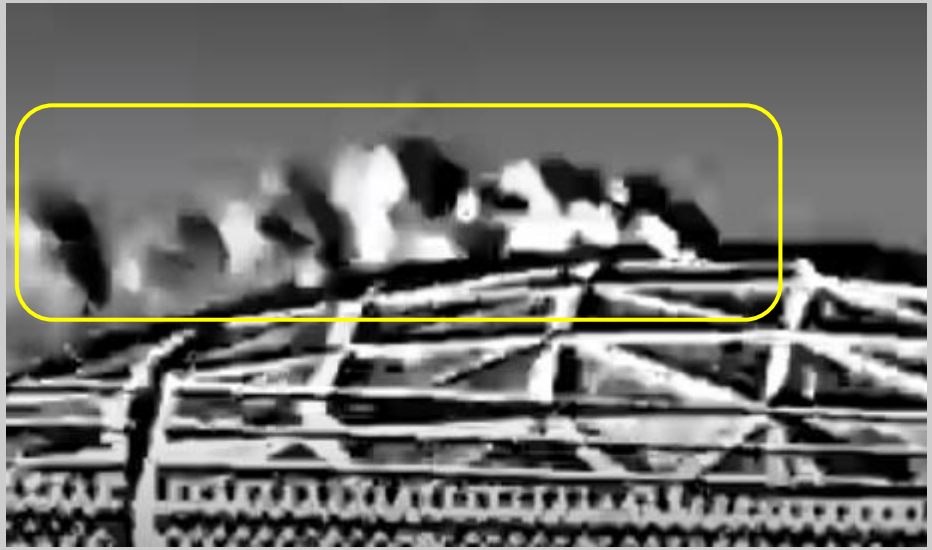
Emissions Identified Using OGI *(continued)*

Domed external floating roof tank





Domed external floating roof tank



Estimating Emissions from Leaks - Leak Reports

- Staff used data from Rule 1178 leak reports and other emissions studies
  - Emissions studies include EPA's 2016 Control Technologies Guidelines for the Oil and Gas Industry and South Coast AQMD's 2015 Optical Remote Sensing Study

- Staff identified 119 fixed roof tank leak reports for 2021

Leaks reported in ppm converted to mass emissions using EPA's Protocol for Equipment Leak Emission Estimates (Table 2-10)*

→

Assumption: Leaks occurred for 45 days

(1/2 the time between inspections for fixed roof tanks)

→

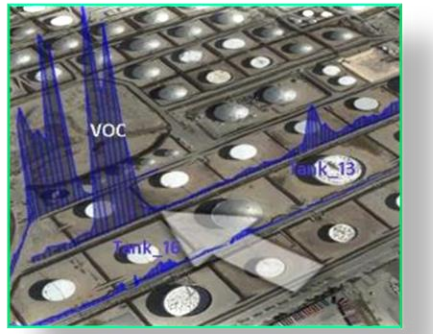
Emissions estimated for all tanks using emissions calculated for 119 tanks

- Total calculated emissions from leaks from 119 fixed roof tanks = 892 lbs in 2021
- Total estimated emissions from leaks from all tanks (1,063 tanks) subject to rule = 7,968 lbs per year = 4.0 tons per year

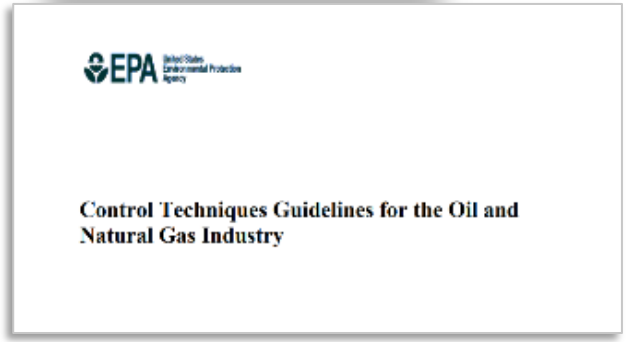
* https://www3.epa.gov/ttnchie1/efdocs/equiplks.pdf

Estimating Emissions from Leaks - Emissions Studies

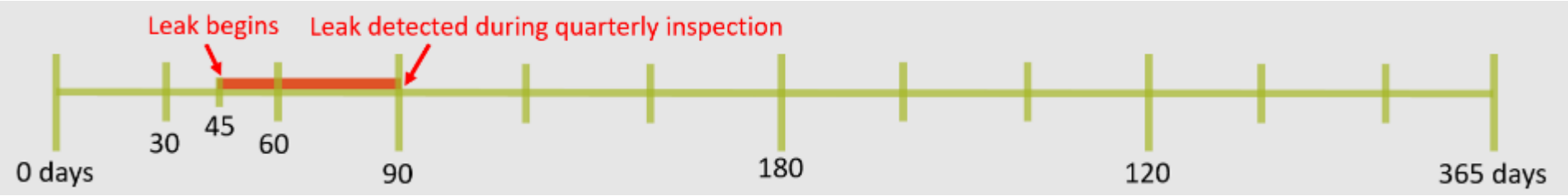
- 2015 Optical Remote Sensing Study identified leaking tank at a refinery
  - Provides direct measurement of mass emission rate from malfunctioning PRV using 2 technologies
  - Average emission rate calculated is 170.45 kg/hr (4.5 tpd)



- EPA's 2016 Control Technologies Guidelines for the Oil and Gas Industry estimates for uncontrolled emissions from tanks (Table 4-2)
  - Provides emission estimates in tons of VOC per barrel of oil per day
  - Calculated uncontrolled emissions rate is 4.0 tpd for average fixed roof tank storing crude



- Assumptions:
  - One tank has one large leak once per year (1 out of 1,063 tanks)
  - Leak occurs for ½ the time between quarterly inspections (45 days)



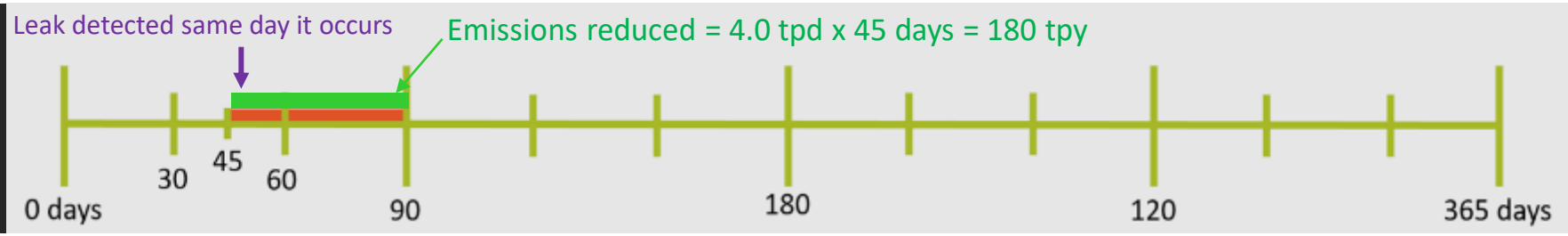
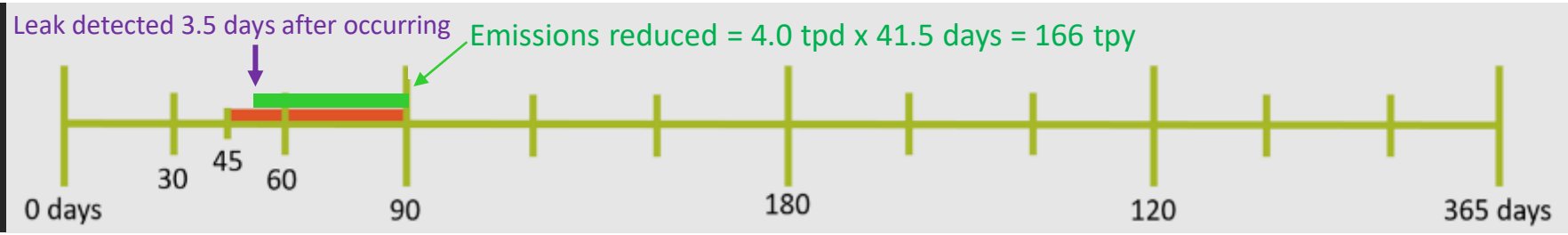
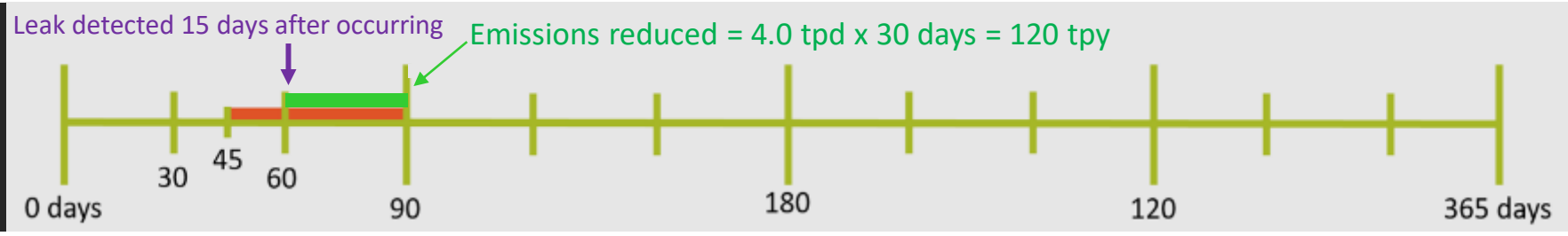
Estimated Emissions from Leaks

Estimating basis	Emission rate (tpd)	Emissions (tpy)
2021 leak reports for fixed roof tanks	0.01	3.9
EPA's 2016 emission estimates for uncontrolled tanks	4.0	180
2015 South Coast AQMD Optical Remote Sensing Study	4.5	202.5

- Leak reports do not fully characterize emissions occurring from leaks
  - Additional leak identified by compliance staff with OGI
  - Visual inspections as required by rule not sufficient for identifying leaks
- EPA's 2016 CTG for Oil and Gas Industry provides emissions information based on several emissions studies
  - Staff will use emission estimate based on EPA's 2016 CTG for Oil and Gas to determine cost-effectiveness for enhanced leak detection methods

Estimated Reductions from Enhanced Leak Detection Methods

- Reductions differ depending on frequency of inspection method
  - Staff estimated reductions for continuous, weekly and monthly leak detection

Continuous monitoring Leak detected when it occurs		180 tons per year
Weekly monitoring Leak detected 3.5 days after occurring (1/2 the time between inspections)		166 tons per year
Monthly monitoring Leak detected 15 days after occurring (1/2 the time between inspections)		120 tons per year

Cost-Effectiveness - Enhanced Leak Detection Methods

- Staff determined emission reductions associated with different monitoring methods with greatest potential to reduce emission impact from leaks

Monitoring Method	Associated Reductions (tpy)
Continuous monitoring with gas sensors	180
Continuous monitoring with open path detection devices	180
Continuous monitoring with OGI cameras	180
Third-party OGI survey – weekly	166
Third-party OGI survey – monthly	120

- Staff calculated cost-effectiveness to implement different monitoring methods at a tank farm with 22 large tanks
- Scaled up costs to determine cost-effectiveness for all Rule 1178 facilities

Example tank farm

Continuous Monitoring

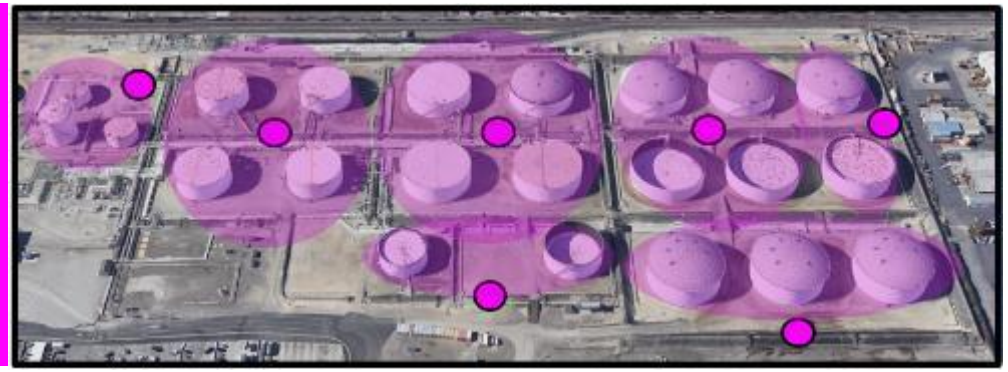
Gas Sensors

- 20 gas sensors
- Equipment + install = $36,000 (replaced every 6 months)
- Annual O&M = $96,000
- Total annual cost = $168,000/$200,000 (as a service)
- Cost-effectiveness for all 1178 facilities= $44,800/$53,400 per ton of VOC reduced

Open Path Devices

- 5 open path devices
- Equipment + install^ = $1,800,000
- Annual O&M° = $25,000
- Total annual cost * = $115,000
- Cost-effectiveness for all 1178 facilities = $30,700 per ton of VOC reduced

Fixed Optical Gas Imaging Cameras



- 7 pan and tilt stationary cameras
- Equipment + install = $1,014,300
- Annual O&M = $35,000
- Total annual cost* = $85,700/$706,900 (as a service)
- Cost-effectiveness for all 1178 facilities = $23,900/$188,500 per ton of VOC reduced

^ 100 percent of equipment cost assumed for install cost
° Based on annual maintenance for optical gas imaging cameras
* Based on 20-year equipment life

Third Party Monitoring with OGI Camera

- Staff identified methods for OGI monitoring with third-party service
- Methods:
  - I) Tank monitoring with OGI camera on monthly or weekly basis
  - II) Partial tank monitoring (15 tanks per inspection) **and** tank farm overview with OGI camera

Revised costs

- $2,000 per day (monitor 10-20 individual tanks + tank farm scan in one day)
  - Cost effectiveness based on 15 tanks surveyed in one day

Cost Effectiveness

	Individual Tank Monitoring		Partial Monitoring (15 tanks) + Tank Farm Overview
Frequency of Inspection	Monthly	Weekly	Weekly
Cost to monitor 1,063 tanks ($/year)	$1,700,800	$7,370,200	$2,808,000 (27 facilities)
Reductions (tpy)	120	166	166
Cost-effectiveness ($/ton)	$14,200	$44,400	$16,900

Enhanced Leak Detection Summary

- Cost-effectiveness to implement different methods of enhanced monitoring:

Monitoring Method	Cost-effectiveness ($/ton VOC reduced)
Continuous – Gas sensors	$44,800/$53,400 (as a service)
Continuous – Open path	$30,700
Continuous – OGI	$23,900/$188,500 (as a service)
Third-party inspections with OGI on weekly basis (tank monitoring)	$44,400
Third-party inspections with OGI on monthly basis (tank monitoring)	$14,200
Third-party inspection w/ OGI on weekly basis (partial tank monitoring + tank farm overview)	$16,900

Enhanced Leak Detection Recommendation

Staff Considerations

- Cost-effectiveness
- Experience/training of technology operators
- Reliability of automatic monitoring technology

Staff Recommendation

- Weekly third-party inspections of 15 individual tanks and tank farm overview with OGI camera; or
- Approved continuous monitoring system implemented as a service to ensure proper operation of the monitoring system

Summary of Proposed Recommendations

- Controls

Current Requirement	Proposed Requirement	Cost-effectiveness	Reductions (tpd)
Dome external floating roof tanks with TVP > 3 psia, excluding crude tanks	Dome external floating roof tanks less than 180 ft in diameter storing crude oil with TVP > 3 psia	$29,900	0.05
Emission control system with 95% efficiency	Combustion emission control systems with 98% efficiency	Units already meeting proposed requirement	0.02
• Primary seal gaps >1.3cm not to exceed 30% of circumference • Primary seal gaps >0.32cm not to exceed 60% of circumference	• Primary seal gaps >1.3cm not to exceed 10% of circumference • Primary seal gaps >0.32cm not to exceed 30% of circumference	Units already meeting proposed requirement	0.01

Summary of Proposed Recommendations *(continued)*

- Leak Detection

Current Requirement	Proposed Additional Requirement	Cost-effectiveness	Reductions
Quarterly EPA Method 21 inspection (fixed roofs)	Partial tank monitoring with + tank farm overview with OGI camera	$16,900 per on of VOC reduced	0.45 tons per day
Semi-annual seal gap inspections* (external floating roofs)			
Semi-Annual visual inspections and seal gap measurements no less than every 10 years* (domed and internal floating roofs)			

* Gap measurements inspections also required when tank is emptied or degassed

Next Steps

- Preliminary Draft Rule Language (August)
- Public Workshop (Fall)
- Public Hearing (December)

Contacts

Melissa Gamoning
Air Quality Specialist
mgamoning@aqmd.gov
909-396-3115

Rodolfo Chacon
Program Supervisor
rchacon@aqmd.gov
909-396-2726

Mike Morris
Planning and Rules Manager
mmorris@aqmd.gov
909-396-3282

Michael Krause
Assistant Deputy Executive Officer
mkrause@aqmd.gov
909-396-2706

James McCreary
Air Quality Specialist
jmccreary@aqmd.gov
909-396-2451

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