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Workgroup Recommendations and Other Potential Control Measures
Volatile Organic Compounds Workgroup

VOC004 – Floating Roof Storage of Petroleum Products

New Jersey Candidate Control Measure Summary: 1. Retrofit kit for external floating roof tanks slotted guide-poles (XFRTs w/sgp) 2. Add-on control for degassing and interior tank cleaning (TDGC) 3. Control for roof landing losses (RLL) 4. Domes for gasoline XFRTs 5. Adoption of NSPS standards for floating roof seal and deck fitting specifications 6. Adoption of NSPS tank preventive inspection and maintenance requirements	**Emissions (tons/year) in New Jersey**	
2002 existing measures in New Jersey: Currently, there are no control measures for VOC emissions from the following storage operations: 1. external floating roof tanks with slotted guide poles, 2. degassing and interior tank cleaning operations 3. floating roof landing losses 4. gasoline XFRTs without domes.	**VOC** Uncontrolled: 2002 $XFRT_{sgp}$ 2002 TDGC 2002 RLL 2002 $XFRT_{domes}$ 2002 Base	 378 tpy(1.035tpd) 50 tpy(0.14 tpd) 3000 tpy (8.2 tpd) 400 tpy (1.1 tpd) 3828 tpy Total
Candidate Measure 1: Retrofit for Slotted Guidepoles *Measure ID: SS-07 - Slotted Guidepole Sleeves and Covers*[1] This measure is part of the Bay Area Air Quality Management District (BAAQMD) requirement under Regulation 8, Rule 5 for external floating roof tanks (XFRTs) for petroleum refinery products, which was implemented in 2000 as a control measure for their one-hour ozone attainment SIP. Retrofit kits are readily available, and easy to install with no downtime for the tank.They are designed to significantly reduce emissions from holes or gaps around slotted guidepoles. The proposed amendments will require the use of gaskets, wipers, pole sleeves, covers, etc to minimize evaporation. *Emission Reductions (99%)*: 1.02 tpd or 374 tpy	**VOC** 2002 Base: 2009 Reduction: 2009 Remaining:	 378 tpy[2] -374 tpy 4 tpy

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Based on 1999 BAAQMD data of 320 tpy for 200 product-specific XFRTs, and an estimated average emission of 12.6 tons per day (4,599 tpy) in from organic storage tanks in the Bay Area were. New Jersey has at least 236 XFRTs (storing VOC and/or refinery products with vapor pressure < 11.0 psia) under the Title V program, not counting XFRTs under the Preconstruction Permit program, based on NJEMS database. Based on BAAQMD data, there is a scaling factor of 1.6 tpy/tank. *Uncontrolled emissions*: 1.6 tpy/tank x 236 tanks = 378 tpy or 1.04 tpd. BAAQMD data indicates $2000 per tank for additional controls. *Estimated cost of control:* $2000/tank x 236 tanks = $472,000 total one-time cost to industry *Cost effectiveness*: $1250/ton of VOC emission reduced, or $154/ton (if annualized over 10 years at an interest rate of 4%), and $92/ton (if annualized over 20 years at an interest rate of 4%). If product is valued at $300/ton ($200 + $100 emission fees), then the measure results in a payback for industry. *Timing of Implementation*: 2009 *Implementation Area*: Entire State of New Jersey		

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Candidate Measure 2: Control for Tank Degassing and Interior Tank Cleaning[3] *Measure ID: 95% control efficiency for Degassing and Interior Tank Cleaning emissions*[4] *Annual Emission Reductions*: 47.5 tpy of VOC for 100 tanks cleaned annually. Proposal is based on success at CARB's San Joaquin Valley Air Pollution Control District (SJVAPCD) May 19, 2005 proposed amendments for changes for VOC storage tanks under Rule 4623. The Valley did not control degassed emissions until recently, when its staff conducted a study for Rule 4623 Amendments and found that costs were economically feasible for control of tank degassing emissions at 95% efficiency. An adoption of similar performance standards is recommended here. The proposal is to use control device (having 95% minimum efficiency) for tank degassing and interior cleaning emissions. Degassing is the process of removing organic vapors from a storage tank. SJVAPCD data indicates 18 tanks are degassed and cleaned in about every 10 years, with uncontrolled emissions of 8.5 tons for all 18 tanks or 0.5 tons/tank. Based on NJEMS database, New Jersey has about 1000 floating roof tanks (storing VOC and/or refinery products with vapor pressure < 11.0 psia) under the Title V program. This number does not include tanks under the Preconstruction Permit program. *Number of tanks cleaned within a10-year cycle:* 1000 tanks/10 yr = 100 tanks/yr *Uncontrolled emissions:* (100 tanks/yr) (0.5 tons/tank) = 50 tpy	**VOC** 2002 Base: 2009 Reduction: 2009 Remaining:	 50.0 tpy -47.5 tpy 2.5 tpy

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Annual Emission Reductions = (95%) (50 tpy VOC) = 47.5 tpy *Estimated Cost of Control:* SJVAPCD cost data indicates $6,283 to $11,781 for degassing a 62,832-barrel floating roof tank *Cost Effectiveness:* $2,288 to $4,290/ton of VOC emission reduced per tank. *Timing of Implementation*: 2009 *Implementation Area*: Entire State of New Jersey		
Candidate Measure 3: Control for Roof Landing Losses *Measure ID: Retrofit with a six-inch lander height or cabled roof retrofit* [5] *Emission Reductions*: 67% (1600-2000 tpy) Total RLL uncontrolled emissions New Jersey are in the range of 3000 tpy. Lowering the average roof leg height of 3.5 ft to 0.5 ft will yield about 67% emission reduction. Additional reductions could be realized if *best management practices* such as, reducing convenience landings, having product-specific tanks, etc., are put in place. *Control Cost*: Two scenarios are presented-retrofitting all floating roof tanks and retrofitting the 20% of tanks with the highest roof landing emissions. The cost analysis is based on AP-42 roof landing loss (RLL) calculation model and the Parato 80/20 rule - which is based on the assumption that 20% of the tanks account for 80% of the total RLL emissions. Basis of calculation and assumptions - Source quantity: 1000 tanks, total uncontrolled emissions: 3000 tpy, source life: 20 years, interest rate: 4% APR, total retrofit cost for 1000 tanks: $220,000,000	**VOC** 2002 Base: 2009 Reduction: 2009 Remaining:	 3000 tpy - 1600-2000 tpy 1000-1400 tpy[7]

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Cost Effectiveness: Roof landing emissions are about 3,000 tons/year (based on scaling Texas Data).[6] The total cost of retrofitting a tank with low landers is assumed to be comparable to converting a fixed roof tank to a floating roof tank. California (SCAQMD) indicates the average present worth value of converting a fixed roof tank to a floating roof tank is $220,000, which includes the cost of taking the tank out of service as well as annual maintenance and insurance costs. The discounted cash flow cost analysis assumes a twenty-year lifetime of floating roof (per SCAQMD) with an annual interest rate of 4 % (per SCAQMD). To convert all floating roof tanks to "low-lander" 1,000 tanks x $220,000 per tank = $220,000,000 Reduction = 0.67 x 3,000 tons/year = 2,000 tons/year Cost effectiveness = $16,200,000/2000 tons = **$8,100 per ton of VOC reduced** Applying the Parato 80/20 rule would yield the following cost effectiveness: 200 tanks would account for 2400 tpy, 200 tanks x $220,000 per tank = $44,000,000 for a 20-year lifetime and 4 percent interest rate, this is an annualized cost of $3,240,000 to tank owners. Reduction = 0.67 x 2400 tons/year = 1600 tons/year Cost effectiveness = $3,240,000/1600 = **$2,000 per ton of VOC reduced** *Timing of Implementation*: 2009 *Implementation Area:* Entire State of New Jersey		

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Candidate Measure 3 continued. Note Additional alternative control measures were considered such as, mandatory product-specific tanks, modified pressure relief devices, and add-on control sys with 95% efficiency; but their respective cost analyses could not be conducted to establish their effectiveness due to time limitation. However, these control measures may be reconsidered for future emission reduction proposals.		

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Candidate Measure 4: Dome Roofs for XFRT Storing Gasoline *Measure ID: Retrofit XFRTs with domes* *Emission Reductions: 63% (189 tpy).* *Cost Effectiveness:* Based on NJEMS database, total emissions from XFRTs in gasoline service totaled over 400 tons in 2002. SCAQMD indicates putting domes on XFRTs cuts emissions by an average of 63%.[8] *SCAQMD indicates the average present value of putting a dome on an XFRT (including annual maintenance and insurance as well as the cost of taking the tank out of service during the conversion) is $350,000.* *From NJEMS data, we have at least 53 floating roof tanks in gasoline service at the major facilities.* Total cost to industry (present value) is $18,550,000. The discounted cash flow cost analysis assumes a twenty-year lifetime of a dome with an annual interest rate of 4 % (per SCAQMD). The resulting annualized cost to industry is $1,365,000. Reported emissions from these tanks totaled over 400 tons in 2002. Total reductions = 0.63 x 400 tons/year = 252 tons/year Cost effectiveness=$1,365,000/252, or **$5,400 per ton of VOC reduced** Also, an additional benefit to facilities implementing this measure is that the floating roofs are protected from rain and snow. *Timing of Implementation*: 2009 *Implementation Area:* Entire State of New Jersey	**VOC** 2002 Base: 2009 Reduction: 2009 Remaining:	 400 tpy -252 tpy 148 tpy

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Other Proposed Amendments:

1. Adoption of NSPS standards for floating roof seal and deck fitting specifications
2. Adoption of NSPS tank preventive inspection and maintenance requirements

References:

[1] See BAAQMD Staff Report, "Amendments to Regulation 8- Organic Compounds, Rule 5 - Storage of Organic Liquids". Retrofits for slotted guidepoles are rate up to about 99% efficiency. The report can be found at http://www.baaqmd.gov/pln/ruledev/8-5/1999/0805_board_memo_111599.htm

[2] Based on NJEMS data for 2002 Emission Statements.

[3] Estimated emission reductions are based on the SJVAPCD Final Draft Staff Report on degassing and interior tank cleaning Proposed Amendments for Rule 4623. The report can be found at:
http://www.valleyair.org/Air_Quality_Plans/AQ_plans_Ozone_Final.htm
Also at: http://www.valleyair.org/Workshops/public_workshops_past.htm

[4] See also, Rob Ferry's model presentation, "Air Emissions from the Cleaning of Storage Tanks", TGB Partnership, Hillsborough, NC, held on April 7, 2005 at the Safe Tank Workshop in Richmond, CA. Bob can be reached at: Rob.Ferry@TGBpartnership.com. Mr. Ferry found that, generally, there is a minimum tank-cleaning yield of about 13,424 lbs (6.712 VOC). The annual reduction will be 6.7 tpy * 95% = 6.4 tpy per tank. Now since routine annual emissions from breathing and working losses are about 2,044 lbs (1.022 tpy VOC), the total emissions from a single cleaning event yields more than 6 years of routine emissions.

[5] See SCAQMD's Final Staff Report, " Further Reductions of VOC Emissions From Storage Tanks At Petroleum Refineries" for Proposed Rule 1178, December 11, 2001.

[6] Based on a scale 3.0 tpy/tank from the Texas data (7,250 tpy with 2200 tanks total) and NJEMS data of approximately 1000 floating roof tanks in New Jersey. The Texas data is based on a recent survey by the Air Quality Division's Industrial Emissions Assessment Section (of the Texas Commission on Environmental Quality). The survey found that an additional 7,250 tons of VOC emitted from tank landings in the Houston-Galveston-Brazoria (HGB) ozone non-attainment area should have been reported in 2003. The roof landing loss of 3.0 tpy/tank is a very conservative estimate, in light of recently reported roof landing losses ranging from 5 - 45 tpy/tank by some of New Jersey's major tank farm owners and operators.

[7] 1000 tpy remaining assumes 100% tanks retrofitted, and 1400 tpy remaining assumes worst 20% emitters.

[8] See Note 5

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