INTERNATIONAL LIQUID TERMINALS ASSOCIATION

November 25, 2009

Bill Baumann, Compliance & Enforcement Section Chief
Office of Air Program Compliance
Wisconsin Department of Natural Resources

Re: Petroleum Terminal Compliance Guidance for DNR Staff Who Inspect Terminal Facilities, November 4, 2009

Dear Mr. Baumann:

The International Liquid Terminals Association ("ILTA") is pleased to submit comments on the above-referenced Wisconsin Department of Natural Resources (DNR) memorandum that addresses compliance requirements as they relate to allowable seal gaps for internal (IFRT) and external (EFRT) floating roof tanks at petroleum terminals.

ILTA is an international trade association that represents eighty-five commercial operators of bulk liquid terminals, aboveground storage tank facilities, and pipeline companies located in the United States and 42 other countries. In addition, ILTA includes in its membership more than three hundred companies that supply products and services to the bulk liquid storage industry.

ILTA member facilities include deepwater, barge, and pipeline terminals whose bulk liquid commodities are essential to the national and international economies. These terminals interconnect with and provide services to the various modes of bulk liquid carriers, including oceangoing tankers, barges, tank trucks, rail cars, and pipelines. The commodities handled include chemicals, crude oil, petroleum products, renewable fuels, asphalt, animal fats and oils, vegetable oils, molasses, and fertilizers. Customers who store products at these terminals include oil producers, chemical manufacturers, product manufacturers, food growers and producers, utilities, transportation companies, commodity brokers, government agencies, and the military.

ILTA's terminal member companies strive to remain in full compliance with all applicable regulations. ILTA believes that DNR guidance on seal gap allowances for internal floating roofs should be consistent with practices outlined in the attached document, *Floating Roof Tanks: Background on Rim Seals*.

This report was prepared by Rob Ferry, co-founder of the TGB Partnership, a consulting firm specializing in air emissions issues. Mr. Ferry has been involved in the development of emission factors for storage tanks since 1980, and his work is cited in EPA's AP-42 document as the basis for EPA's rim seal emission factors. Mr. Ferry has been involved in the development of every EPA rule regulating storage tanks in the petroleum industry from NSPS Subpart Kb to the present.

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In his analysis, Mr. Ferry points out that EPA has historically imposed limitations on the seal gap areas for EFRTs only. Referencing EPA regulatory language, he states, "The inspection requirements specified for IFR tank rim seals requires inspecting only for holes, tears, or other opening in the seal, and does not require inspecting for gaps between the seal and the wall of the vessel…The limit on seal gap areas for an IFRT in this regulation, then, is limited only by the requirement that the floating roof must have no defects....It is evident from the language of more recent regulations that, when EPA intends to impose inspection criteria concerning gaps between the floating roof seal and the wall of an IFR tank, they expressly specify such criteria."

Furthermore, Attachment 2 of the report references the most recent EPA standard for storage tanks, 40 *CFR* 63, Subpart WW, which states that domed tanks with a floating roof are defined as internal floating roof tanks, and shall be regulated as such.

ILTA recommends that the DNR amend its guidance consistent with EPA's regulatory practices as presented in Mr. Ferry's report.

Thank you for your consideration.

Sincerely,

E. David Doane
President

Attachment

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Floating Roof Tanks
Background on Rim Seal Gaps

Prepared by Rob Ferry, P.E.

This report presents background on emissions estimating and regulatory issues pertaining to floating roof rim seals. In particular, this report addresses the issue of gaps between the rim seal and the shell of the tank.

Seal Gap Assumptions in U.S. EPA Emission Factors

The rim seal emission factors published in EPA's AP-42 document and programmed into EPA's TANKS software are not based on rim seals that fit perfectly tight with no gaps, but rather are based on an assumption that gaps exist between the rim seal and the shell of the tank.

The reference given for these emission factors by EPA in AP-42 is: *Documentation of Rim Seal Loss Factors for the Manual of Petroleum Measurement Standards: Chapter 19 – Evaporative Loss Measurement: Section 2 – Evaporative Loss from Floating Roof Tanks*, prepared by R. L. Ferry, April 5, 1995. Data for the development of these rim seal emission factors were obtained from tests conducted by API in cooperation with EPA, in which gaps of various sizes were intentionally introduced into the rim seals being tested.

The rim seal emission factors were then developed as the weighted average of emission rates for multiple seal gap scenarios. The determination of the gap sizes to include and the percent of the total to assign to each were based on field data that EPA had obtained from California. For the case of a mechanical-shoe seal with a rim-mounted secondary seal, the distributions of gap sizes included in the emission factors were as summarized below:

Seal Gap Areas in Weighted Average Emission Factors
Square Inches of Gap per Foot of Tank Diameter (in^2/ft diam)

	Gap Area (in^2/ft diam)		
	Case 1	Case 2	Case 3
Primary Seal	0, 1.7, 3.8	1.7, 3.8	9.4
Secondary Seal	0	0	0.76, 2.66
	Distribution in Emission Factors		
Tight Fitting	100%	0%	0%
Average Fitting	75%	25%	0%
Loose Fitting	20%	70%	10%

Case 1, then, was based on the average of test results in which the primary seal had a gap area of 0 in^2/ft diam, test results in which the primary seal had a gap area of 1.7 in^2/ft diam, and test results in which the primary seal had a gap area of 3.8 in^2/ft diam, with the secondary seal having a gap area of 0 in^2/ft diam in each of these tests. A gap area of 0 in^2/ft diam was defined as there being no gaps greater than one-eighth inch in width. Case 2 was similar, except that the test results in which the primary seal had a gap area of 0 in^2/ft diam were not included. Case 3, with the largest gaps, was based on the average of test results in which the primary seal had a gap area of 9.4 in^2/ft diam and the secondary seal had a gap area

of 0.75 in^2/ft diam, and test results in which the primary seal had a gap area of 9.4 in^2/ft diam and the secondary seal had a gap area of 2.66 in^2/ft diam.

The emission factor for tight-fitting rim seals was based entirely on the results for Case 1. The emission factor for average-fitting rim seals was based on a weighted average of Cases 1 and 2, with Case 1 weighted 75% and Case 2 weighted 25%. A weighted-average emission factor for loose-fitting rim seals was developed for riveted tanks, with Case 1 weighted 20%, Case 2 weighted 70%, and Case 3 weighted 10%.

Sensitivity of Rim Seal Emission Factors to Gap Size

A comparison of the estimated emissions for a loose-fitting rim seal to the estimated emissions for a tight-fitting rim seal would indicate the sensitivity of estimated emissions to the rim seal gap area. A typical external floating-roof tank (EFRT) is equipped with a mechanical-shoe type primary seal and a rim-mounted secondary seal. A wind speed of 10 miles per hour (mph) is typically used to represent an annual average wind speed in the continental United States.

When an EFRT is equipped with an aluminum dome roof, the dome roof reduces emissions by blocking the wind. The rim seal emission factor for the Domed EFRT is then based on a wind speed of 0 mph, as is the case for the rim seal emission factor for an internal floating-roof tank (IFRT).

Attachment 1 presents a summary of the difference in estimated rim seal emissions in terms of pounds per day for an EFRT and a Domed EFRT (IFRT). Selected results are summarized in the table below:

Difference in Estimated Emissions Between Loose-Fitting and Tight-Fitting Rim Seals
Mechanical-Shoe Primary Seal with Rim-Mounted Secondary Seal
Pounds per day (lb/day)

	True Vapor Pressure of the Stored Liquid (psia)			
	3.0	4.0	5.0	6.0
	Domed EFRT (0 mph wind speed)			
Tank Diameter (ft)	Emissions Difference (lb/day)			
40	0.31	0.43	0.56	0.70
80	0.61	0.85	1.11	1.40
120	0.92	1.28	1.67	2.10
160	1.22	1.70	2.22	2.80
	EFRT (10 mph wind speed			
Tank Diameter (ft)	Emissions Difference (lb/day)			
40	2.71	3.76	4.91	6.19
80	5.41	7.52	9.83	12.38
120	8.12	11.28	14.74	18.56
160	10.82	15.04	19.66	24.75

The difference in estimated emissions for a loose-fitting rim seal versus a tight-fitting rim seal is approximately an order of magnitude greater for an EFRT than for a Domed EFRT. For example, the case of an 80-foot diameter tank storing a liquid with a true vapor pressure of 5.0 psia has a difference of about 10 lb/day for an EFRT, but only 1 lb/day for a Domed EFRT.

It is evident that estimated emissions from an EFRT are much more sensitive to seal gap areas than are estimated emissions from a Domed EFRT (or an IFRT).

Regulatory Requirements

Consistent with the greater sensitivity to rim seal gap areas of EFRTs versus IFRTs, U.S. EPA regulations for storage tanks have historically imposed limitations on the seal gap areas for EFRTs only.

Typical of these regulations is NSPS Subpart Kb,[1] which includes the following inspection criteria for the rim seals of EFRTs:

> §60.113b(b) After installing the control equipment required to meet §60.112b(a)(2) (external floating roof), the owner or operator shall:
>
> (1) Determine the gap areas and maximum gap widths, between the primary seal and the wall of the storage vessel and between the secondary seal and the wall of the storage vessel according to the following frequency.
>
> (i) Measurements of gaps between the tank wall and the primary seal (seal gaps) shall be performed during the hydrostatic testing of the vessel or within 60 days of the initial fill with VOL and at least once every 5 years thereafter.
>
> (ii) Measurements of gaps between the tank wall and the secondary seal shall be performed within 60 days of the initial fill with VOL and at least once per year thereafter.
>
> (iii) If any source ceases to store VOL for a period of 1 year or more, subsequent introduction of VOL into the vessel shall be considered an initial fill for the purposes of paragraphs (b)(1)(i) and (b)(1)(ii) of this section.
>
> (2) Determine gap widths and areas in the primary and secondary seals individually by the following procedures:
>
> (i) Measure seal gaps, if any, at one or more floating roof levels when the roof is floating off the roof leg supports.
>
> (ii) Measure seal gaps around the entire circumference of the tank in each place where a 0.32-cm diameter uniform probe passes freely (without forcing or binding against seal) between the seal and the wall of the storage vessel and measure the circumferential distance of each such location.
>
> (iii) The total surface area of each gap described in paragraph (b)(2)(ii) of this section shall be determined by using probes of various widths to measure accurately the actual distance from the tank wall to the seal and multiplying each such width by its respective circumferential distance.
>
> (3) Add the gap surface area of each gap location for the primary seal and the secondary seal individually and divide the sum for each seal by the nominal diameter of the tank and compare each ratio to the respective standards in paragraph (b)(4) of this section.
>
> (4) Make necessary repairs or empty the storage vessel within 45 days of identification in any inspection for seals not meeting the requirements listed in (b)(4) (i) and (ii) of this section:
>
> (i) The accumulated area of gaps between the tank wall and the mechanical shoe or liquid-mounted primary seal shall not exceed 212 Cm^2 per meter of tank diameter, and the width of any portion of any gap shall not exceed 3.81 cm.
>
> (A) One end of the mechanical shoe is to extend into the stored liquid, and the other end is to extend a minimum vertical distance of 61 cm above the stored liquid surface.
>
> (B) There are to be no holes, tears, or other openings in the shoe, seal fabric, or seal envelope.
>
> (ii) The secondary seal is to meet the following requirements:
>
> (A) The secondary seal is to be installed above the primary seal so that it completely covers the space between the roof edge and the tank wall except as provided in paragraph (b)(2)(iii) of this section.
>
> (B) The accumulated area of gaps between the tank wall and the secondary seal shall not exceed 21.2 cm^2 per meter of tank diameter, and the width of any portion of any gap shall not exceed 1.27 cm.
>
> (C) There are to be no holes, tears, or other openings in the seal or seal fabric.

These inspection requirements for EFRTs include requirements to measure gaps between the seal and the wall of the vessel (seal gaps), in addition to stating that there are to be "no holes, tears, or other openings in the seal or seal fabric." It is evident, then, that the prohibition on holes, tears, or other openings in the seal is a separate consideration from gaps between the seal and the wall of the vessel. The inspection requirements specified for IFRT rim seals requires inspecting only for holes, tears, or other openings in the seal, and does not require inspecting for gaps between the seal and the wall of the vessel. The language in Kb reads as follows:

[1] U.S. Environmental Protection Agency, "Standards of Performance for Volatile Organic Liquid Storage Vessels (including Petroleum Liquid Storage Vessels) for Which Construction, Reconstruction, or Modification Commenced After July 23, 1984," 40 CFR Part 60, Subpart Kb.

> §60.113b(a)(4) Visually inspect the internal floating roof, the primary seal, the secondary seal (if one is in service), gaskets, slotted membranes and sleeve seals (if any) each time the storage vessel is emptied and degassed. If the internal floating roof has defects, the primary seal has holes, tears, or other openings in the seal or the seal fabric, or the secondary seal has holes, tears, or other openings in the seal or the seal fabric, or the gaskets no longer close off the liquid surfaces from the atmosphere, or the slotted membrane has more than 10 percent open area, the owner or operator shall repair the items as necessary so that none of the conditions specified in this paragraph exist before refilling the storage vessel with VOL. In no event shall inspections conducted in accordance with this provision occur at intervals greater than 10 years in the case of vessels conducting the annual visual inspection as specified in paragraphs (a)(2) and (a)(3)(ii) of this section and at intervals no greater than 5 years in the case of vessels specified in paragraph (a)(3)(i) of this section.

The limit on seal gap areas for an IFRT in this regulation, then, is limited only by the requirement that the floating roof must have no defects. That is, if there is a gap between the seal and the wall of the vessel that results from a defect in the floating roof, then that condition should be repaired.

It is evident from the language of more recent regulations that, when EPA intends to impose inspection criteria concerning gaps between the floating roof seal and the wall of an IFRT, they expressly specify such criteria. The HON rule,[2] for example, adds a requirement that there shall be no visible gap between the seal and the wall of the vessel when viewed from the fixed roof at the top of the tank. This requirement is specified as follows:

> §63.120(a)(4) If during the inspections required by paragraph (a)(2)(i) or (a)(3)(ii) of this section, the internal floating roof is not resting on the surface of the liquid inside the storage vessel and is not resting on the leg supports; or there is liquid on the floating roof; or the seal is detached; or there are holes or tears in the seal fabric; or there are visible gaps between the seal and the wall of the storage vessel, the owner or operator shall repair the items or empty and remove the storage vessel from service within 45 calendar days. If a failure that is detected during inspections required by paragraph (a)(2)(i) or (a)(3)(ii) of this section cannot be repaired within 45 calendar days and if the vessel cannot be emptied within 45 calendar days, the owner or operator may utilize up to 2 extensions of up to 30 additional calendar days each. Documentation of a decision to utilize an extension shall include a description of the failure, shall document that alternate storage capacity is unavailable, and shall specify a schedule of actions that will ensure that the control equipment will be repaired or the vessel will be emptied as soon as practical.

And the inspections referred to are the inspections from the top of the tank:

> §63.120(a)(2) For vessels equipped with a single-seal system, the owner or operator shall perform the inspections specified in paragraphs (a)(2)(i) and (a)(2)(ii) of this section.
>
> (i) Visually inspect the internal floating roof and the seal through manholes and roof hatches on the fixed roof at least once every 12 months after initial fill, or at least once every 12 months after the compliance date specified in §63.100 of subpart F of this part.
>
> *
>
> §63.120(a)(3) For vessels equipped with a double-seal system as specified in §63.119(b)(3)(iii) of this subpart, the owner or operator shall perform either the inspection required in paragraph (a)(3)(i) of this section or the inspections required in both paragraphs (a)(3)(ii) and (a)(3)(iii) of this section.
>
> *
>
> (ii) The owner or operator shall visually inspect the internal floating roof and the secondary seal through manholes and roof hatches on the fixed roof at least once every 12 months after initial fill, or at least once every 12 months after the compliance date specified in §63.100 of subpart F of this part,

EPA has specified that, in the event of overlap between NSPS Subpart Kb and the HON, a facility need comply only with the HON. In that EPA is not allowed to backslide, this overlap provision indicates that the HON is deemed more stringent that NSPS Subpart Kb. Therefore this inspection for seal gaps only from the tank top represents a more stringent measure than NSPS Subpart Kb, which did not prohibit visible gaps for IFRTs.

Finally, for documentation that a Domed EFRT is effectively converted to an IFRT, see Attachment 2.

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[2] U.S. Environmental Protection Agency, "National Emission Standards for Organic Hazardous Air Pollutants from the Synthetic Organic Chemical Manufacturing Industry for Process Vents, Storage Vessels, Transfer Operations, and Wastewater," 40 CFR Part 63, Subpart G.

Attachment 1 – Mechanical-Shoe Primary Seal with Rim-Mounted Secondary Seal
Sensitivity of Estimated Rim Seal Emissions to Seal Gap Area

Mechanical-shoe seal with Rim-mounted secondary seal -- Loose versus Tight Fit

Emission Factors	Kra	Krb	n			Wind speed (mph) 0	10
	lb-m/ft-yr	lb-m/(mph)^n ft-yr	dimensionless			Kr (lb-m/ft-yr)	
Loose fit	1.1	0.3	1.5	(riveted tank)		1.1	10.6
Tight fit	0.4	0.4	1.0	(no gaps > 1/8 inch)		0.4	4.4
Ref: *API MPMS 19.2* , Table 4					difference:	0.7	6.2

Stock liquid parameters

Assumptions:

Refined stocks; Kc = 1.0

Atmospheric pressure Pa = 14.7

TVP	1.0	2.0	3.0	4.0	5.0	6.0
P*	0.018	0.037	0.057	0.079	0.104	0.130
Mv	90	80	70	70	70	70
P* Mv Kc	1.585	2.924	3.990	5.546	7.249	9.127

Domed EFRT (0 mph)

Tank Diameter (feet)	Emissions Difference (pounds per day)					
40	0.12	0.22	0.31	0.43	0.56	0.70
80	0.24	0.45	0.61	0.85	1.11	1.40
120	0.36	0.67	0.92	1.28	1.67	2.10
160	0.49	0.90	1.22	1.70	2.22	2.80

EFRT (10 mph)

Tank Diameter (feet)	Emissions Difference (pounds per day)					
40	1.07	1.98	2.71	3.76	4.91	6.19
80	2.15	3.96	5.41	7.52	9.83	12.38
120	3.22	5.95	8.12	11.28	14.74	18.56
160	4.30	7.93	10.82	15.04	19.66	24.75

Attachment 2 – Domed EFRTs Regulated as IFRTs

The U.S. EPA provides regulatory guidance to the States in the form of Control Techniques Guidelines. The most recent such document for storage tanks, dated January 1994, is titled "Alternative Control Techniques Document: Volatile Organic Liquid Storage in Floating and Fixed Roof Tanks".[3] Page 1-1 of the document expresses that its purpose is to provide "information on emissions, controls, control options, and costs that States can use in developing rules" for storage tanks. Section 2.2.3, Internal Floating Roof Tanks, describes two general types of IFRTs. One is typically a fixed roof tank that has been retrofit with an internal floating roof, and the other is an external floating roof tank that has been converted to an internal floating roof tank. This conversion of an EFRT to an IFRT is addressed again in Section 4.4.3, which states:

> "Retrofitting an external floating roof tank with a self-supporting fixed roof would convert the tank to an internal floating roof tank and eliminate the wind influence thereby reducing the rim seal losses."

The document then describes typical self-supporting fixed roofs used for this purpose, in section 4.6.5, with the observation that "the self-supporting fixed roofs are typically made of aluminum."

The EPA guidance to the States, then, clarifies that Domed EFRTs are to be regulated as IFRTs.

The effective conversion of an EFRT to an IFRT by equipping the EFRT with a dome is underscored in the most recent EPA standard for storage tanks, Part 63 Subpart WW.[4] Subpart WW defines an "internal floating roof" at §63.1061 as follows:

> "*Internal floating roof or IFR* means a floating roof located in a storage vessel with a fixed roof. For the purposes of this subpart, an external floating roof located in a storage vessel to which a fixed roof has been added is considered to be an internal floating roof."

A storage vessel that is equipped with both a floating roof and a fixed roof is, by definition, an internal floating roof tank, and should be regulated as such.

[3] U.S. Environmental Protection Agency, "Alternative Control Techniques Document: Volatile Organic Liquid Storage in Floating and Fixed Roof Tanks," EPA-453/R-94-001. Research Triangle Park, NC. January 1994.
[4] U.S. Environmental Protection Agency, "National Emission Standards for Storage Vessels (Tanks)–Control Level 2," 40 CFR Part 63, Subpart WW.