UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NATIONAL VEHICLE AND FUEL EMISSIONS LABORATORY
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OFFICE OF AIR AND RADIATION

MEMORANDUM

September24, 2012

SUBJECT: Calculation of Emissions from GDFs

FROM: Glenn W. Passavant, Office of Transportation and Air Quality

TO: Public Docket EPA-HQ-OAR-2011-0151

A. Introduction:

This memo addresses technical and emission aspects of how the emission and throughput values in Table 3 of the proposed rule (General Permits and Permits by Rule for the Tribal Minor New Source Review Program) were calculated. The table is copied below for ease of reference:

Table 3. Emissions from Gasoline Dispensing Facilities with ORVR Consideration

NSR CATEGORY			End of Calendar Year	% ORVR	Disp. lb/1000 gal	Breathing Losses lb/1000 gal	Stage I lb/1000 gal	Total lb/1000 gal	Gallons per year (gpy) Equivalent	Gallons per month (gpm) Equivalent
1a	2 tpy	Ozone NA	2011	72%	2.1	0.25	0.3	2.65	1,509,434	125,786
1b	2 tpy	Ozone NA	2014	82%	1.35	0.25	0.3	1.9	2,105,263	175,439
1c	2 tpy	Ozone NA	2020	92%	0.60	0.25	0.3	1.15	3,478,261	289,855
1d	2 tpy	Ozone NA	2025	96%	0.3	0.25	0.3	0.85	4,705,882	392,157
2a	5 tpy	Ozone attain	2011	72%	3.02	0.25	0.3	3.57	2,801,112	233,427
2b	5 tpy	Ozone attain	2014	82%	1.94	0.25	0.3	2.49	4.016,064	334,673
2c	5 tpy	Ozone attain	2020	92%	0.86	0.25	0.3	1.41	7,142,857	595,238
2d	5 tpy	Ozone attain	2025	96%	0.43	0.25	0.3	0.98	10,204,082	850,340

Gasoline vapor emissions from operations at GDFs arise from four major categories normally identified as occurring either in Stage I or Stage II operations at the GDF. Stage I involves transfer of gasoline from the tanker truck to the storage tank while Stage II involves transfer of gasoline from the storage tank to the vehicle/equipment. EPA's emission factors document AP-42 contains background information on these sources and some information on emission rates.[1]

B. Discussion

Stage I GDF emissions are those vented from the storage tank when gasoline is off-loaded from the tanker truck. As indicated in AP-42, if uncontrolled these emissions can be quite large (11.5 lb/1000 gal). However, vapor balance submerged filling technology reduces these emissions by over 95 percent and this control technology is commonly required. The 0.3 lb/1000 gal emission rate listed above includes implementation of vapor balance submerged filling technology.

Stage II refueling emissions from GDFs are comprised of three different segments including vapor displacement from the vehicle gasoline tank, gasoline spillage during refueling related to system design and by the person handling the nozzle, and breathing losses related to the storage tank drawing in fresh air after refueling events and as a result of diurnal changes in atmospheric pressure and temperature. Most breathing loss emissions occur during extended periods of very low or no dispenser activity such as in the late evening and overnight hours.

Displacement emissions are a function of the gasoline Reid vapor pressure (RVP), the temperature of the dispensed gasoline, and the temperature of the fuel in the vehicle's gasoline tank. AP-42 estimates a national average annual value of about 11 lbs VOC/ per 1000 gallons of gasoline dispensed, but this value is substantially lower in states with vapor pressure control. In this analysis, displacement losses are being modeled using 7 RVP for ozone non- attainment areas with dispensed and tank fuel temperatures representative of the summer time western US and 10 RVP gasoline for ozone attainment areas with dispensed and tank fuel temperatures representative of the summertime US national average.[3] The emission rate was then reduced by applying the onboard refueling vapor recovery (ORVR) control technology required by section 202(a)(6) of the Clean Air Act. Other analyses conducted by EPA show that ORVR is 98 percent efficient and that the percentage of gasoline dispensed to ORVR equipped vehicles will increase over time as ORVR-equipped vehicles replace those without ORVR.[4,5]

AP-42 estimates breathing losses to average about 1 lb VOC /1000 gallons of fuel dispensed. Under the requirements of 40CFR63 CCCCCC, most GDFs have installed pressure/vacuum valves on storage tank vent pipes which suppress air inflow and vapor outflow. Test data available to EPA indicates that these p/v valves are at 50-75 percent efficient. The uncontrolled emission rate measured in the referenced study was less than ten percent of the value cited in AP-42, so the higher end of the efficiency range was used here, yielding an emission rate of about 0.25 lb VOC /1000 gallon dispensed.[6]

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[1] US EPA, AP-42, Compilation of Air Pollutant Emission Factors, Volume I, Fifth Edition, Chapter S.

[2] The equation for calculating the emission rate was taken from the 1988 CRC report prepared by ATL entitled, A Study of Uncontrolled Automotive Refueling Emissions. This report is availablee in public docket A-87-11. The emission rate in g/gal = exp[-1.2798-.0049(L'-T)+.0203(Td)+0.1315(RVP)].

[3] See EPA report, Refueling Emissions from Uncontrolled Vehicles, EPA-AA-SDSB-85-6, 1985. This report is available in public docket A-87-11.

[4] See EPA Memorandum, Updated ORVR In-Use Efficiency, Glenn W. Passavant, EPA Office of Transportation and Air Quality, February 7, 2012. This is available at EPA public docket EPA-HQ-OAR-2010-1076.

[5] See EPA Memorandum, Updated ORVR Widespread Use Assessment, Glenn W. Passavant, EPA Office of Transportation and Air Quality, February 29, 2012. This is available at EPA public docket EPA-HQ-OAR-2010-1076.

[6] Underground Storage Tank Vent Line Emissions from Retail Gasoline Outlets, Western States Petroleum Association, project FR-92-01-204R2, May, 1994. This is available at EPA public docket EPA-HQ-OAR-2010-1076.

The three emission rates in lb VOC/1000 gallons dispensed are then summed to get a total rate for the GDF. These were then converted to tons VOC/1000 gal and divided into the 2 ton/year and 5 ton/year threshold values to get the annual value or further divided by 12 to get the monthly values as shown above

Gasoline spillage is a source of emissions in the refueling event, but could be considered a fugitive emission for NSR purposes under current EPA regulations and thus would not be part of the overall inventory calculation. Early studies of gasoline spillage during refueling indicated that spillage was about 0.7lb VOC/1000 gallons of fuel dispensed. Of this amount, about one-half was related to either incompatibility between the vehicle fill pipe design and the dispensing rate and the other half was related to the design of the nozzle and the effects of handling of the nozzle as it was removed from and replaced in the dispenser.[7] EPA regulatory actions in the 1990's reduced spillage in-use through emission standards and test procedures which encouraged compatibility between fill pipe designs, nozzle geometries, and dispensing rates and EPA also limited dispensing rates in-use.[8] EPA estimates that these actions have reduced spillage emission rates by about 50 percent relative to the values in AP-42 or about 0.35 lb/1000 gal.[9] If spillage was included, the gpy and gpm values would be proportionally lower. For example, in 2014 the ozone nonattainment values would be calculated by dividing the 2 tons/yr (4000 lb/yr) value by 2.25 lb/1000 gal instead of the value shown in Table 5, column 9 (1.9 lb/1000gal).

[7] Investigation of Passenger Car Refueling Losses: Malcolmm Smith, Scott Research Laboratories, Society of Automotive Engineers, Paper 720931. This is available at EPA public docket EPA-HQ-OAR-2010-1076.
[8] See EPA regulatory requirements for in-use dispensing rate limits (61 FR 33034, June 26, 1996) and the fuel dispensing spit back standard (58 FR 16021, March 24, 1993) and ORVR test procedures which require that any fuel spilled in the SHED be counted in the 0.20 g/gal amount allowed for by the emission standard under 40 CFR 86 Subpart B.
[9] US EPA report: Development of Evaporative Emissions Calculations for the Motor Vehicle Emissions Simulator MOVES 2010, EPA-420-R-12-027, September 2012.