California Environmental Protection Agency

Air Resources Board

Gasoline Dispensing Facility (GDF)
Fueling Point Population Report

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July 20, 2011

Introduction

In October 2010, California Air Resources Board (CARB) staff conducted an analysis of gasoline dispensing facility (GDF) population data gathered from air quality management districts (AQMDs) within California to determine and characterize the population of fueling points at permitted GDFs. The purpose of this analysis was to assist in quantifying emissions from these fueling points due to hose permeation. From this analysis, staff estimates that there are approximately 95,130 fueling points using vapor recovery hoses at permitted GDFs in California. This analysis further indicates that approximately 65,420 of these hoses are vacuum assist style hoses and the remaining 29,700 are balance style hoses. Additionally staff estimates from this data that there are approximately 1010 fueling points using conventional hoses at facilities exempted from phase II vapor recovery requirements due to servicing fleets which are only composed of vehicles with on On-Board Refueling Vapor Recovery (ORVR).

Background

It is part of CARB's mission to promote and protect the public health and welfare through the effective and efficient reduction of air pollutants. In carrying out this mission, CARB, in cooperation with local AQMDs, has sought to control hydrocarbon emissions at GDFs in California since 1975. Hydrocarbon emissions are reactive organic gases (ROG) which can react in the atmosphere to form photochemical smog. Recently, CARB staff has identified GDF hoses as a source of uncontrolled ROG due to gasoline's ability to permeate through common GDF hose materials.

California GDFs, with few exceptions must use vapor recovery hoses. A vapor recovery hose is different from a conventional fuel delivery hose in that it has two paths: one for fuel delivery and the other for vapor return. There are two different styles of vapor recovery hose: balance and vacuum assist. For permeation purposes, vacuum assist hoses are similar to conventional fuel delivery hoses in that the liquid fuel is carried against the inside of the outer hose wall. Balance hoses are different, carrying vapor against the outer hose wall (Figure 1).

Another category of hoses that staff was interested in quantifying in this analysis were conventional fuel delivery hoses in use at GDFs that are exempt from phase II vapor recovery requirements due to servicing fleets which are only composed of vehicles with ORVR. These GDFs do not require phase II vapor recovery systems because displaced vapors during fueling are captured in the vehicles and are not returned to the station. These GDFs are commonly referred to as ORVR fleet exempt facilities. The conventional hoses at these facilities are similar to vacuum assist hoses in most respects, including permeation, with the significant difference that conventional fuels hoses do not have a vapor path to return gasoline vapors to the GDF.

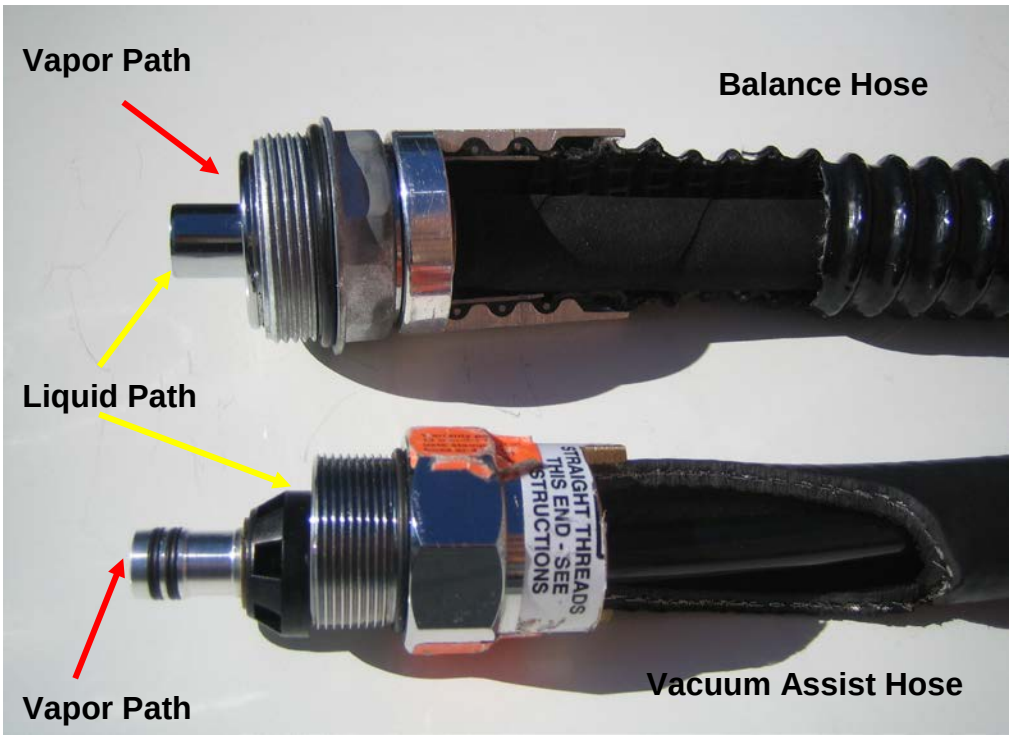

Figure 1. Cutaways of vapor recovery GDF hose showing vapor and liquid paths.

Methodology

In order to calculate statewide emissions from GDF hoses, it is necessary to quantify the total number of hoses being used at California GDFs which CARB and AQMDs have the authority to regulate. The method which CARB staff employed was to first determine the number of these GDFs. Next, Staff sought to determine an average number of fueling points for each of these GDFs, and then apply this average number of fueling points across the GDF population.

For the purposes of this paper, a fueling point is defined as a set of fixed hardware at a GDF connected to a gasoline dispenser for the purpose of fueling a vehicle. This set of fixed hardware normally includes a hose and a nozzle among other necessary hardware. Most dispensers at a GDF have two fueling points associated with them. Because there is one nozzle and one hose associated with each fueling point, staff equated the number of fueling points directly to the number of hoses.

Under the California Health and Safety Code, Section 41954, it is CARB's responsibility to adopt certification procedures for evaporative emissions control systems for use at GDFs. It is the local AQMD's responsibility to regulate GDFs and issue them each a permit to operate. Because the AQMDs are responsible for permitting GDFs, staff believes that they are the best source of detailed information available for developing a California GDF hose population.

When an AQMD issues a permit, information about the characteristics of the GDF is recorded in the permit to operate, including number of fueling points. With this data from the AQMDs, staff was able to estimate the number of permitted GDFs and the average number of fueling points at these GDFs. With this information, staff was able to estimate the number of hoses at these permitted GDFs.

GDF Data Sited

CARB staff collected several data sets relating to GDF population from the AQMDs in 2010 through the California Air Pollution Control Officers Association (CAPCOA). CAPCOA is an association of the air pollution control officers from all 35 air quality districts throughout California whose purpose is to promote clean air and to provide a forum for sharing of knowledge, experience, and information among the air quality regulatory agencies around California. The Data sets collected from CAPCOA include:

- CAPCOA Phase II EVR Compliance Survey
- CAPCOA List of GDFs Using VST Vapor Recovery Systems

The above data may be viewed online at CARB's website at http://www.arb.ca.gov/vapor/gdfhe/low_permeation_gdf_hose_emissions_spreadsheet.xls

Due to the difficulty involved in surveying all 35 districts, some GDF population data was collected from several large districts and then extrapolated to the entire population. In this analysis, data was collected from South Coast AQMD and Bay Area AQMD. Staff estimates from CAPCOA's GDF 2009 EVR deadline compliance data that together these two districts comprise approximately 57% of the permitted GDFs. Data used in this analysis collected specifically from the South Coast and Bay Area AQMDs include:

- CAPCOA ORVR Fleet Facility Estimates
- 2010 South Coast and Bay Area Hose Survey Updates

The above data may also be viewed the link given above.

Finally, staff used data from CARB's Initial Statement of Reason (ISOR) for its 2007 rulemaking for the Certification and Testing Gasoline Vapor Recovery Systems using Aboveground Storage Tanks (ASTs).[1] This document may be viewed online at http://www.arb.ca.gov/regact/2007/ast07/isor.pdf.

Fueling Point Calculations

All numbers discussed in this section can be viewed in the GDF and Population Summary Data Table located at the end of this paper (Attachment 1).

The majority of the GDFs which CARB and the AQMDs have authority to regulate use underground storage tanks (USTs). These facilities require enhanced vapor recovery (EVR) systems which employ either vacuum assist or balance hoses to facilitate vapor transfer to the UST during fueling. From the CAPCOA GDF 2009 EVR deadline compliance data, there are currently 10,159 of these GDFs that have been permitted to operate as of January 2010.

There is also a relatively small numbers of GDFs which CARB and the AQMDs have authority to regulate that use ASTs. Further even a smaller fraction of these are required to have phase II vapor recovery. From CARB's ISOR for its 2007 rulemaking for Certification and Testing Gasoline Vapor Recovery Systems using ASTs, staff determined that there are 1,548 AST GDFs with phase II vapor recovery.

Adding the above UST and AST GDFs together, CARB staff determined that there are a total of 11,707 GDFs required to have phase II vapor recovery.

$$10{,}159 + 1{,}548 = 11{,}707$$

In July of 2010, CARB staff received data from the South Coast and Bay Area AQMDs detailing the number of GDFs with phase II vapor recovery along with the total number of phase II fueling points within those districts. These numbers included GDFs employing both USTs and ASTs. From the data, CARB staff calculated an average of 8.126 fueling points per GDF with phase II vapor recovery. As previously mentioned, these two districts together make up approximately 57% of the GDF population. Because of the difficulty in surveying all 35 AQMDs within California, and because the South Coast and Bay Area AQMDs represent a majority of the GDF population, staff decided it was appropriate to apply 8.126 fueling points per station as the average for all GDFs with phase II vapor recovery within California.

Multiplying 8.1 fueling points across the population of 11,707 GDFs, staff determined that there are approximately 95,130 phase II vapor recovery fueling points within California.

$$8.126 \times 11{,}707 = 95{,}130$$

**After rounding for significant figures.*

Because GDFs with ASTs generally have smaller capacities and smaller throughputs, staff assumed an average of 2 fueling points for these facilities.

Based upon this assumption, the number of statewide AST GDF phase II fueling points would be 3,096.

$$2 \times 1{,}548 = 3{,}096$$

Subtracting the number of AST GDF phase II fueling points from the total number of GDF phase II fueling points will then yield the number of UST GDF phase II fueling points. Staff calculated this number to be 92,030.

$$95{,}130 - 3{,}096 = 92{,}030^{*}$$

**After rounding for significant figures.*

Further, dividing the number of UST GDF phase II fueling points by the number of UST GDFs with phase II vapor recovery yields 9.059 as the average number of fueling points at these facilities.

$$92{,}030 / 10{,}159 = 9.059$$

Fueling Points by Vapor Recovery System Type

As discussed earlier under the background section of this paper, there are two distinct styles of phase II vapor recovery systems: balance and vacuum assist (see Figure 1). Fueling point emissions due to hose permeation are different for these styles. Because of this difference, it is important to be able to separate the number of both balance and vacuum assist fueling points from the overall number of phase II fueling points.

In 2008, CARB staff conducted a survey of the districts to determine the number of permitted vapor recovery hoses in use at California GDFs. At that time staff had determined that approximately 84.7% of all phase II vapor recovery fueling points were balance style and the remaining 15.3% were vacuum assist style.[2] However, in April of 2009, there was an EVR compliance deadline which caused many station owners at UST GDFs to switch from a balance vapor recovery system to a vacuum assist vapor recovery system in order to satisfy EVR requirements. This EVR deadline did not apply to AST GDFs.

Because AST GDFs were unaffected by the 2009 EVR compliance deadline, staff assume that AST GDF phase II vapor recovery systems are still 85% balance and 15% vacuum assist. Given this, staff estimates that there are approximately 1,311 AST GDFs with a balance style phase II vapor recovery system with 2,622 associated fueling points.

$$0.8470 \times 1{,}548 = 1{,}311$$

and

$$0.8470 \times 3{,}096 = 2{,}622$$

Similarly, staff estimates that there are approximately 237 AST GDFs with a vacuum assist style phase II vapor recovery system with 474 associated fueling points.

$$0.1530 \times 1{,}548 = 237$$

and

$$0.1530 \times 3{,}096 = 474$$

In July of 2010, CARB staff received a survey from the districts listing all GDFs employing the VST Phase II EVR system, which is a balance style vapor recovery system. The survey listed 2,989 GDFs using the VST system. Because these VST systems account for nearly all current UST GDF balance systems in California, staff was able to determine that the remaining 7,170 UST GDFs must be using vacuum assist style phase II vapor recovery systems.

$$10{,}159 - 2{,}989 = 7{,}170$$

From this, staff determined that approximately 29.42% of current UST GDFs in California employ balance type phase II vapor recovery systems while the remaining 70.58% employ vacuum assist type phase II vapor recovery systems. From this, staff calculated that 27,080 of these UST GDF phase II fueling points were balance type and 64,950.

$$0.2942 \times 92{,}030 = 27{,}080$$

and

$$0.7058 \times 92{,}030 = 64{,}950$$

Collectively, staff determined that for both AST and UST California GDFs with phase II vapor recovery systems, there are approximately 29,700 balance type fueling points and 65,420 vacuum assist type fueling points.

$$27{,}080 + 2{,}622 = 29{,}700^*$$

And

$$64{,}950 + 474 = 65{,}420^*$$

**After rounding for significant figures.*

Private vs. Government Percentages of California GDFs

As discussed in the previous section, in 2010 staff had received an exhaustive and detailed survey from California's air quality management districts which identified almost all of the 2989 GDFs using balance style vapor recovery systems at that time. From further analysis of the survey, staff was able to identify 2743 (91.8 percent) of these GDFs as being operated by private (non-government) entities, 213 (7.1 percent) of these GDFs as being operated by local government entities, 27 (0.90 percent) of these GDFs being operated by State government entities and 6 (0.20 percent) of these GDFs being operated by federal government entities. Staff assumes that these percentages are applicable to the entire California GDF population, as there are no better data sets that staff is aware of from which to estimate private vs. government share of the GDF population. The table below illustrates staff's estimate of private vs. government of ownership of GDFs.

Table of Ca. GDF Population Ownership:
Private vs. Government

	Private	Government		
		Local	State	Federal
Percent of all Ca. GDFs	91.8%	7.1%	0.9%	0.2%

ORVR Fleet Exempt GDFs and Fueling Points

As discussed earlier under the background section of this paper, ORVR fleet exempt facilities are UST GDFs that do not require vapor recovery hoses at a fueling point, as there are little or no vapors to return to the GDF. Therefore, fueling points at these GDFs employ conventional hose. However, these conventional hoses permeate at rates that are the same as vacuum assist style hoses. Therefore, it is necessary for CARB to quantify the number of these facilities and fueling points in order to estimate and control emissions at these facilities.

In 2010, CARB staff received data from the South Coast and Bay Area AQMDs detailing the number of ORVR fleet exempt facilities along with the total number of associated fueling points within those districts. From the data, CARB staff calculated that there were 335 of these facilities with an average of 3 fueling points per GDF. As previously discussed in the fueling point calculations section of this paper, these two districts together make up 57% of the GDF population. Because of the difficulty in surveying all 35 AQMDs within California, and because the South Coast and Bay Area AQMDs represent a majority of the GDF population, staff decided it was appropriate to apply 3 fueling points per station as the average for all ORVR fleet exempt facilities within California. From this staff determined that there were approximately 1010 fueling points at California ORVR fleet exempt facilities.

$$3 \times 335 = 1{,}010^*$$

**After rounding for significant figures.*

Previous CARB Fueling Point Data

In 2008, CARB staff conducted a survey of the districts to determine the number of permitted vapor recovery hoses in use at California GDFs. At that time staff had determined that there were approximately 173,000 vapor recovery hoses and that approximately 85% of all phase II vapor recovery fueling points were balance style and the remaining 15% were vacuum assist style. However, in April of 2009, there was an EVR compliance deadline which caused many station owners at UST GDFs to switch from a balance vapor recovery system to a vacuum assist vapor recovery system in order to satisfy EVR requirements. Further, the vapor recovery hose population was reduced significantly down to approximately 95,000 as demonstrated earlier in this paper.

Staff attributes most of the steep drop in hose population to the elimination of many six-pack dispensers when stations exchanged their older vapor recovery systems for new ones that are EVR compliant. Six-packs are prohibited for new facilities and those undergoing major modification under section 4.10 of CARB's CP-201, *Certification Procedure for Vapor Recovery Systems at Gasoline Dispensing Facilities*.[3]

Six-pack dispensers are different from conventional dispensers in that they employ 3 sets of hanging hardware (nozzles and hoses) for each fueling point. There is one hose for each octane grade of gasoline: 87, 89, and 91. Most conventional dispensers have ratio of 1 nozzle and hose per fueling point. Dispensers, whether six-packs or not, generally have 2 fueling points. Therefore, a six-pack dispenser has 6 nozzles and hoses instead of the conventional 2 nozzles and hoses, tripling the number of hoses that would normally be employed at a GDF. For example, a GDF with a modest 8 fueling points employing six-pack dispensers would have 24 nozzles and hoses instead of the normal 8 nozzles and hoses.

In 2010, as a follow-up to the 2008 survey, CARB staff collected data from South Coast AQMD detailing the number of GDFs with phase II vapor recovery along with the total number of in-use vapor recovery hoses within those districts. These numbers included GDFs employing both USTs and ASTs. This data revealed that the South Coast hose population had dropped from an estimated 103,000 hoses in 2007 down to approximately 38,000 hoses in 2010, after the EVR compliance deadline. The reason for the drop given by South Coast staff was that there had previously been a high number of facilities with six pack dispensers which had now been eliminated with EVR upgrades.

Conclusion

Based upon the data collected from the AQMDs, CARB staff estimates that there are approximately 95,130 fueling points using vapor recovery hoses at permitted GDFs in California. This analysis further indicates that approximately 65,420 of these hoses are vacuum assist style hoses and the remaining 29,700 are balance style hoses. Further, staff estimates that there are approximately 1010 fueling points using conventional hoses at facilities exempted from phase II vapor recovery requirements at ORVR exempt facilities.

Works Cited

[1] California Air Resources Board (CARB). STAFF REPORT: INITIAL STATEMENT OF REASONS FOR PROPOSED RULEMAKING PUBLIC HEARING TO CONSIDER ADOPTION OF REGULATIONS FOR THE CERTIFICATION AND TESTING OF GASOLINE VAPOR RECOVERY SYSTEMS USING ABOVEGROUND STORAGE TANKS. 2007. pp.10. <http://www.arb.ca.gov/regact/2007/ast07/isor.pdf>

[2] California Air Resources Board (CARB). Gasoline Dispensing Facility (GDF) Vapor Recovery Hose Population Report 2008. pp.1. <http://arb.ca.gov/vapor/gdfhe/gdf_hose_population_survey_report_08_post.pdf>

[3] California Air Resources Board (CARB). CP-201, Certification Procedure for Vapor Recovery Systems at Gasoline Dispensing Facilities. 2006. pp.19. <http://www.arb.ca.gov/testmeth/vol2/cp201_may2006.pdf>

Attachment 1

GDF and Hose Population Summary Table

California UST GDF Population with Phase II Vapor Recovery Affected by Rulemaking			
UST GDFs Characteristics			
UST GDFs with Phase II EVR	10,159		CAPCOA GDF 2009 EVR deadline compliance data.
Fueling Points per UST GDF	9.059		CARB Staff Calculation.
UST Phase II Fueling Points	92,030		CARB Staff Calculation.
Vapor Recovery Characteristics			
Balance UST GDFs*	2,989	29.42%	CAPCOA 2010 population of GDFs using VST EVR systems
Balance UST Fueling Points*	27,080		CARB Staff Calculation.
Vacuum Assist UST GDFs	7,170	70.58%	CARB Staff Calculation.
Vacuum Assist UST Fueling Points	64,950		CARB Staff Calculation.
South Coast and Bay Area AQMD Share of Total UST GDFs with Phase II EVR			
South Coast UST GDFs	3,954	38.9%	CAPCOA GDF 2009 EVR deadline compliance data.
Bay Area UST GDFs	1,813	17.9%	CAPCOA GDF 2009 EVR deadline compliance data.
Combined UST GDFs for above AQMDs	5,767	56.8%	CAPCOA GDF 2009 EVR deadline compliance data.
ORVR Fleet EVR Exempt UST GDFs			
Exempt UST GDFs	335		CARB Staff calculation from South Coast and Bay Area AQMD surveys of 2010 Population of ORVR fleet exempt facilities.
Fueling Points per Exempt GDF	3		CARB Staff calculation from South Coast and Bay Area AQMD surveys of 2010 Population of ORVR fleet exempt facilities.
Exempt Fueling Points	1,010		CARB Staff Calculation.
California AST GDF Population with Phase II Vapor Recovery Affected by Rulemaking			
AST GDFs Characteristics			
ASTs with Phase II Vapor Recovery	1,548		CARB's ISOR for its 2007 rulemaking for the Certification and Testing Gasoline Vapor Recovery Systems using ASTs
Fueling Points per AST GDF with Phase II	2		CARB Staff assumption.
AST Phase II Fueling Points	3,096		CARB Staff calculation.
Vapor Recovery Characteristics			
Balance AST GDFs*	1,311	85%	Percentage from CARB 2008 GDF Vapor Recovery Hose Population Report.
Balance AST Fueling Points*	2,622	85%	CARB Staff calculation.
Vacuum Assist AST GDFs	237	15%	Percentage from CARB 2008 GDF Vapor Recovery Hose Population Report.
Vacuum Assist AST Fueling Points	474	15%	CARB Staff calculation.
Average Fueling Point per GDF with Phase II Vapor Recovery Affected by Rulemaking			
Combined UST and AST GDF Population with Phase II Vapor Recovery	11,707		CARB Staff calculation.
AST and UST Combined Average Fueling Points per GDF	8.126		CARB Staff calculation from 2010 Population of GDFs with phase II vapor recovery data submitted by South Coast and Bay Area AQMDs.
Total Phase II Fueling Points	95,130		CARB Staff calculation.
AST Phase II Fueling Points	3,096	3.3%	CARB Staff calculation.
UST Phase II Fueling Points	92,030	96.7%	CARB Staff calculation.
Average Fueling Points per AST GDF	2		CARB Staff assumption.
Average Fueling Points per UST GDF	9.059		CARB Staff calculation.
Hose Population Affected by Rulemaking			
Total Fueling Points	96,140		CARB Staff calculation.
Vapor recovery hoses	95,130	98.95%	CARB Staff calculation.
- Balance hoses*	29,700	30.89%	CARB Staff calculation.

Attachment 1

- Vacuum Assist hoses	65,420	68.05%	CARB Staff calculation.
Conventional hoses	1,010	1.05%	CARB Staff calculation.
Estimated Hoses Affected in 2017	66,430	69.10%	CARB Staff calculation.
Estaimted GDFs Affected in 2017	7,742		CARB Staff calculation.
Estimated Fueling points affected			
if Phase II is ever eliminated	96,140	100%	CARB Staff calculation.

* Stations with balance systems are subject to EVR requirements but are exempted from low permeation requirements. However, were these balance GDFs to convert to vacuum assist GDFs, or be allowed to remove Phase II vapor recovery due to ORVR market penetration, then they would be subject to low permeation hose requirements.