–Appendix G–

ISD Overpressure Alarm No Trouble Found Analysis

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The purpose of this appendix is to describe the methodology and assumptions used to estimate the In-Station Diagnostics (ISD) overpressure (OP) alarm "no trouble found" (NTF) rate encountered at gasoline dispensing facilities (GDF) by authorized service contractors (contractors) during ISD OP alarm responses.

I. BACKGROUND

California Air Resources Board (CARB) certification procedure CP-201 [CARB, 2019a] requires GDFs that dispense more than 600,000 gallons per year to be equipped with an ISD system. CARB first adopted ISD requirements in 2001 as part of the Enhanced Vapor Recovery (EVR) regulations for GDFs equipped with underground storage tanks (USTs). ISD requirements were fully implemented throughout the state by 2010. The ISD system (comprised of various hardware components and software) continuously monitors the collection and containment of gasoline vapors within the UST and issues warning and failure alarms when regulatory thresholds listed in Section 9 of CP-201 are exceeded. The purpose of the alarms is to provide an early indicator of vapor recovery equipment malfunctions that need repair so that GDF operators can better maintain in-use effectiveness of vapor recovery systems.

Among the parameters monitored by ISD is the pressure within the headspace or ullage of the UST. If the pressure within the UST ullage exceeds a certain threshold, an OP alarm is triggered. The basis for this alarm is that when pressure is above atmoshpheric and exceeds a certain threshold, pressure driven emissions will increase. ISD will activate a warning alarm that notifies the GDF operator of a potential vapor recovery system problem that may require maintenance. When an ISD OP alarm is triggered, the GDF operator will typically call/schedule a contractor for troubleshooting and repair service. When responding to the ISD OP alarm, the contractor conducts recommended testing and troubleshooting per the ISD Installation, Operation, and Maintenance Manuals contained within CARB Executive Order VR-202 [CARB, 2019b] or VR-204 [CARB, 2018]. If the GDF operator ignores an ISD warning alarm and the OP condition persists, an ISD failure alarm is triggered, leading to a shutdown of GDF dispensing operations. ISD systems also have warning

and failure alarms for vapor collection and leaks, but in this appendix, only ISD OP alarms will be analyzed.

Over the past eleven years, CARB staff has studied the increase in ISD OP alarms at GDFs equipped with Phase II EVR systems. ISD OP alarms are caused by gasoline evaporation rates that generate vapor volumes that cannot be contained within the UST vapor space and exceed the capacity of vapor processors used to manage UST pressure. The majority of ISD OP alarms are triggered by the ISD system during the winter fuel period (November through February) when there is no restriction on gasoline volatility as measured by the Reid vapor pressure (RVP) [CARB, 2017a and 2017b]. Gasoline sold during the winter fuel period without RVP limits is the primary driver for ISD OP alarms, not vapor recovery equipment malfunctions at the GDFs [CARB, 2017a and 2017b]. The objective of this appendix is to describe the analysis that demonstrates equipment malfunctions rarely cause ISD OP alarms.

II. METHODOLOGY

In 2011, CARB staff collected three sets of data pertaining to contractor alarm responses to ISD OP alarms. The first data set was from six long-term study GDFs located in Northern California. These sites were previously established by CARB staff to support the development of revised GDF emission factors and to evaluate in use performance of Phase II vapor recovery systems. The second data set consisted of 18 randomly selected GDFs in San Diego County. The third (and most comprehensive) data set consisted of alarm response information from 250 GDFs (statewide) as provided by a major oil company. Combined, CARB staff evaluated 1,032 ISD OP alarm response events.

CARB staff downloaded ISD alarm history from each long-term study GDF in Northern California and each San Diego study GDF and manually reviewed each contractor repair response associated with an OP alarm. CARB staff requested OP alarm contractor repair response records from a major oil company and was provided with data from 250 GDFs. For this data set, CARB staff did not download the ISD alarm history. Instead, CARB staff relied upon detailed contractor billing invoices that described the ISD alarm condition upon contractor arrival for each ISD OP alarm event. When reviewing the major oil company repair records, CARB staff found a small number of leak and collection repair responses included in the data set. These records were not included in this analysis.

Contractor repair response logs from November 2009 through April 2011 were used in this analysis. Newer data were not used because in 2009, CARB staff, in cooperation with the California Air Pollution Control Officers Association (CAPCOA), issued Advisory 405 [CARB, 2016], which allowed GDF operators to clear ISD OP alarms during the winter fuel period. As GDF operators became more comfortable with clearing ISD OP alarms, the number of repair responses to OP alarms during the

winter fuel period decreased significantly. Furthermore, OP alarm repair responses in which the contractor reset the OP alarm due to Advisory 405 were not used in this analysis.

For each data set, CARB staff analyzed the contractor repair logs to determine if a repair would eliminate the OP alarm and reduce OP emissions. If a contractor traveled to a GDF, conducted testing and or troubleshooting, and did not find an equipment problem that contributed to overpressure and excess pressure-driven emissions, then CARB staff determined the repair to be NTF. Attachment 1 provides a summary spreadsheet of all GDF repair logs and CARB staff's evaluation of each repair in a separate Microsoft Excel file (Review of OP Alarm Contractor Repair Responses 20200213.xls). The decision was made to provide the information as an attachment to this appendix because it is too large to include in a document format.

CARB staff reviewed contractor responses to all ISD OP alarms. When reviewing contractor repair responses, CARB staff assumed that the contractor repair would reduce overpressure conditions regardless of defect severity. For example, for most contractor repair responses, the severity/size of a leak was not known but if the contractor mentioned a leak then CARB staff assumed that the leak was inward and it contributed to overpressure and overpressure emissions as long as there was a valid repair. An inward leak results in excess air ingestion into the UST headspace resulting in higher evaporation rates and excess pressure-driven emissions. If a contractor repair response included replacement of multiple vapor recovery equipment components, CARB staff chose the equipment problem that most likely caused the OP alarm. Equipment problems, such as ISD vapor pressure sensor inoperable, ISD vapor pressure sensor 3-way ball valve handle left in the wrong position, replacement of Phase I vapor adaptor dust cap, or low fuel alarms were not counted as valid repairs for this analysis because while these problems may lead to overpressure alarms, they do not lead to excess emissions.

CARB staff also attempted to evaluate whether another existing ISD alarm (i.e., vapor collection or leak alarm) and weekly and annual inspections would find the equipment problems associated with OP alarms. However, this evaluation is somewhat limited because the major oil companies only provided contractor repair logs for OP alarms. The repair logs for the evaluated sites typically did not note information needed to determine if a collection or leak alarm would be triggered (e.g., the size of a leak or a nozzle vapor to liquid (V/L) ratio[1]).

The contractor response logs and ISD monitoring reports did not contain the information needed to estimate the emissions that result from equipment malfunctions. To estimate the emissions, additional equipment would need to be

[1] The V/L ratio is the volume of vapor and/or air returned to the GDF underground storage tank divided by the volume of gasoline dispensed from the nozzles.

installed at each GDF (e.g., a leak-free pressure/vacuum (P/V) vent valve and a data acquisition system that could download and save detailed pressure-ullage data not able to be saved by the ISD system).

III. RESULTS

After all repair records were reviewed, the number of valid repairs and NTF repair responses were tabulated. Table 1 summarizes the results of the NTF analysis.

Table 1
Winter, Summer, and Overall NTF Rate

Period	Total # (%) of Contractor Responses	Total # NTF	Total # of Repairs	NTF Rate
Winter	896 (87%)	866	30	96.7%
Summer	136 (13%)	120	16	88.2%
Overall	1032	986	46	95.5%

CARB staff analyzed 1,032 OP alarm responses and found the majority (87 percent) of contractor responses to ISD OP alarms occur during the November through February winter season. CARB staff found only 46 responses resulted in repairs that would have eliminated an OP alarm that caused excess pressure-driven emissions. During the winter fuel period, 96.7 percent of all contractor responses resulted in no trouble found. During the summer fuel period, when the gasoline volatility is controlled, the NTF rate decreased approximately nine percent but was still relatively high. This analysis finds that, on a yearly average, a contractor repair response to an OP alarm is only effective approximately 4.5 percent of the time. As previously mentioned, the primary cause of ISD OP alarms is the uncontrolled RVP during the winter fuel season and not vapor recovery equipment problems.

Table 2 summarizes the vapor recovery equipment problems found during contractor responses to OP alarms.

Table 2
Vapor Recovery Equipment Problems Found

Vapor Recovery Equipment Problem during ISD OP Alarm Response	# of Times Vapor Recovery Equipment Problem Found
Dispenser Vapor Return Plumbing Leak	14
Phase I Vapor Adaptor	11
Torn Nozzle Bellows	6
Nozzle	5
Fuel Filter	3
Dispenser Outlet Casting O-rings	3
P/V Vent Valve	2
High V/L Ratio	1
Loose Phase I Spill Bucket	1
Total	**46**

Dispenser vapor return plumbing leaks, Phase I vapor adaptors, torn nozzle bellows, dispenser outlet casting o-rings, P/V vent valve, and a loose Phase I spill bucket comprise approximately 80 percent of all repairs that were made in response to an OP alarm. All six of these vapor recovery equipment problems were assumed to cause OP due to inward leaks. Even though the size of the leak was unknown, it was assumed that the leak was large enough to cause the OP alarm and excess pressure-driven emissions. As a result, CARB staff concludes that the assumption of all inward leaks and not having detailed defect severity/repair information likely biases the NTF rate low by an unknown amount, i.e. an overestimation of the number of OP alarms associated with equipment repairs that would reduce overpressure emissions.

As summarized in Table 3, annual inspections/annual compliance testing have the ability to identify all (100 percent) of the equipment problems listed in Table 2, and weekly inspections may identify approximately 22 percent of the problems. In addition, ISD vapor collection and leak alarms can identify the presence of torn nozzle bellows and elevated V/L (approximately 15 percent of the equipment problems identified in Table 2). However, without information about leak severity and V/L associated with the other equipment problems identified in Table 2, it is not possible to determine whether the collection and leak alarms would also identify these problems, nor to estimate the emissions that could result from these equipment problems.

Even so, these equipment problems likely do not cause a measurable increase in region- and state-wide emissions from GDFs because they account for only about 2 percent of all OP alarms and they would be identified by semi-annual inspections/compliance testing in the South Coast AQMD which has approximately

40 percent of all GDFs in California, and annual inspections/compliance testing in the rest of the Air Districts. Further, equipment problems severe enough to lead to excess emissions (e.g., dispenser or vapor adaptor leaks) would trigger ISD leak alarms.

Table 3
Alternate Means of Identifying Vapor Recovery Equipment Problems Found by ISD Overpressure Alarms

Vapor Recovery Equipment Problem during ISD OP Alarm Response	# of Times Vapor Recovery Equipment Problem Found by OP Alarm	Could Existing ISD Alarm Other than OP Alarm Find Equipment Problem?	Could Weekly Inspection Find Equipment Problem?	Could Annual and Semi-Annual Compliance Tests Find Equipment Problem? [2]
Dispenser Vapor Return Plumbing Leak	14	u/d [1]	Yes, if hose is loose	Yes
Phase I Vapor Adaptor	11	u/d	No	Yes
Torn Nozzle Bellows	6	Yes	Yes	Yes
Nozzle	5	u/d	Yes, if broken spout or nozzle	Yes
Fuel Filter	3	u/d	No	Yes
Dispenser Outlet Casting O-rings	3	u/d	No	Yes
P/V Vent Valve	2	u/d	No	Yes
High V/L Ratio	1	Yes	No	Yes
Loose Phase I Spill Bucket	1	u/d	No	Yes
Total	**46**	**7 (15%)**	**10 (22%)**	**46 (100%)**

[1] u/d: Unable to determine without additional information.

[2] The South Coast Air Quality Management District conducts semi-annual inspections/compliance testing and have approximately 40 percent of all GDFs in California.

IV. CONCLUSIONS

This analysis finds that less than five percent of contractor responses to ISD OP alarms resulted in an equipment repair that eliminated the OP alarm and reduced OP emissions, and that other ISD alarms and inspections would find the equipment problems that could cause excess OP emissions. The analysis indicates that the ISD OP alarms are not effective at detecting vapor recovery equipment malfunctions and therefore do not accomplish the purpose of ISD alarms envisioned when CARB adopted the EVR regulations. As described by other CARB technical study documents (e.g., CARB, 2017a and 2017b), the ISD OP alarms are primarily caused by gasoline RVP volatility and site-specific operating parameters. Consequently, CARB staff recommends considering alternatives to the existing ISD OP alarm criteria.

V. REFERENCES

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