California Environmental Protection Agency

Air Resources Board

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

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Nisei Farmers League
OPW
Steel Tank Institute
Tom Ward, Inc.
Vapor Systems Technologies, Inc.
Western States Petroleum Association
Western United Dairymen

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I. EXECUTIVE SUMMARY

The Air Resources Board (ARB) has a number of requirements in place to reduce gasoline vapor emissions because these emissions contribute to the formation of ozone. Current requirements apply to various sources of gasoline vapors including automobile gas tanks, portable gas cans, and gasoline dispensing facilities (GDF) like gas stations. In this proposal staff seeks to further reduce emissions from GDFs that use aboveground storage tanks (AST). The reductions will be achieved through more stringent certification requirements for the vapor recovery systems and equipment used with ASTs. The proposal will establish new performance standards and specifications for the vapor recovery systems and components used with ASTs, called Enhanced Vapor Recovery (EVR) for ASTs.

An AST is a fixed installation gasoline storage tank located either above ground or below ground, without backfill, that may have an emergency vent. Typical ASTs have capacities ranging from 250 gallons to 12,000 gallons. ASTs are commonly described as single wall or protected. Single wall ASTs are constructed with a primary (single) wall. Protected ASTs are typically constructed with a primary and secondary wall for containment with an insulating material between the walls.

There are approximately 9,600 ASTs in California that emit approximately 3.31 tons per day (TPD) of vapors or reactive organic gases (ROG). Approximately 33 percent of these ASTs have currently certified vapor recovery systems installed. Agricultural tanks make up a majority of the remaining 67 percent of ASTs, and at present most are uncontrolled. Controlling emissions from all ASTs is a key part of ARB and Air Pollution Control Districts and Air Quality Management Districts (District) efforts to attain the state and federal ozone air quality standards.

Staff's proposal would reduce 1.98 TPD of ROG emissions. Most of the emission reductions will come from agricultural tanks. Reductions will be achieved primarily by controlling AST diurnal evaporative (standing loss) emissions. The controls to minimize these evaporative losses are termed Standing Loss Control (SLC). Standing losses contribute approximately 90 percent of the total uncontrolled emissions from ASTs. In addition to standing losses, working losses (Phase I and Phase II) are the other categories of emissions. Phase I relates to emissions that occur when the AST receives gasoline from a gasoline cargo tank truck. Phase II relates to emissions that occur when vehicles are refueled. The proposed regulation will result in gasoline savings of approximately 600 gallons per day.

Whenever ARB adopts new or revises vapor recovery performance standards, State law provides that existing installations have up to four years from the effective date to comply. The effective date for the proposed regulation will be January 1, 2009. All currently installed ASTs subject to this regulation will be required to comply by January 1, 2013, under the four year delay imposed by State law.

ARB and District Roles

ARB is responsible for certifying vapor recovery systems. In the process of certifying vapor recovery systems, ARB establishes performance standards and specifications for systems and their components. Districts have the primary responsibility of regulating emissions from stationary sources such as gas stations. To this end, Districts have adopted rules that require gasoline storage and transfer operations, including those using ASTs, to be equipped with vapor recovery systems certified by ARB. Usually, District rules incorporate ARB performance standards; however, District rules may specify more stringent performance standards than ARB's but Districts may only implement more stringent standards if at least two systems are already certified to such levels by ARB. District rules vary as to which facilities require control with vapor recovery systems.

Technical Proposal

Most of the proposed performance standards and specifications are similar to the existing Phase I and Phase II requirements that the Board approved in 2000 for underground storage tank (UST) systems, which is called enhanced vapor recovery (EVR). This similarity in performance standards and specifications will achieve consistency between AST and UST vapor recovery requirements. However, as stated earlier, the major impact of, and difference with, this proposal is reduced emissions achieved through defining and controlling diurnal or standing loss evaporative emissions.

Staff worked with agricultural stakeholders to evaluate control technologies that would reduce standing loss emissions in a field study conducted during the summer of 2005. This study also evaluated the effects of various control technologies on ASTs and compared them to uncontrolled tanks at the same location. The results from the study form the basis for staff's recommendations for the standing loss control levels of 90 percent for new tanks and 60 percent for existing tanks. The 90 percent control level can be met using a pressure/vacuum (P/V) valve and insulation. The field study showed that single wall tanks with three inches of polyurethane foam provided adequate insulation. Additional testing showed that currently certified protected tanks also provide the needed insulation properties. The 60 percent control level can be met using a P/V valve coupled with 1) white paint, 2) shading the tank from direct sunlight, or 3) installing a carbon canister in the vent line. In addition to technologies demonstrated in the field study, other technologies such as the use of a thermal processor are viable as well.

Additional, smaller emission reductions are anticipated from the application of the EVR Phase I and Phase II standards and specifications and enhanced containment and testing requirements.

Applicability and Cost

While District rules vary throughout the state, all Districts exempt some ASTs based on tank size, date of installation, and gasoline throughput. For the purpose of this proposal, staff assumed that the District rules and exemption levels would not change, except for the adoption of SLC requirements. Thus, if an AST is currently subject to Phase I requirements, it would continue to be subject to the same general requirements, which would include SLC vapor recovery. To require only SLC vapor recovery Districts will need to amend their rules. The following three examples illustrate how some tanks might be affected.

- <u>Example 1</u>: A single wall 750 gallon AST in the San Joaquin Valley installed in 1991 with an annual throughput of 10,000 gallons currently must be equipped with Phase I only. Under this proposal, that same tank would be expected to meet the SLC and Phase I EVR standards by January 1, 2013. Table I-1 shows that there are approximately 1,610 tanks statewide that would be required to make a similar modification at an average incremental cost of $473.

- <u>Example 2</u>: A similar 750 gallon single wall AST is required to have Phase I vapor recovery but does not have the Phase I equipment installed. This AST is listed in the second row of the table as having “No Vapor Recovery (Not in Compliance with District rules).” The proposal estimates that this AST would be retrofitted with SLC and Phase I EVR. The cost to come into compliance for this tank is $2,023. The difference in cost between this and Example 1 is attributed to installing the Phase I equipment that was required but not in place in addition to installing SLC. Most of the 3,383 tanks in this category are used in agriculture. Because state law until recently exempted agricultural sources from District permitting, control requirements were largely not enforced.

- <u>Example 3</u>: If a District amends their rules to require SLC only, then AST owners that meet the conditions of the rule would be required to retrofit to that level. Therefore, a single wall 750 gallon AST with no vapor recovery that is expected to come into compliance with the amended rule would be required to install SLC only. The average cost for an AST owner would be approximately $432. This cost is not reflected in Table I-1 since the Districts do not have rules in place and it would be difficult to project how many tanks would be subject to this statewide.

Incremental costs represent the difference between current technologies' cost compared to the similar components that meet the enhanced standards and specifications. For example, if a currently certified nozzle costs $150 and the EVR version of this nozzle costs $200, then the incremental cost of $50 is reflected in Table I-1 below.

Table I-1
Incremental Cost of Proposed Regulation

AST	Current Configuration	Proposed Configuration	No. of tanks	Incremental Cost per tank ($)
Single Wall	No Vapor Recovery (Exempt)	No Vapor Recovery (Exempt)	2,394	$0
	No Vapor Recovery (Not in Compliance with District rules)	SLC + Phase I EVR	3,383	$2,023
	Phase I	SLC + Phase I EVR	1,610	$473
	Phase I/II	SLC + Phase I/II EVR	233	$594
Protected	No Vapor Recovery (Exempt)	No Vapor Recovery (Exempt)	39	$0
	No Vapor Recovery (Not in Compliance with District rules)	Phase I EVR	225	$1,693
	Phase I	Phase I EVR	383	$143
	Phase I/II	Phase I/II EVR	1,315	$264
		total	9582	

The cost effectiveness of the proposed regulation is approximately $1.87 per pound ROG emissions reduced. Adding in the cost savings from gasoline and assuming $2.50 per gallon, the cost effectiveness is improved by approximately $0.40 per pound. The net cost effectiveness of the proposed regulation is $1.47 per pound.

Certification and Test Procedures

Staff's proposal centers on a new certification procedure, CP-206, *Certification Procedure for Vapor Recovery Systems at Gasoline Dispensing Facilities Using Aboveground Storage Tanks* which is specifically designed for ASTs and establishes:

- Standing loss control performance standards and specifications applicable to all tanks required to have vapor recovery

- Standing loss control certification by a performance or design based process

    - Performance based certification is a “system” approach where the system is required to be fully integrated

    - Design based certification is “component” based where components are interchangeable

- An option is provided to allow applicants to certify to standing loss control levels that exceed the minimum retrofit requirement of 60 percent. Equipment will be evaluated by ARB and will be validated at the 76 and 90 percent levels in addition to the 60 percent level. The importance of these optional levels for retrofits is that they create a mechanism to encourage AST owners to use equipment which exceeds the minimum retrofit requirements. These optional retrofit levels will offer the opportunity to choose retrofit technologies that might be more costly but increase benefits such as fuel savings. Higher level retrofit certification may also allow for emission credits to be earned or funded as a cleaner-than-required technology.

- Phase I EVR transfer efficiency at 98 percent rather than the current level of 90 percent

- Phase II EVR transfer efficiency at 95 percent rather than the current level of 90 percent

- An operational test of at least 180-days for systems and components helps ensure field durability while conforming with performance standards and specifications

- Vapor recovery system certification will have a limited term of four years, but will be renewable without further testing if data indicate no major deficiencies with the certification

The proposed certification for AST Phase I and Phase II vapor recovery systems and equipment relies on many of the test procedures (TP) that the Board has adopted for UST Phase I and Phase II vapor recovery systems and equipment. Staff is also proposing the adoption of three new test procedures to evaluate conformance with the proposed performance requirements that are specific to AST systems and equipment:

- TP-206.1, *Determination of Emission Factor for Standing Loss Control Vapor Recovery Systems Using Temperature Attenuation Factor at Gasoline Dispensing Facilities with Aboveground Storage Tanks*

- TP-206.2, *Determination of Emission Factor for Standing Loss Control Vapor Recovery Systems Using Processors at Gasoline Dispensing Facilities with Aboveground Storage Tanks*

- TP-206.3, *Determination of Static Pressure Performance of Vapor Recovery Systems at Gasoline Dispensing Facilities with Aboveground Storage Tanks*

These new procedures test systems that reduce the tank temperature, control emissions directly, and reduce leaks, respectively.

Staff is also proposing the modification of TP-201.2, *Efficiency and Emission Factor for Phase II Systems*. The proposed modification corrects the equation used to calculate the efficiency/emission factor, and clarifies the fugitive emissions determination. Likewise, staff proposes amendments to the Vapor Recovery Definitions, D-200, to clarify and add terms used in the AST vapor recovery certification and test procedures.

II. INTRODUCTION AND BACKGROUND

This section of the staff report summarizes the legal authority and regulatory history, provides an AST emissions overview, and discusses the public participation process.

A. Legal Authority

1. State Law

Section 41954 of the Health and Safety Code (HSC) requires the Air Resources Board to adopt procedures and performance standards for controlling gasoline emissions during gasoline marketing operations, including transfer and storage operations, to achieve and maintain ambient air quality standards (see Appendix A). This section also authorizes ARB, in cooperation with Districts, to certify vapor recovery systems. HSC section 39607(d) requires ARB to adopt test procedures to determine compliance with ARB and District non-vehicular standards. State law (HSC section 41954) requires Districts to use ARB test procedures to determine compliance with performance standards and specifications established by ARB.

To comply with state law, the Board has adopted regulations in title 17, California Code of Regulations (CCR), sections 94000 to 94015 that incorporate by reference comprehensive certification and test procedures. In separate regulations in title 17, sections 94101 to 94167, the Board has adopted by incorporation by reference the vapor recovery test procedures that Districts may use in conducting compliance testing. The proposed changes and additions to the CCR are located in Appendix B.

2. District Rules

Air pollution control districts and air quality management districts (Districts) have the primary responsibility of regulating emissions from stationary sources or air pollution such as GDFs with ASTs. To carry out their responsibility, Districts have adopted rules requiring that gasoline storage and transfer operations be equipped with a vapor recovery system certified by the ARB. District rules vary as to which facilities are subject to vapor recovery requirements. To better understand the implications of District rules, the following reviews information from the San Joaquin Valley Air Pollution Control District (SJVAPCD) rules specifying Phase I and Phase II vapor recovery requirements. Other Districts have similar requirements but have different exemption levels. A summary of these and other District vapor recovery rules is presented in Appendix C.

SJVAPCD rules exempt aboveground gasoline storage tanks from Phase I and Pressure/Vacuum valve requirements, and Phase II requirements for the situations described below

a. Phase I and Pressure/Vacuum Valve exemption

For stationary containers storing gasoline:

- with a capacity of less than 250 gallons;
- a capacity of 550 gallons or less when used exclusively for fueling implements of husbandry (as such vehicles are defined in Division 16 of the California Vehicle Code) if such container is equipped with a permanent submerged fill pipe;
- a capacity of 2,000 gallons or less when installed before July 1, 1975, if such container is equipped with a permanent submerged fill pipe;
- containers installed prior to July 1,1975 and equipped with offset fill pipe, if such container is equipped with a permanent submerged fill pipe.

b. Phase II exemption

- only applicable to those facilities installed on or before May 21, 1992; and
- less than 24,000 gallons of throughput per calendar year; and
- less than 10,000 gallons of throughput in any consecutive 30-day period.

3. Comparable Federal Regulations

There are no comparable federal regulations that certify gasoline vapor recovery systems for GDFs; however, changes to ARB vapor recovery certification regulations may have a national impact. ARB certification is required by many other states and countries that mandate the installation of vapor recovery systems in GDFs.

B. Regulatory History

Vapor recovery systems have been used in California to control ROG emissions, and specifically hydrocarbon (HC) emissions for over thirty years and to control emissions of the toxic air contaminant benzene for almost twenty years. The feasibility of the first vapor recovery system was evaluated at the District level, particularly in the San Diego and Bay Area Districts in the early 1970s. In 1975, the ARB was authorized by state law to establish a certification program to control gasoline vapor emissions from gasoline marketing operations, including storage and transfer operations. In December 1975, ARB adopted the first certification and test procedures for vapor recovery systems installed on GDFs. Certification procedures contain performance standards and specifications and other criteria that must be met for certification. Test procedures describe the methods which are used to generate data that are compared to the performance standards and specifications. In addition to GDFs, the Board has adopted certification procedures for bulk plants, terminals, cargo tanks, and novel facilities. Over the last thirty years the Board has periodically updated the certification and test procedures to reflect improvements in vapor recovery technologies and the certification processes.

To achieve additional ROG reductions and increase the reliability of vapor recovery system components, the Board approved enhanced vapor recovery (EVR) regulations for systems with USTs in March 2000. The EVR regulations represented the first major change to the certification requirements since 1975. Although ASTs and USTs share many of the same vapor recovery system components, EVR requirements were not made applicable to AST systems. A new rulemaking is required to apply appropriate EVR performance standards and specifications to AST systems and to incorporate controls for standing loss emissions. Staff proposes adoption of CP-206, *Certification Procedure for Vapor Recovery Systems at Gasoline Dispensing Facilities Using Aboveground Storage Tanks*, to specifically apply to AST vapor recovery systems.

Today's AST vapor recovery systems are certified as "novel" systems under CP-205, *Certification Procedure for Vapor Recovery Systems of Novel Facilities*. The certification is based on testing an AST with a vapor recovery system certified for USTs and includes only the control of transfer emissions (working losses) through the application of Phase I and Phase II vapor recovery systems. The testing verifies that vapor recovery efficiencies are at least 90 percent, or 95 percent if requested by applicant. If the system successfully passes the test, the system is certified by issuance of an Executive Order. Currently, there are 38 AST vapor recovery systems certified.

C. Applicability of Proposed Regulation

The proposed regulation will incorporate a major change in vapor recovery by certifying Standing Loss Control (SLC) systems and components to control standing loss emissions from new and existing ASTs. Standing loss emissions occur when no gasoline is transferred from the tank but emissions are affected by diurnal temperature changes. Under the proposal, ARB will issue three types of certifications, (1) standing loss control (SLC); (2) SLC and Phase I; and (3) SLC, Phase I and Phase II. The intent is to provide Districts with flexibility in choosing control options. This regulation will have the effect of terminating the current Phase I and Phase II vapor recovery system Executive Orders.

The addition of Standing Loss Control may prompt Districts to amend their rules to require a configuration that only utilizes SLC. Phase I EVR systems will only be certified with ASTs that have SLC and therefore the Districts will not need to modify their rules to incorporate SLC with Phase I EVR. The same is true for Phase II EVR, as it includes Phase I EVR and SLC and thus modification to District rules will not be necessary.

Districts issue permits for the operation of gasoline transfer and storage operations within their enforcement jurisdiction. Until recently, Health and Safety Code section 42310(d) prohibited Districts from requiring permits for "any equipment used in agricultural operations in the growing of crops or the raising of fowl or animal." Without a permit and the associated fees, Districts have been limited in their ability to determine if installed agricultural ASTs have been in compliance. In 2003, the enactment of Senate Bill 700 (Florez) removed this prohibition and authorized Districts to issue permits for agricultural operations.

There are approximately 9,582 ASTs in California. District rules will require 7,149 ASTs to have ARB certified vapor recovery equipment installed (approximately 2,433 tanks are exempt from vapor recovery requirements based on current District rules). A summary of selected Districts such as San Joaquin Valley, Sacramento, and South Coast District vapor recovery rule applicability is presented in Appendix C. Table II-1 summarizes the applicability of the proposed regulation for the number of tanks in each current configuration based on District rules.

Table II-1
Applicability of Proposed Regulation on AST Population

Tank	Current Configuration	Proposed Configuration	No. of tanks	
			Exempt	Subject to Vapor Recovery
Single Wall	No Vapor Recovery (Exempt)	No Vapor Recovery (Exempt)	2,394	
	No Vapor Recovery (Not in Compliance)	SLC + Phase I EVR		3,383
	Phase I	SLC + Phase I EVR		1,610
	Phase I/II	SLC + Phase I/II EVR		233
Protected	Exempt	Exempt	39	
	Not in Compliance	Phase I EVR		225
	Phase I	Phase I EVR		383
	Phase I/II	Phase I/II EVR		1,315
			2,433	7,149

Under the proposal, Standing Loss Control, Phase I EVR, and Phase II EVR requirements would become effective January 1, 2009, and all existing tanks shall be in compliance by January 1, 2013, in accordance with State law. New tanks installed or existing tanks undergoing major modifications after January 1, 2009 would be required to meet the proposed performance standards for SLC, Phase I EVR, and Phase II EVR.

D. Emissions Inventory

Historically, the Air Resources Board's emissions inventory reporting system accounted for AST emissions through the gasoline dispensing facilities methodology (http://www.arb.ca.gov/ei/areasrc/onehtm/one4-10.htm). The gasoline dispensing facilities methodology estimates emissions from ASTs as an areawide source, which means that emissions are estimated for ASTs in the aggregate, rather than individually, and are then reported under a single category.[1]

In preparation for this rulemaking, ARB staff developed an improved methodology to estimate the emissions from AST. This methodology is based on the following underlying data sources and is detailed in the Appendicies of this report:

1) 2004 MLD survey of companies who supply gasoline fuel to owners of ASTs across the state (Table H-3 of Appendix H);
2) 2006 MLD survey of local air districts for data on permitted ASTs (Table H-4 of Appendix H);
3) Temperature response data of fuel temperature in ASTs to changing ambient temperatures (attenuation factors) from several MLD tests (Appendix I);
4) Evaporation rates of fuel for open AST systems (tanks without any pressure/vacuum valve) from several MLD tests (Appendix D);
5) Monthly average ambient temperatures for 15 California cities from U.S. EPA's AP-42 methodology (Appendix I);
6) AST emissions equation model from U.S. EPA's AP-42 (Appendix I).

Using this information, the current AST inventory methodology accounts for emissions from individual ASTs across the state, rather than on estimating emissions on an aggregated, statewide basis. From these new data, an estimate of reactive organic gas (ROG) emissions from ASTs in the state was developed for 2004.

[1] The gasoline dispensing facilities methodology estimates emissions from the storage of gasoline fuel for both on-road and off-road use. Emissions estimates from the storage of fuel sold for on-road use is separate from that sold for off-road use. One assumption in the methodology is that gasoline used for off-road purposes is stored in tanks without Phase II vapor control. The statewide inventory had previously accounted for emissions from ASTs as if they were used exclusively to store gasoline sold for off-road purposes, thus assuming a worst-case situation with respect to vapor losses.

As with most estimates, certain assumptions were made. The assumed fuel throughput for ASTs, based on a suggestion from key stakeholders, was derived by assuming each AST was re-filled four (4) times a year and each re-filling supplied 80 percent of the AST's maximum capacity (i.e., it was assumed the tank was not completely empty when re-filled). Using these assumptions and the estimated population and tank sizes of ASTs in the state, an annual throughput for 2004 of 30,029,000 gallons of gasoline is obtained. The resulting calculated emissions from all ASTs in the state for 2004 was approximately 3.31 tons per day (TPD) of ROG. By comparison, the Gasoline Dispensing Facilities methodology previously used in the statewide emissions inventory for ASTs would result in an estimated 0.80 TPD ROG for the same throughput of 30,029,000 gallons of gasoline. The difference in emissions with the new methodology increases emissions from ASTs by approximately 2.51 TPD ROG (3.31 TPD - 0.80 TPD).

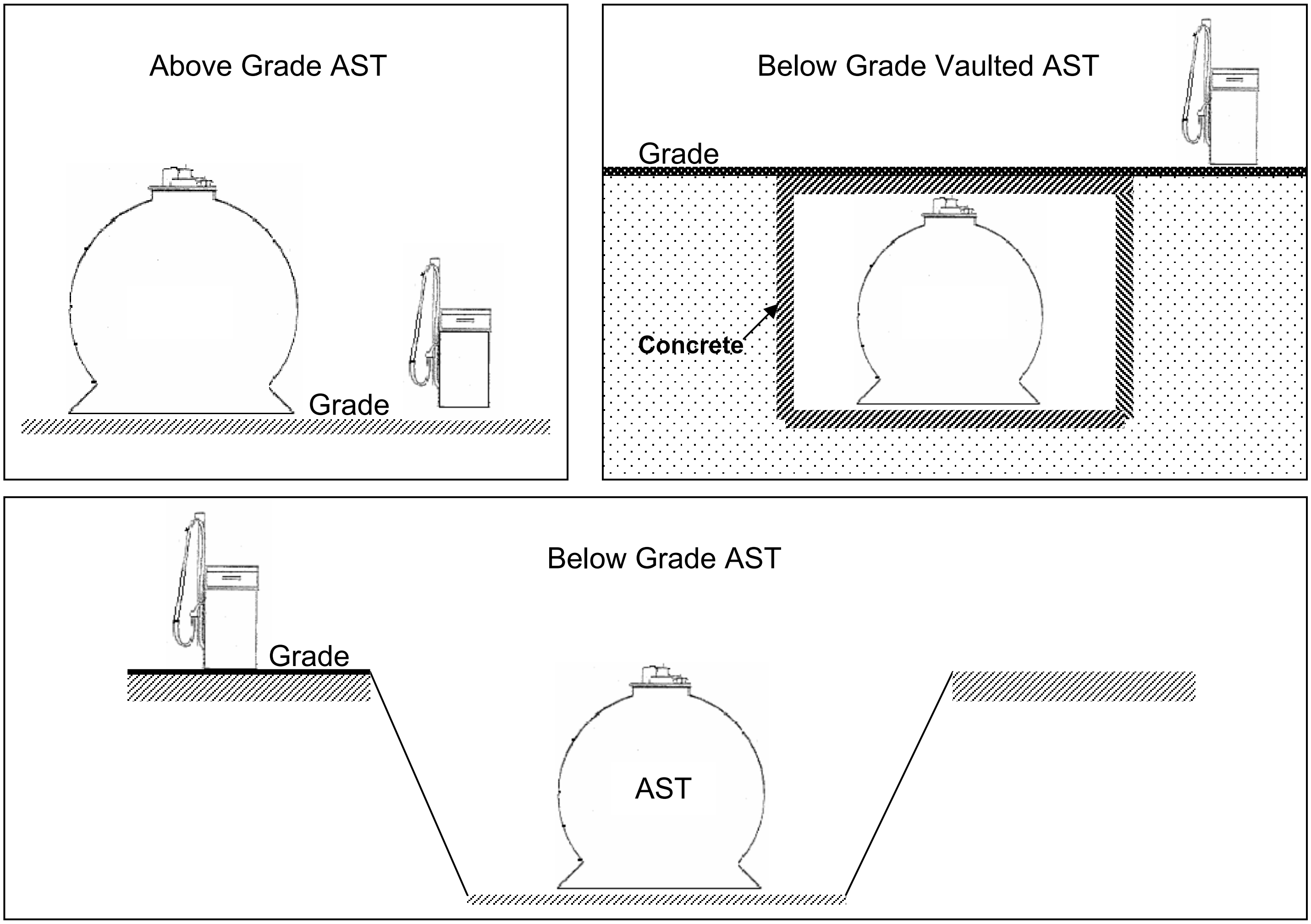
The ARB will continue to work with the local districts and other stakeholders to spatially resolve this current AST emissions estimate of 3.31 TPD to the county, air basin, and air district levels which will enable the estimates in the ARB's emissions inventory electronic data system.

E. AST Emissions Overview

1. AST Description

An AST is a gasoline storage tank intended for fixed installations, without backfill, that is located above or below grade. Some ASTs require an emergency pressure relief vent. Typical ASTs have capacities ranging from 250 gallons to 12,000 gallons. ASTs are used on farms, government facilities, private facilities, construction sites, and gasoline service stations. There are three main types of ASTs: single wall, protected, and below-grade vaulted tanks. Single wall ASTs are gasoline storage tanks located above or below grade that are typically constructed with a primary (single) wall for containment. Protected ASTs are gasoline storage tanks located above or below grade that are typically constructed with a primary and secondary wall for containment with an insulating material between the walls. Below-grade vaulted ASTs are single wall or protected gasoline storage tanks located below grade, inside a vault, that requires continuous ventilation. Figure II-1 shows examples of above and below grade ASTs.

Figure II-1
Examples of Above and Below Grade ASTs



2. Sources of Emissions

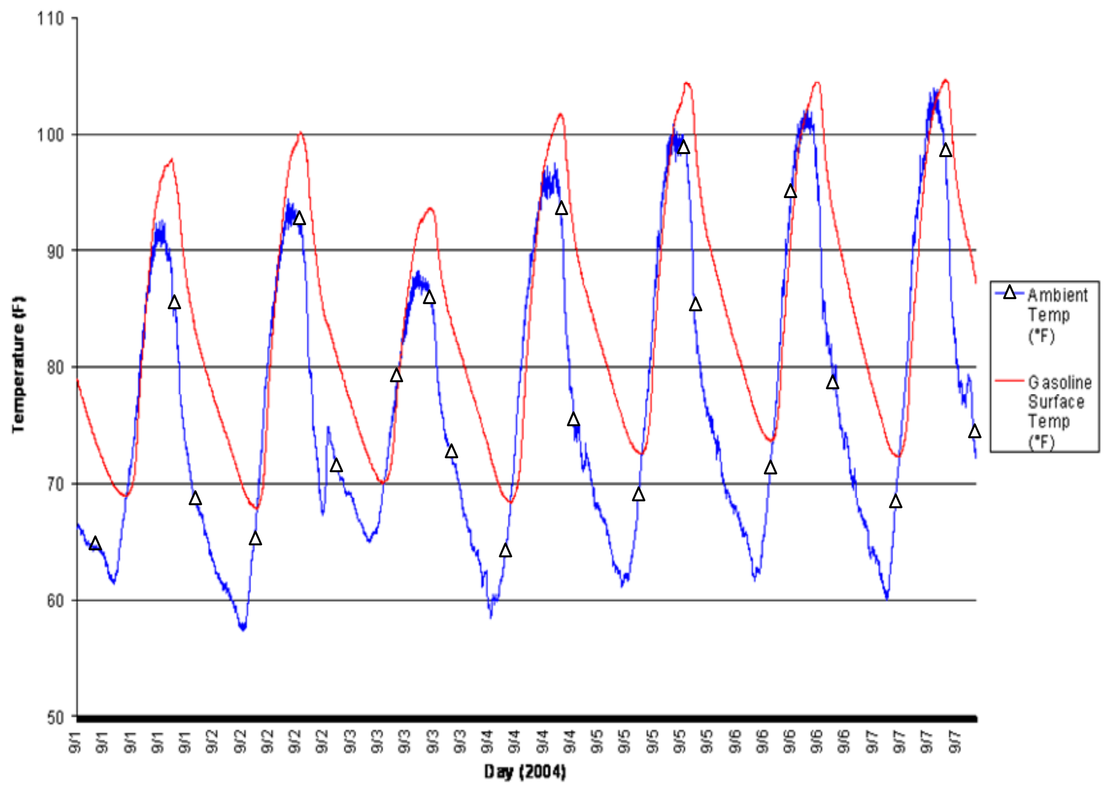
Gasoline vapor emissions from ASTs are a significant source of ROG that contribute to the formation of ozone, a criteria pollutant. Gasoline vapor emissions from ASTs also contain benzene, a toxic air contaminant. There are two main types of gasoline vapor emissions from ASTs: Standing Losses and Working Losses.

a. Standing Losses

Standing losses are gasoline vapor emissions that occur whenever the gasoline evaporates including during periods of no gasoline transfer. These evaporative emissions escape through open vent pipes and leaks in the AST. They occur when internal tank pressure increases as a result of diurnal temperature changes. Standing losses from ASTs vary based on the different tank configurations and size, and contribute approximately 90 percent of the total uncontrolled emissions from ASTs (approximately 2.95 TPD).

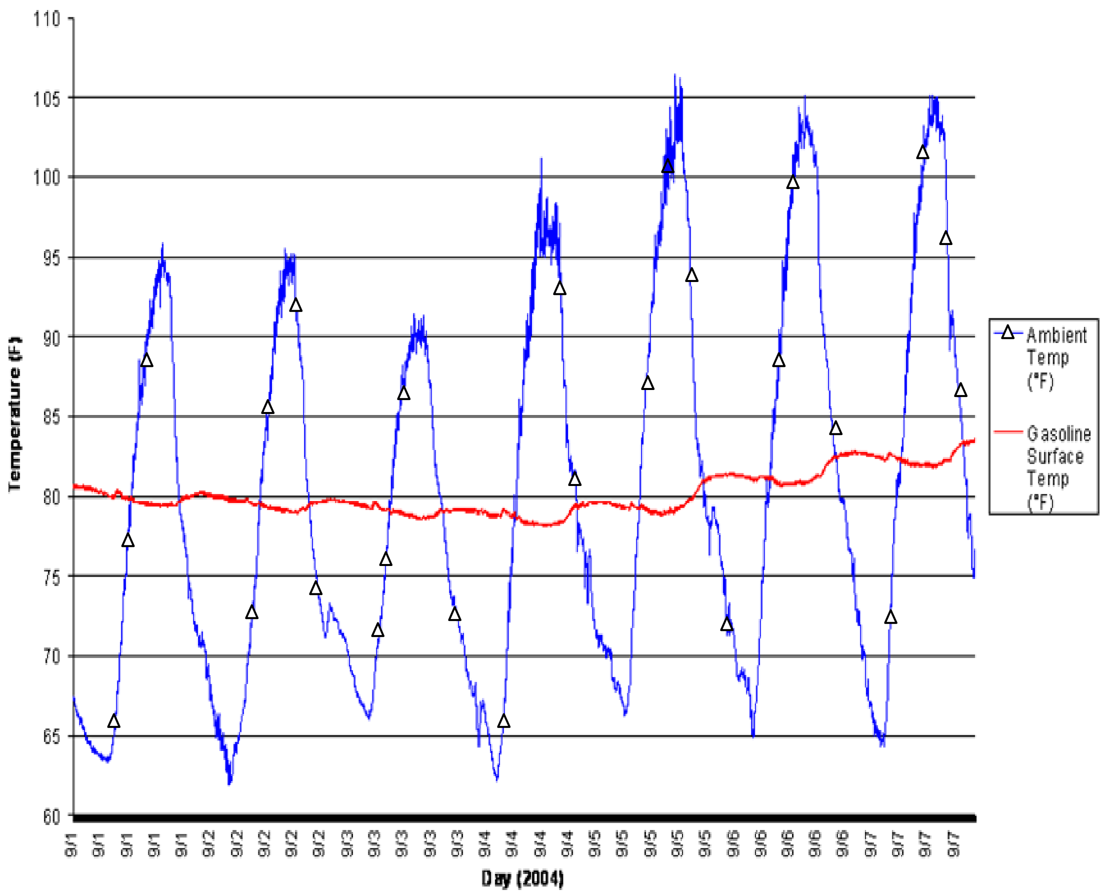
In single wall ASTs, diurnal changes in ambient temperature have a direct effect on the fuel surface temperature. As shown in Figure II-2, these ambient temperature changes cause fuel surface temperatures to change resulting in gasoline evaporation.

Figure II-2
Influence of Ambient Temperature on Fuel Surface Temperature
Single Wall AST



In protected ASTs, diurnal changes in ambient temperature have very little effect on the fuel surface temperature. As shown in Figure II-3, the fuel surface temperature remains relatively constant resulting in emission reductions of approximately 90 percent compared to single wall ASTs.

Figure II-3
Influence of Ambient Temperature on Fuel Surface Temperature
Protected AST



b. Working Losses

Working losses are emissions during gasoline transfer operations. Phase I and Phase II vapor recovery systems are used to collect vapors during delivery to and dispensing from an AST, respectively. Working losses contribute approximately 10 percent of the total emissions from ASTs (approximately 0.34 TPD). Currently certified Phase I vapor recovery systems collects 90 percent of the vapors released during delivery operations. Currently certified Phase II vapor recovery systems collect 90 percent of the vapors released while dispensing fuel.

c. Spillage Losses and Liquid Retention

Spillage losses are emissions occurring when liquid gasoline spills to the ground. Liquid retention is when gasoline is retained in the hanging hardware (nozzles, hoses, etc.) and then evaporates. These emissions are released during pre-fueling, fueling and post fueling operations. Spillage loss emissions contribute approximately one percent of the total emissions from ASTs (approximately 0.02 TPD).

F. Public Process

Beginning in 2001, the ARB staff has conducted 10 AST Vapor Recovery Workshops in consultation with the public, agriculture, industry, vapor recovery equipment manufacturers, tank manufacturers, associations, and Districts to address specific technical issues, define regulatory development timelines, and discuss implementation strategies. Additionally, multiple workgroup meetings were held with interested parties to have open discussions and address concerns.

The dates and locations of workshops are listed in Table II-1.

Table II-1
Workshop Meetings

DATE	LOCATION
June 21, 2001	Sacramento
February 5, 2002	Sacramento
August 20, 2002	Sacramento
April 24, 2003	Fresno
November 14, 2003	Sacramento
February 10, 2004	Sacramento
November 3, 2004	Sacramento
June 7, 2005	Sacramento
September 27, 2006	Sacramento
December 13, 2006	Sacramento

In addition to the workshops listed above, staff kept the California Air Pollution Control Officers Association (CAPCOA) Vapor Recovery Committee informed at its quarterly meetings on the progress in developing the AST certification procedure. CAPCOA formed a subcommittee, headed by the San Joaquin Valley APCD, to provide input and suggestions.

Staff provided information and updates on the AST proposal to the ARB Agricultural Advisory Committee for Air Quality, which consists of over 50 representatives of farm bureaus, commissions, and associations as well as government representatives. Staff also held one workshop and some agricultural workgroup meetings in the San Joaquin Valley to facilitate participation from agricultural interests. Staff also participated in subcommittee meetings and discussions related to the State Implementation Plan (SIP) for ozone, some of which also involved agricultural community representatives.

Staff has met with other stakeholders such as the California Independent Oil Marketers Association, Steel Tank Institute (STI), and various agricultural groups and associations to discuss the AST proposal, and met again with STI to specifically discuss testing conducted for the proposed regulation as well as the cost analysis. Meetings with the State Water Resources Control Board (SWRCB) staff are scheduled regularly to discuss regulatory activities that affect gasoline storage and transfer.

Staff established the AST web site (www.arb.ca.gov/vapor/ast/ast.htm) providing stakeholders with information regarding the AST program as well as updates of the regulatory proposal. All persons on the e-mail list serve are notified whenever new information is posted on the vapor recovery web site. Workshop presentations and associated documents are posted on the web site prior to the workshop date and sent by mail to stakeholders on the vapor recovery mailing list. Interested stakeholders participated in the workshops in person or via conference call.

III. NEED FOR AST RULEMAKING

This section discusses the justification for the proposed regulation.

A. State Implementation Plan

All non-attainment areas are required by the federal Clean Air Act to submit a State Implementation Plan (SIP) containing strategies to improve air quality and achieve the federal ambient air quality standards. In 1994, ARB adopted a comprehensive ozone SIP. Since 1994, most of the existing near-term control measures have been adopted.

In 1999, the ARB settled a lawsuit with three Los Angeles-based environmental groups regarding the 1994 ozone SIP. Under the terms of the settlement, the ARB must achieve specified reductions in hydrocarbons and oxides of nitrogen. This settlement was amended in 2003 and includes a commitment by the ARB to consider a measure reducing emissions from ASTs.

ARB has developed a state strategy plan to be incorporated in the 2007 California State Implementation Plan for ozone which is due to U.S. EPA in June 2007. Enhanced vapor recovery for ASTs is one of the proposed SIP measures to reduce the Reactive Organic Gases (ROG) emissions from ASTs statewide. The staff's proposal will satisfy the requirements of the SIP and related settlement.

The proposed regulation will further reduce ozone forming hydrocarbon emissions necessary to assist California in meeting SIP commitments and protecting public health.

B. Consistency with UST EVR Regulations

The EVR regulations approved by the Board in 2000 for UST based vapor recovery systems do not apply to ASTs. To obtain additional emission reductions, staff is proposing to apply the EVR standards and specifications for USTs to ASTs. This will remove any unintended incentive to install ASTs instead of USTs.

IV. SUMMARY OF PROPOSAL

A. Introduction

This section summarizes the proposed performance standards and specifications and discusses the basis for the proposed regulation and the availability of control technologies for meeting these performance standards and specifications.

The central element of the proposal is the establishment of new performance standards or specifications to reduce emissions from standing losses. Other proposed changes include applying UST EVR performance standards and specifications, where feasible, to control working loss emissions from ASTs. With certain exceptions, new certifications will require an operational test of at least 180 days.

This section discusses the key elements of staff's proposed regulation in the following order:

- Standing Losses
- Working Losses
- New, Modified and Applicable Current Certification Procedures

B. Standing Losses

During the summer of 2005, staff conducted a field study on various sizes of ASTs in Fresno County, California in cooperation with the agricultural stakeholders. The purpose of the field study was to evaluate emission reductions from ASTs when retrofitted with various control technologies during periods of no fuel transfers. The study, concluding that standing loss emissions are significant and that controls are currently available which reduce these losses (see Appendix D for more detail), provides the basis for the proposal to control standing loss emissions.

The following sub-sections describe the certification process, proposed standards, need for the proposed standard, and available standing loss control technologies.

1. Performance Based Certification

Performance based certification tests standing loss control components as a system for the specified minimum time period. After successfully meeting the proposed standards, these components remain together as a system in a specific Executive Order (EO). This approach is similar to current Phase I and Phase II certification, where the EO specifies the components that are required to be installed. No modification to the system is allowed without the Executive Officer's approval.

2. Design Based Certification

Under the design based certification, the system configuration is defined. The configuration also includes the components. Individual component specific standards are listed. After successfully meeting the component standards, the design based approach allows components more flexibility in being combined with other components that are part of another configuration. These components will be interchangeable in specific combinations as defined in the certification procedure. The design based component is added to a universal EO.

3. Proposed Standards

The 2005 field study showed how various technologies performed. That data provided a technical basis for establishing the proposed standards. Results from the field study demonstrate that a P/V relief valve and insulation technologies can reduce emissions up to 97 percent when compared to a tank with no controls.

The following standing loss performance standards are proposed for new and/or existing ASTs. The proposed standards are more stringent for new ASTs compared to existing ASTs. The lower standard for existing ASTs allows more cost effective options for GDF owner/operators with tanks presently in the field. The proposed standards are lower than the field study results to maintain a margin of error based on engineering judgment and are given in units of pounds of hydrocarbons per 1000 gallons of tank ullage per day. Percent reduction is provided to show equivalent emission reductions. Additionally, Standing Loss Controls levels may be certified at two levels higher than the proposed standard (for existing ASTs) to allow for emission credits. Table IV-1 through IV-3 lists the technologies that are capable of meeting the proposed standards for new and existing tanks.

a. New Installations: 0.57 lbs/1000 gallon tank ullage/day (90%)

Table IV-1
Standing Loss Control Proposed Performance Standards for New ASTs

Performance Standard	Control*	Control Technology Combination
0.57 lbs/1000 gal tank ullage/day	90 Percent	P/V + Insulation, or P/V + Protected Tank

* compared to a tank with no controls

Staff recommends a proposed performance standard emission factor of 0.57 pounds of hydrocarbons per 1000 gallons of gasoline ullage per day for new installations. This proposed performance standard will apply to new AST installations and major modifications of existing AST installations.

b. Existing Installations: 2.26 lbs/1000 gallon tank ullage/day (60%)

Table IV-2
Standing Loss Control Proposed Performance Standards for Existing ASTs

Performance Standard	Control*	Control Technology Combination
2.26 lbs/1000 gal tank ullage/day	60 Percent	P/V + Paint, or P/V + Shade, or P/V + Carbon Canister

*compared to a tank with no controls

Results from the 2005 field study demonstrate that P/V relief valve and paint, shade, or carbon canister technologies can reduce emissions between 65 and 67 percent when compared to tanks with no controls. To provide a safety margin, staff recommends a proposed performance standard emission factor of 2.26 pound of hydrocarbons per 1000 gallons of gasoline ullage per day (60 percent control) for existing installations. This proposed performance standard would apply to retrofits of existing ASTs.

c. Optional Controls for Existing Installation

Table IV-3
Standing Loss Control Proposed Levels for Existing ASTs

	Performance Standard	Control*	Control Technology Combination
Required	2.26 lbs/1000 gal tank ullage/day	60 Percent	P/V + Paint, or P/V + Shade, or P/V + Carbon Canister
Optional	1.34 lbs/1000 gal tank ullage/day	76 Percent	P/V + Paint, or P/V + Shade, or P/V + Carbon Canister
Optional	0.57 lbs/1000 gal tank ullage/day	90 Percent	P/V + Insulation, or P/V + Protected Tank

* compared to a tank with no controls

To encourage the use of SLC technologies that achieve higher emission reductions for existing installations, staff proposes validating SLC vapor recovery systems and components to retrofit existing ASTs that exceed the 60 percent certification level, specifically at 76 and 90 percent. The increased emission reduction benefits can be used as emission credits. This concept was developed in conjunction with stakeholders and the Districts and will allow for the use of in-use retrofit technologies that higher control efficiencies.

Upon request from an applicant, staff will evaluate control technologies using all the same certification and test procedures. Those technologies that meet or exceed the 2.26 lbs/1000 gallons/day Standing Loss Control performance standard for retrofits will be certified to either the 76- or 90-percent-control-level performance standard as determined through operational testing.

Again, these levels are optional for both the applicant and the end users under staff's proposed certification procedure regulations.

4. Need for Proposed Standard

The field study results identified standing losses as the primary source of gasoline vapor emissions from ASTs. Measurements recorded from the field study indicate a significant amount of hydrocarbons (approximately 90 percent of total AST emissions) are released as standing losses, proportional to the size of the AST. A 1,000 gallon AST lost approximately 32 gallons of gasoline over a period of three months. A 350 gallon AST lost approximately five gallons of gasoline over a period of two months. The results of the field study helped to identify technologies that provided significant emission reductions. Appendix D summaries the results of the field study.

C. Working Losses

Working losses are emissions during the transfer of gasoline from cargo tank truck to the AST (Phase I) and during the transfer of gasoline from the AST to a motor vehicle (Phase II). Phase I and Phase II vapor recovery systems are currently certified for ASTs through Executive Orders. These systems are subject to less rigorous certification testing under CP-205, *Certification Procedures for Vapor Recovery Systems of Novel Facilities*. With the introduction of EVR systems for USTs, improved component reliability was required along with higher transfer efficiencies. It is the intention of the proposed regulation to certify Phase I and Phase II EVR systems to performance standards that increase transfer efficiency and component reliability. This will also make the AST and UST programs consistent. Certification testing for Phase I and Phase II EVR systems will be minimum 180 days.

1. Proposed Standards

The proposed regulations will require ASTs to be certified to performance standards and specifications contained in the proposed CP-206. CP-206 is more stringent than CP-205, which is currently used for AST certification. The proposed changes are nearly identical to the revised EVR program for USTs and will take advantage of technology advances and design improvements. Where applicable, testing data from EVR certifications for USTs will be used to demonstrate compliance with the standards. Because of the similar standards, it is expected that many of the components will meet the AST criteria without any modifications. Table IV-4 highlights major changes in the standards and specifications, compared to the existing requirements for ASTs.

Table IV-4
Summary of Proposed Changes to the Phase I and II Performance Standards and Specifications

Performance Type	Proposed Requirement	Existing Requirement
Phase I Efficiency	≥ 98.0%	≥ 90.0%
Phase I Emission Factor	HC ≤ 0.15 pounds/1,000 gallons dispensed	none
Pressure Integrity of Drop-Tube with Overfill Protection	Leakrate ≤ 0.17 CFH at 2.0 inches H_2O	none

Performance Type	Proposed Requirement	Existing Requirement
Static Pressure Performance	Lowered the allowable leakrate, based on ullage of tank (see TP-206.3)	TP-201.3B
Phase I Product and Vapor Adaptors	1. Fixed or Rotatable 360^o 2. $\leq$108 inch-pound Static Torque, if rotatable 3. Cam and Groove Dimensions	1. none 2. none 3. none
Side or Bottom Fill Phase I Adaptor	Poppetted or Close-Coupled Shut-Off Valve	none
Pressure/Vacuum Relief Valves	2.5" to 6.0" H_2O Positive Pressure 6.0" to 10.0" H_2O Negative Pressure Leakrate at +2.0" $H_2O \leq 0.17$ CFH Leakrate at –4.0" $H_2O \leq 0.63$ CFH	+3.0" $\pm$ 0.5"H_2O -8.0" $\pm$ 2.0"H_2O same same
Spill Container-Drain Valve	Leakrate $\leq$ 0.17 CFH at +2.0" H_2O	none
Emergency Relief Venting	No indication of vapor leaks @ 2" H_2O	same
Vapor Connectors and Fittings	No indication of vapor leaks @ 2" H_2O	same
Compatibility with Fuel Blends	Materials shall be compatible with approved fuel blends	same
Phase II Emission Factor Includes: Refueling and Vent Emissions	1. Summer Fuel: 95% Efficiency and HC $\leq$ 0.38 lbs/1,000 gals dispensed 2. Winter Fuel: 95% Efficiency or HC $\leq$ 0.38 lbs/1,000 gals dispensed	1. 90% efficiency 2. 90% efficiency
Connectors and Fittings	No indication of vapor leaks @ 2" H2O	same
Nozzles	1. Spillage: $\leq$ 0.24 pounds/1,000 gallons 1. Post-Refueling Drips: $\leq$ 3 Drops/Refueling 3. Dimensions: OD $\leq$ 0.840 inches and a length of 2.5 inches 4. Liquid Retention: $\leq$ 100 ml/1,000 gallons 5. Spitting: $\leq$ 1.0 ml per nozzle per test 6. Capable of fueling any vehicle that can be fueled with a conventional nozzle	1. none 2. none 3. none 4. none 5. none 6. none

Performance Type	Proposed Requirement	Existing Requirement
ORVR Compatibility*	Refueling ORVR Vehicles Shall Not Cause the System to Exceed the Applicable Efficiency or Emission Std	none
Phase II Vapor Riser	Minimum 1” Nominal ID	same
Vapor Return Piping	No liquid or fixed blockage Minimum 3” Nominal ID after first manifold Recommended slope ¼” per foot Minimum slope ⅛” per foot Rigid piping or equivalent	same
AST Vaulted System	Based on Certification Procedure 201	none
Liquid Removal System	Capable of Removing 5 ml/ gal. (average)	same
Liquid Condensate Traps	Shall have Automatic Evacuation System	none

*Effective January 1, 2001, state law requires the certification of only those systems that are ORVR compatible (H&SC section 41954).

2. Need for Proposed Requirements

The most common emission sources of working losses are leaking components. Operational testing for certification of AST vapor recovery systems under CP-205 was much less than the proposed minimum 180-day testing duration. This led to AST vapor recovery components that were unreliable in the field and did not pass testing requirements for in-use evaluation. The introduction of stricter performance standards and specifications for leaks, transfer efficiencies, and longer operational test periods will provide AST EVR systems a higher level of durability and reliability, similar to the UST EVR systems.

3. Availability of Controls to Meet Standard

Technologies are currently available under the UST EVR program. It is most likely that these components will be certified for use with ASTs. Vapor recovery equipment manufacturers have already completed some research and development of EVR systems for USTs. Vapor recovery equipment manufacturers already have commercially available components that may meet the proposed EVR performance standards and specifications. Additionally, EVR technology is currently certified that will compliment the proposed AST EVR program. More durable tank components will improve the containment of gasoline vapors in ASTs.

D. New, Modified, and Applicable Current Certification Procedures

1. Definitions: D-200

D-200, *Definitions for Vapor Recovery Procedures,* defines the terms and acronyms used in the vapor recovery certification procedures and test procedures for gasoline dispensing facilities, bulk plants, terminals, cargo tanks, and novel facilities. The following describes the proposed changes to D-200. For a complete copy of D-200 with changes in ~~strikeout~~/underline format, see Appendix F.

a. Aboveground Storage Tank

The definition of an AST has been changed by removing the words, “and required emergency relief venting” to recognize that not all tanks are required to have this capability.

b. Applicability

The term, Aboveground Storage Tank, was added to the applicability paragraph to recognize the proposed new certification procedure for aboveground storage tanks.

c. Below-grade Vaulted Tank

A below-grade vaulted tank definition is added to highlight the differences in certification requirements. Since such tanks are operated in the same manner as a UST, CP-206, *Certification Procedures for Vapor Recovery Systems at Gasoline Dispensing Facilities Using Aboveground Storage Tanks,* would require below-grade vaulted tanks to comply with component standards and effective dates listed in CP-206 and certification requirements of CP-201, *Certification Procedures for Vapor Recovery Systems at Gasoline Dispensing Facilities.*

d. Modification

The proposed change defines a major modification for an AST to mean replacing the tank. An exception is when the tank is installed after retrofitting to comply with requirements of CP-206 or when an existing tank is exchanged with a retrofitted tank of equal capacity to comply with CP-206.

e. Standing Loss Control

The “Standing Loss Control” definition is added as a new vapor recovery system for ASTs to control evaporative emissions during periods of no gasoline transfers.

f. Temperature Attenuation

“Temperature Attenuation” is added to define a means to test a Standing Loss Control vapor recovery system’s ability to control the effects that diurnal ambient temperature changes and solar radiation have on the fuel surface temperature in ASTs. It is the ratio of the fuel surface temperature range to ambient temperature range.

2. TP-201.2 Efficiency and Emission Factor for Phase II Systems

Staff proposes to amend Section 12.7 of TP-201.2, *Efficiency and Emission Factor for Phase II Systems,* to provide the correct equation for the calculation of Phase II system efficiency. Staff also proposes to modify Sections 7.7 and 11.1 to make the determination of fugitive emissions consistent with the adopted and referenced test procedure, *Pressure Related Fugitive Emissions* (TP-201.2F).

3. TP-206.1 Temperature Attenuation

Temperature attenuation is a mathematical comparison of the fuel surface temperature divided by the ambient temperature. Temperature attenuation tests are used to measure the ability of technologies applied to tanks to control the effects of ambient temperature and solar radiation on gasoline surface temperatures in the AST. Field testing conducted during the summer of 2005 showed that certain technologies, such as insulation, can reduce ROG emission up to 97 percent. Other technologies, used in combination, reduce ROG emissions between 43 percent and 87 percent. The relationship between fuel surface temperature and emissions reduction was developed from the field testing and is summarized in Appendix G. To evaluate the effectiveness of these technologies, TP-206.1, *Determination of Emission Factor for Standing Loss Control Vapor Recovery Systems Using Temperature Attenuation Factor at Gasoline Dispensing Facilities with Aboveground Storage Tanks*, was developed to compare the ratio of average fuel surface temperature range to average ambient temperature range. The test is conducted for a minimum of 30 consecutive days during the summer months (June through September), with 7 days when ambient temperatures are greater than 95 degrees Fahrenheit. Technologies that can achieve a temperature attenuation factor that correlates to the emission factor performance standard for existing (retrofit) and new facilities will be certified in an Executive Order.

4. TP-206.2 Hydrocarbon Source Testing

Hydrocarbon source tests are used to directly measure emissions from destructive and non-destructive processors, and passive purge systems applied to ASTs to control standing losses. Field testing conducted during the summer of 2005 showed passive purge systems can reduce emissions up to 65 percent when used alone. When used in configurations that control fuel surface temperature, passive purge systems can reduce up to 83 percent of standing loss emissions. Currently certified destructive and non-destructive processors have been tested to be up to 98 percent efficient.

Processors and passive purge systems will be evaluated with a new test procedure, TP-206.2, *Determination of Emission Factor for Standing Loss Control Vapor Recovery Systems Using Processors at Gasoline Dispensing Facilities with Aboveground Storage Tanks*, by directly measuring the processor outlet emissions. Processors and passive purge systems that meet the minimum emission factor performance standard will be certified in an Executive Order. ARB staff tested both processors and passive purge systems using TP-206.2 to evaluate the accuracy and reproducibility of this test procedure.

5. TP-206.3 Static Pressure Performance

Static pressure performance tests are used to measure leaks in vapor recovery systems. Field testing on ASTs systems showed that systems were able to meet the currently adopted TP-201.3B in spite of visible emissions at various locations (Appendix F). Because the final decay values are so low, it is possible to have a significant leak and yet pass the standard. Also, the current TP-201.3B, *Determination of Static Pressure Performance of Vapor Recovery Systems at Gasoline Dispensing Facilities with Aboveground Storage Tanks*, does not allow for testing below 300 gallons ullage. Our inventory assessment found that a significant number of the tanks are small in size. Staff performed numerous pressure decay tests and demonstrated that ASTs can meet a higher final decay value, which corresponds to reducing the leak rate by half. This value was used to calculate a new pressure decay profile constant and thereby establishing a new allowable decay table in the proposed new static pressure performance test for ASTs, TP-206.3

6. CP-206 Certification Process

The certification process is similar to CP-201. The following sub-sections highlight the differences between CP-206 and CP-201.

a. Applicability

A significant difference between CP-201 and CP-206 is that Standing Loss Control, Phase I, and Phase II vapor recovery systems will be certified separately. Compatibility between systems will still be evaluated, but separate certifications will allow Districts and stakeholders more flexibility than is currently available in CP-201.

b. Effective/Operative Dates

Staff proposes an effective date of January 1, 2009 for this measure. The effective date will start the four-year clock mentioned below, which will require existing certified AST systems to meet the proposed EVR standards by January 1, 2013. This means that new AST installations occurring on or after January 1, 2009 must comply with the new AST EVR performance standards and specifications. The January 1, 2009, effective date will allow manufacturers sufficient time and opportunity to develop and certify vapor recovery systems and components that would comply with the new AST EVR performance standards and specifications. The proposal authorizes the Executive Officer to modify or change the effective date in the event a system is not commercially available.

Although existing facilities can continue to operate for up to four years after the January 1, 2009 effective date, components on these systems may need replacement within this four-year timeframe. Staff has proposed a limited-term certification process to address certification of replacement components so that installed systems can continue operation with the best replacement parts available. The certification for these replacement parts will expire at the end of the four-year clock if the parts do not meet all of the new standards. However, when replacement parts certified to meet the new standard are commercially available and are compatible, only those replacement parts shall be installed.

c. State Law Requirements and Four-Year Clock

The proposal specifies new performance standards and specifications for Standing Loss, Phase I, and Phase II vapor recovery systems as well as new certification and test procedures. The change in performance standards and specifications means that existing AST vapor recovery system certifications will expire on the effective date of the new requirements. After the effective date, ARB may only certify systems that comply with the new performance standards and specifications.

Health and Safety Code Section 41956.1 provides that vapor recovery systems certified under procedures in effect prior to adoption of revised performance standards and specifications, and installed prior to the effective date of the revised standards, may continue to be used for a period of four years after the effective date of the revised standards. This is commonly referred to as the “four-year clock.” Thus, for example, a station owner who purchased and installed a new vapor recovery system before the date of the new standard will have four years to comply.

New facilities installed on or after the effective date must comply with the new standards and specifications. Existing facilities that undergo a major modification after the effective date must also comply with the new standards and specifications. For AST systems, a major modification means replacing the tank. An exception is when the tank is installed after retrofitting to comply with requirements of CP-206 or when an existing tank is exchanged with a retrofitted tank of equal capacity to comply with CP-206.

d. Standing Loss Control

Standing Loss Control vapor recovery systems will be certified either through performance based or design based testing. Performance based testing will evaluate Standing Loss Control systems. These systems of components that meet or exceed the performance standards will be certified and given a system specific Executive Order. Standing Loss Control systems must remain together. Design based testing will evaluate Standing Loss Control components independently. Components that meet or exceed the performance standards will be certified and added to a universal Executive Order from which the GDF owner/operator may select for control.

e. Phase I and Phase II

Phase I and Phase II certification will be similar to the certification process defined in CP-201. Systems will be evaluated for a minimum 180 days. Systems that meet or exceed all the performance standards and specifications will be given a specific Executive Order. Phase I and Phase II systems must remain together. Certification of Phase I and Phase II systems will be tested independently, although compatibility between systems will remain a requirement.

f. Limited Term Certification

Staff proposes a four-year limited term certification, as already required for UST vapor recovery systems under EVR.

Currently, certifications for AST vapor recovery equipment have no expiration date. State law provides for decertifying systems if the system no longer meets the required specifications or standards (H&SC section 41954(c)(2)); however, this process is not often invoked, because of the consequences of revocation. As a result, equipment may be purchased and installed while identified problems are being resolved. Also, systems that are no longer manufactured or supported remain installed and, in some cases, are still being installed from old stockpiles of equipment.

Staff is proposing limited term certifications of four years duration that could be renewed continuously without additional testing unless renewal is denied based on data demonstrating deficiencies. ARB staff would process the renewal automatically if there were no deficiencies. If deficiencies are found, ARB staff would work with the equipment manufacturer to resolve the problems before a new certification is issued. This process allows timely correction of problems while avoiding the negative attributes associated with decertification.

Installed systems affected by certification expiration may remain in use for the remainder of the useful life, or four years, whichever is shorter, as required by state law.

g. Below Grade Vaulted Tanks

Below-grade vaulted storage tanks have become more popular recently primarily due to water quality concerns and environmental clean-up considerations. A partial sales tax exemption has made the use of vaulted systems attractive as the increased installation costs are often recouped in a short period for high throughput stations. The ARB has evaluated and certified several vaulted systems in California and has determined that these systems operate very similarly to UST vapor recovery systems, with the exception of the emergency vent requirements. For this reason, staff is proposing to certify the vaulted systems in nearly an identical manner as the UST vapor recovery systems and is, therefore, referencing CP-201 for the certification requirements for most aspects of these systems.

h. Test Procedures

Staff proposes to incorporate the following test procedures into the Gasoline Vapor Recovery Certification and Test Methods 206 series to evaluate systems and components specific to an AST.

- TP-206.1, Determination of Emission Factor for Standing Loss Control Vapor Recovery Systems Using Temperature Attenuation Factor at Gasoline Dispensing Facilities with Aboveground Storage Tanks,

- TP-206.2, Determination of Emission Factor for Standing Loss Control Vapor Recovery Systems Using Processors at Gasoline Dispensing Facilities with Aboveground Storage Tanks, and

- TP-206.3, Determination of Static Pressure Performance of Vapor Recovery Systems at Gasoline Dispensing Facilities with Aboveground Storage Tanks.

V. ENVIRONMENTAL AND ECONOMIC IMPACT

This section discusses the environmental and economic impacts of the proposed regulation. The environmental impact includes the AST population distribution, baseline emissions, and emission reductions achieved through adoption of the proposed regulation. Economic impacts consider standing- and working- loss EVR system costs, staff assumptions related to those costs, and an evaluation of the cost effectiveness of the proposed regulation.

A. Environmental Impact

Staff's proposed regulation will provide ROG emission reductions of up to 1.98 tons per day (TPD).

1. AST Population Distribution

The number of ASTs in California is determined through a 2004 Fuel Carrier survey and provides the basis for environmental and economic impact calculations (Appendix H). The survey distributes different size ranges of ASTs into two categories: single wall and protected. The 2004 Fuel Carrier survey data is summarized in Table V-1.

Table V-1
Vapor Recovery Configurations of Single Wall and Protected ASTs

Tank	Current Configuration	No. of tanks	
		Exempt	Subject to Vapor Recovery
Single Wall	No Vapor Recovery (Exempt)	2,394	
	No Vapor Recovery (Not in Compliance with District rules)		3,383
	Phase I		1,610
	Phase I/II		233
Protected	No Vapor Recovery (Exempt)	39	
	No Vapor Recovery (Not in Compliance)		225
	Phase I		383
	Phase I/II		1,315
	Total	2,433	7,149

The 2004 Fuel Carrier Survey also categorized ASTs into three applications: farm (agriculture), marina, and other (retail GDFs and municipalities). ASTs in the farm category are assumed to be non-permitted by Districts. ASTs in the marina and other categories are assumed to be permitted by Districts.

The total number of tanks identified in the 2004 Fuel Carrier survey data is 9,582, of which 7,149 will be subject to the proposed regulation (total tanks minus exempt tanks).

2. Baseline AST Emissions

The baseline AST emissions were developed from the 2004 Fuel Carrier survey. The methodology used to develop the emissions inventory is detailed in Appendix I. Staff estimates there are 3.31 TPD of ROG emissions from ASTs operating in California.

The 2004 fuel carrier survey did not have information on the number of ASTs for each of the districts in the state and therefore the emissions could not be calculated for each district. However, emissions can be estimated for a defined region based on the number of tanks in that particular region. The emissions from San Joaquin Valley region defined in Appendix I, are estimated to be 1.13 TPD which is approximately 34 percent of the total AST emissions.

Table V-2 summarizes the 2004 Statewide emissions from ASTs in their current configurations.

Table V-2
2004 Statewide AST Emissions

Emission Source	Emissions (TPD)
Standing Losses	2.95
Phase I losses	0.14
Phase II losses	0.20
Spillage losses	0.02
Total AST Emissions	**3.31**

3. Emission Reductions

ARB is authorized by the HSC to certifying vapor recovery systems and Districts have the primary responsibility of regulating emissions from stationary sources such as service stations and ASTs. To achieve emission reductions Districts have adopted rules that require gasoline storage and transfer operations to be equipped with a vapor recovery system certified by the ARB. All emission reductions assume 100 percent compliance with District rules.

a. Standing Losses

The majority of emission reductions resulting from the proposal come from reducing standing loss emissions. These emissions are due to the release of gasoline vapors through leaks in the system when tank pressure increases due to increases in fuel surface temperatures that are affected by diurnal ambient temperature changes. Through the application of Standing Loss Control (SLC) vapor recovery systems, the fuel surface temperature range can be attenuated to reduce emissions and components can be used to control vent emissions. Proposed TP-206.1 and TP-206.2 provide test procedures to evaluate systems that attenuate fuel surface temperature and processed hydrocarbon emissions to CP-206 performance standards and specifications.

The emission factor performance standard defined in CP-206 allows for emission reductions for new facilities (0.57 lbs./1000 gallons/day) and retrofitting existing facilities (2.26 lbs./1000 gallons/day). The emission reductions associated with new facilities will not be realized until these systems are installed. Therefore most of the emission reductions come from application of Standing Loss Control vapor recovery systems to existing ASTs. Emission reductions from the application of Standing Loss Control vapor recovery systems to existing ASTs by January 1, 2013, are summarized in Table V-3.

Table V-3
Standing Loss Control Vapor Recovery System Emission Reductions for AST Retrofits

Category	No. of tanks	Percent Reduction	Emission Reduction (TPD)
Existing ASTs	7,149	60%	1.77

New ASTs will be required to meet 90 percent standing loss control begining January 1, 2009. Assuming the growth from 2009-2020 is approximately 13.5 percent, the additional emission reductions from new tanks will be approximately 0.34 TPD by 2020.

b. Working Losses

The introduction of EVR for Phase I and Phase II, as well as the use of the new test procedure, TP-206.3, will provide higher transfer efficiencies and stricter standards for allowable leak rates in AST systems. TP-206.3 improves the testing strategies as compared to the current test procedure, TP-201.3B, "*Determination of Static Pressure of Vapor Recovery Systems at Gasoline Dispensing Facilities with Aboveground Storage Tanks*." Current Phase I and Phase II systems are certified at 90 percent transfer efficiency. To be consistent with underground tank systems, staff's proposal is to increase transfer efficiencies to 98 percent for Phase I and 95 percent for Phase II. Although these proposed transfer efficiency increases do not contribute to large emission reductions, making Phase I and Phase II consistent with EVR standards and specifications assures higher component and system durability and will improve overall system performance and align the UST and AST vapor recovery requirements. The allowable static pressure decay value will be approximately half what is currently allowed by TP-201.3B. Certification testing will assure those future systems and components meet the new performance standards and are reasonably durable in use.

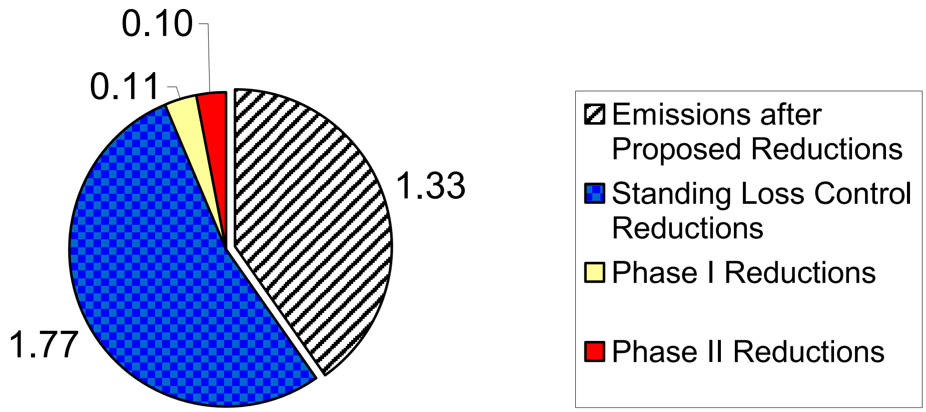
Table V-4 summaries the emission reductions associated with increasing Phase I and Phase II transfer efficiencies to EVR performance standards and specifications.

Table V-4
Phase I and Phase II Vapor Recovery System Emission Reductions

Category	No. of tanks	Transfer Efficiency	Emission Reduction (TPD)
Phase I	5,601	98%	0.11
Phase II	1,548	95%	0.10
Total	7,149	--	**0.21**

The estimated statewide emission reductions achieved with staff's proposal will be 1.98 TPD. The estimated emission reductions are illustrated in Figure V-1.

Figure V-1
Emissions Reductions and Remaining Emissions for Proposal



B. Economic Impact

1. Gasoline Savings

Emissions are directly related to gasoline lost through evaporation. As stated in the previous section there are approximately 1.98 TPD of emissions reduced with the adoption of the proposed regulation. This is equivalent to approximately 600 gallons of gasoline saved per day. At a current market price of $2.50 per gallon of gasoline, the potential cost savings attributed to the proposed regulation is approximately $1,516 per day, or $0.40 per pound of ROG emissions. Cost savings from gasoline savings are included in the cost analysis or cost effectiveness of the regulation.

2. Cost Analysis

The cost analysis is based on AST Pre-EVR and UST EVR equipment from three vapor recovery system manufacturers. Research and development, and certification costs were not considered since these systems are already certified or undergoing certification testing. The price of EVR systems includes these costs.

The cost to install and/or upgrade each tank to meet the proposed regulatory requirements depends on multiple factors: type of tank (single wall or protected), current District vapor recovery requirements (Phase I and/or Phase II), and compliance status with District rules (no vapor recovery). These categories determine capital cost associated with a single wall or protected tank to install and/or upgrade with Standing Loss Control, Phase I EVR, and/or Phase II EVR systems. Table V-5 summarizes the capital cost per tank of the proposed regulation assuming 100 percent compliance with District rules. The following three examples illustrate how some tanks might be affected.

- Example 1: A single wall 750 gallon AST in the San Joaquin Valley which was installed in 1991 with an annual throughput of 10,000 gallons currently requires Phase I only. Under this proposal, that same tank would be expected to meet the SLC and Phase I EVR standards by January 1, 2013. Table I-1 shows that there are approximately 1,610 tanks statewide that would be required to make a similar modification at an average incremental cost of $473.

- Example 2: A similar 750 gallon single wall AST is required to have Phase I vapor recovery but does not. This AST is listed in the second row of the table as having “No Vapor Recovery (Not in Compliance with District rules)”. The proposal estimates that this AST would be retrofitted with SLC and Phase I EVR just as in Example 1. The cost to come into compliance for this tank is $2,023. This difference in cost between this and Example 1 is attributed to installing equipment that was required but is not in place. Most of the 3,383 tanks in this category are used in agriculture and until recently were exempt from District permitting, thus control requirements were not enforced.

- Example 3: If a District amends their rules to require SLC only, then AST owners that meet the conditions of the rule would be required to retrofit to that level. Therefore, a single wall 750 gallon AST with no vapor recovery that is expected to come into compliance with the amended rule would be required to install SLC only. The average cost for an AST owner would be approximately $432. This cost is not reflected in Table I-1 since the Districts do not have rules in place and it would be difficult to project how many tanks would be subject to this statewide.

Table V-5
Estimated Incremental Cost per Tank

Tank	Current Configuration	Proposed Configuration	No. of tanks		Incremental Cost per tank ($)
			Exempt	Subject to Vapor Recovery	
Single Wall	No VR (Exempt)	No VR (Exempt)	2,394		$0
	No VR (Not in Compliance with District rules)	SLC + Phase I EVR		3,383	$2,023
	Phase I	SLC + Phase I EVR		1,610	$473
	Phase I/II	SLC + Phase I/II EVR		233	$594
Protected	No VR (Exempt)	No VR (Exempt)	39		$0
	No VR (Not in Compliance with District rules)	Phase I EVR		225	$1,693
	Phase I	Phase I EVR		383	$143
	Phase I/II	Phase I/II EVR		1,315	$264
		Total	2,433	7,149	

From the 2004 Fuel Carrier AST population survey, each category of single wall and protected tank current is compared to District rule applicability. This comparison provides the basis for the cost assumptions (Appendix J) used to determine which, if any, vapor recovery requirements will apply to current vapor recovery configurations. District rules determine which ASTs will be exempt from vapor recovery or require Standing Loss Control, Phase I EVR, and/or Phase II EVR vapor recovery.

3. Cost-Effectiveness of Proposed Regulations

The cost effectiveness analysis distributes the number of ASTs in each category, quantifies the annualized upgrade/installation costs per AST in each category, converts these costs to annualized statewide cost, and divides the annualized statewide cost by the annualized statewide emission reductions for each vapor recovery category. Annualized costs include the opportunity cost of capital at a 5 percent discount rate. Once the cost effectiveness is determined for each category, the annual statewide cost effectiveness of the proposed regulation is determined.

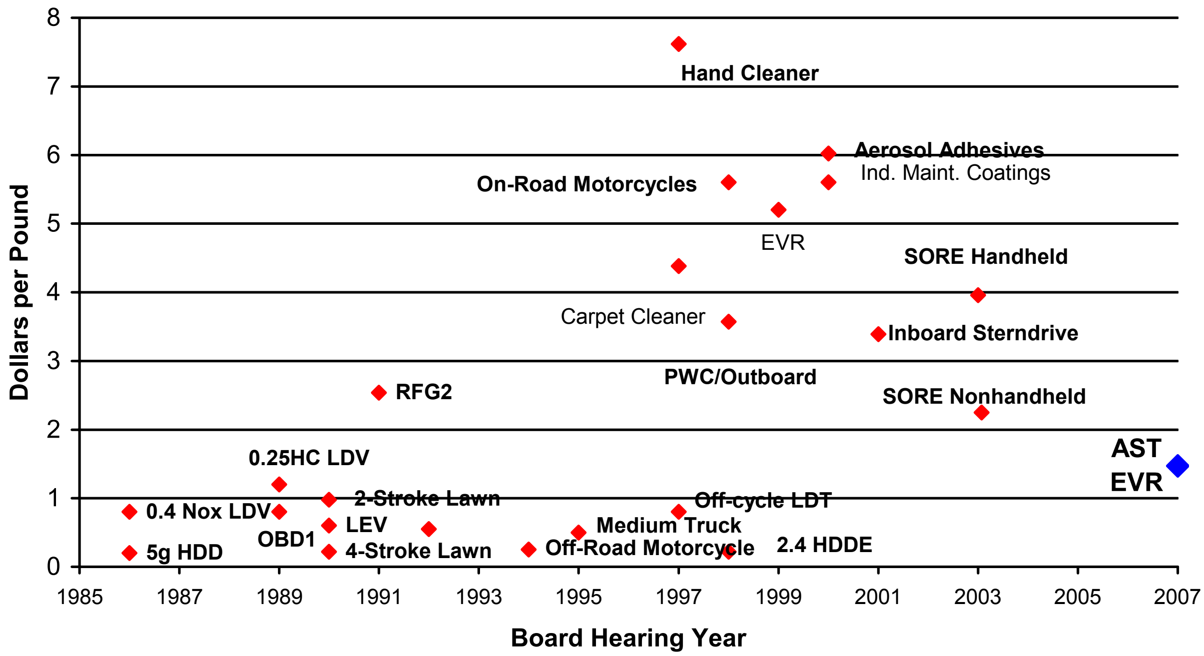
The cost effectiveness for all California ASTs is approximately $1.87 per pound of ROG emissions reduced. Including the cost savings from gasoline (approximately $0.40 per pound gasoline saved) the net cost effectiveness of the proposed regulation is approximately $1.47 per pound. Table V-6 summarizes the cost effectiveness of the proposed regulation.

Table V-6
Cost Effectiveness of Proposed Regulation

Tank	Current Configuration	Proposed Configuration	No. of tanks		Annualized Statewide Cost	Statewide emission reductions (TPD)	Cost effectiveness ($/lbs.)
Single Wall	No VR (Exempt)	No VR (Exempt)	2,394		—	—	—
	No VR (Not in Comp.)	SLC + Phase I EVR		3,383	$2,165,120.00	1.20	$2.48
	Phase I	SLC + Phase I EVR		1,610	$309,635.20	0.57	$0.74
	Phase I/II	SLC + Phase I/II EVR		233	$52,932.94	0.10	$0.74
Protected	No VR (Exempt)	No VR (Exempt)	39		—	—	—
	No VR (Not in Comp.)	Phase I EVR		225	$103,356.00	0.00	$41.28
	Phase I	Phase I EVR		383	$4,473.44	0.01	$1.03
	Phase I/II	Phase I/II EVR		1,315	$61,200.10	0.11	$0.80
			2,433	7,149	$2,696,717.68	1.98	$1.87
Net Cost Effectiveness with Gasoline Savings							**$1.47**

To put these figures into context, Figure V-2 compares the overall cost effectiveness of this proposal with other recent ARB rulemakings.

Figure V-2
Cost Effectiveness Comparison of Major Regulations



4. Economic Impact on the Economy of the State

Staff does not expect the proposed regulation to impose an unreasonable cost burden on gasoline dispensing equipment manufacturers, component suppliers, or gasoline dispensing facilities. Most of the major manufacturers are located outside of California although some may have small operations in California. Predominate costs are to owners and operators of gasoline dispensing facilities with ASTs.

Staff estimates the cost of the proposed regulations to be approximately $10.8 million dollars upon full implementation in 2013. These costs represent equipment retrofits, upgrades, and installations required by District rules.

a. Legal Requirement

Section 11346.3 of the Government Code requires State agencies to assess the potential for adverse economic impacts on California business enterprises and individuals when proposing to adopt or amend any administrative regulation. The assessment shall include a consideration of the impact of the proposed regulation on California jobs, business expansion, elimination or creation, and the ability of California business to compete.

Section 11346.5 of the Government Code requires State agencies to estimate the cost or savings to any state, local agency and school district in accordance with instructions adopted by the Department of Finance. The estimate shall include any non-discretionary cost or savings to local agencies and the cost or savings in federal funding to the State.

Health and Safety Code Section 57005 requires the ARB to perform an economic impact analysis of submitted alternatives to a proposed regulation before adopting any major regulation. A major regulation is defined as a regulation that will have a potential cost to California business enterprises in an amount exceeding ten million dollars in any single year.

b. Businesses Affected

Businesses potentially affected by the proposed regulation include manufacturers of ASTs and vapor recovery equipment, contractors servicing and installing ASTs and vapor recovery equipment, and owners and operators of GDFs with ASTs.

c. Vapor Recovery Equipment Manufacturers

The proposed regulation will impose additional certification costs on manufacturers of ASTs and vapor recovery equipment. These costs were discussed in the cost effectiveness section and are included in the cost of vapor recovery equipment. Costs for development of AST vapor recovery equipment to meet the new performance standards are minimal because the technologies are commercially available. Equipment unique to ASTs, such as leak-tight emergency vents, is also already commercially available. Staff does not expect the proposed regulation to cause a noticeable adverse impact on the affected manufacturers.

d. Vapor Recovery Equipment Distributors and Contractors

Contractors will potentially benefit from staff's proposal. Contractors will experience an increase in demand for their services, as manufacturers require certification testing and GDFs require installation and testing of EVR equipment.

e. Owners and Operators of Gasoline Dispensing Facilities

Gasoline dispensing facilities with ASTs are the main focus of the proposed regulation. Owners and operators of GDFs with ASTs would be required to retrofit, upgrade, and/or install EVR systems based on their current equipment and District rule requirements. Based on ARB's Fuel Carrier survey, there are 9,582 ASTs dispensing gasoline to vehicles in California. Of these 9,582 ASTs, 2,433 are exempt from vapor recovery requirements per District rules. The new requirements are expected to impose additional costs on the remaining 7,149 ASTs. The annualized cost ranges from $12 to $1,148 per tank.

f. Potential Impact on Retail Consumers

A typical retail service station has throughputs exceeding 100,000 gallons per month, but most ASTs are used to fuel farm vehicles or fleets (utilities, government, etc.). Most ASTs have throughputs far less than retail service stations. Therefore, the effects from this proposal have a minimal effect on the general public. However, businesses affected by the proposal may pass on costs to the customer by increasing the price per gallon of gasoline dispensed. Staff calculates an annualized cost increase of approximately $0.10 per gallon for ASTs with 1,000 gallons per month throughput to offset the "worst case" scenario of $1,148 annually per tank. This cost could be passed on to the consumer. Non-retail GDFs such as those used on farms are discussed in section VI of this report

g. Potential Impact on Business Competitiveness

The proposed regulation would have no significant impact on the ability of California manufacturers to compete with manufacturers of similar products in other states. All EVR equipment manufactured for sale in California is subject to the proposed regulation regardless of origin. Most EVR manufacturers are located outside of California although some may have facilities within the State. Out of a total 62 manufacturers of AST measuring and dispensing equipment, only 15 were located in California in 2002 according to the U.S. Census Bureau.

h. Potential Impact on Employment

California accounts for only a small share of the manufacturing employment for EVR equipment. According to the U.S. Census Bureau, California employment in the industry (NAICS 333911 or SIC 3586) was 352 in 2002, or about 9.6 percent of the national employment for establishments primarily involved in manufacturing measurement and dispensing pumps, such as gasoline pumps and lubricating oil measuring and dispensing pumps. This represents only 0.02 percent of the total manufacturing jobs in California. These employees from the 15 establishments in California generated approximately $27 million in payroll. Six establishments had more than 20 employees and the other nine establishments have fewer than 20 employees. The proposed regulation is unlikely to cause a noticeable change in employment for EVR manufacturers because they are likely to pass on the majority of the cost increase to GDF owners and operators.

Contractors that install and maintain vapor recovery systems may benefit from Staff's proposed regulation as demand could potentially increase for these contractor's services, resulting in an employment increase for that sector.

i. Potential Impact on Business Creation, Elimination, or Expansion

The proposed regulation is not expected to have a significant impact on the status of California businesses. Most manufacturers are likely to pass on the majority of cost increases to GDF owners and operators. Some operators of GDFs with ASTs may reassess whether the cost increase is justified for continued operation.

GDF owners and operators in the small business sector may lack the financial resources to install EVR systems within a timely basis. Grants and low-interest loans for EVR installations and retrofits available under the Replacement and Removal of Underground Storage Tank (RUST) program are not available for ASTs. The State of California offers information on loan programs for small businesses at: http://www.commerce.ca.gov/state/ttca/ttca_homepage.jsp.

The proposed regulation may result in the creation of some business opportunities in California by potentially increasing the demand for contractor services to install and maintain vapor recovery equipment. As a result, some existing businesses may expand, and some new businesses may be created to meet the increased demand for installation, retrofitting, and maintenance of EVR equipment.

j. Potential Impacts to California State and Local Agencies

Staff does not expect a substantial adverse impact on local Districts. ARB will continue to conduct certification testing of EVR systems and equipment, and the Districts' roles of inspecting the in-field applications of EVR equipment will not change. However, Districts may need to undergo a new rulemaking to require Standing Loss Control requirements. This will require additional District staff time and resources to evaluate current rules, potentially amend those rules, and conduct public workshops prior to local Board hearings.

Additionally, California State and local agencies with AST GDFs, such as the California Highway Patrol, local fire districts, and school districts, will incur costs to retrofit and/or install EVR systems and equipment to meet the new performance standards. The annualized costs of ASTs for these agencies will range from $12 to $1,148.

C. Environmental Justice Impacts

The ARB is required to evaluate community impacts of proposed regulations including environmental justice concerns. Because some communities experience higher exposure to toxic pollutants, it is a priority of ARB to ensure that full protection is afforded to all Californians. The proposed AST EVR regulation is not expected to result in significant negative impacts in any community. The proposed regulation is designed to reduce emissions of ROG in mostly rural areas of California. This has the effect of reducing exposure of gasoline vapors containing benzene, a toxic air contaminant, to farm labor working near ASTs.

VI. IMPACTS ON AGRICULTURE

This section summarizes the impacts the proposed regulation is anticipated to have on agricultural operations. It includes a discussion of the background, applicability, and costs associated with the proposed regulation with respect to agriculture, specifically.

A. Background

The California Health and Safety Code (HSC) provide exemptions from vapor recovery requirements for stationary storage tanks used primarily for the fueling of "implements of husbandry" (HSC section 41950(e)). The HSC defined implements of husbandry by reference to their definitions in the California Vehicle Code (HSC section 39034 and Vehicle Code section 36000, et. seq.). The Vehicle Code's basic definition says that an implement of husbandry is a vehicle which is used exclusively in conduct of agricultural operations. Specific examples of implements of husbandry in the Vehicle Code include tractors, harvesters, and other vehicles involved in the cultivation of crops and breeding and raising of livestock. Aboveground Storage Tanks (AST) used for fueling implements of husbandry are considered agricultural sources of air pollution, specifically hydrocarbon emissions. These ASTs are typically located in remote areas far from gasoline dispensing facilities and fuel off-road farm equipment. There are approximately 6,400 agricultural ASTs in California identified in the 2004 fuel carrier survey.

B. Applicability to Agricultural Sources

Air pollution control and air quality management district rules specify requirements for vapor recovery for stationary gasoline tanks. Most District rules include exemption criteria for Phase I and Phase II vapor recovery for ASTs used primarily for fueling implements of husbandry. For example, San Joaquin Valley Air Pollution Control District (SJVAPCD) rules exempt agricultural ASTs used exclusively for fueling implements of husbandry less than or equal to 550 gallons that operate with a permanent submerged fill pipe from Phase I requirements. The SJVAPCD also exempts tanks from Phase II requirements based on installation date and gasoline throughput. Under District rules, most ASTs that do not meet the exemption criteria are required to have only Phase I vapor recovery equipment. Larger tanks with higher throughputs are required to have Phase I and Phase II vapor recovery systems.

Historically, ASTs used in agricultural operations have been exempted by state law from District permit requirements; however, with the passage of Senate Bill 700 (Florez, 2003) agricultural sources of air pollution, including stationary gasoline storage tanks, are no longer exempt from district permits. Currently ASTs used in agricultural operations that do not meet district rule exemption criteria would be required to have currently certified Phase I and Phase II vapor recovery systems. The district's size and throughput exemptions would remain in force, unless changed through a district rulemaking. District rules may now require permits for ASTs as well.

C. Agricultural Costs

Agricultural stakeholders are concerned that retrofitting and upgrading existing ASTs with vapor recovery equipment certified to the performance standards and specifications proposed in the Certification Procedure will be cost prohibitive. The cost associated with the proposed regulation is shown in the Environmental and Economic Impact, Section V, of the staff report. The typical configurations of agricultural ASTs and their associated cost and cost effectiveness are summarized in Table VI-1. Most agricultural ASTs operating in California are single wall and/or exempt from Phase II vapor recovery in District rules. Aboveground Storage Tanks that are exempt from District rules (2,394) are expected to remain exempt. A large number of single wall ASTs (3,383) that are not in compliance with District rules (No Vapor Recovery, or No VR) will be required to install Standing Loss Control (SLC) and a Phase I EVR system under this proposal. The last category represents single wall ASTs (1,610) that are in compliance with District rules and will be required to install SLC and upgrade to Phase I EVR system under this proposal.

Table VI-1
Cost and Cost Effectiveness of Agricultural ASTs

Single Wall AST	Total Lifetime Cost ($) per tank	Annualized Cost ($) per tank	Cost Effectiveness* ($/lbs)
Exempt	$0	$0	--
No VR to SLC and Phase I EVR	$6,650	$640	$2.48
Phase I to SLC and Phase I EVR	$2,000	$192	$0.74

*does not include gasoline cost savings

Many ASTs used in agricultural operations do not currently have vapor recovery systems installed. District rules require vapor recovery systems on permitted and non-permitted ASTs that do not meet District exemption requirements. ASTs that are exempt from District rules will not be required to have EVR systems unless the District changes their exemption criteria. The cost of the proposed regulation varies depending on the current configuration of the AST.

D. Impact of Proposed Standard

ARB staff recommends existing agricultural ASTs that are not exempt by District rule be required to retrofit to meet a minimum Standing Loss Control level of 2.26 lbs./1000 gallons/day. Staff recommends new agricultural tanks meet a minimum Standing Loss Control level of 0.57 lbs./1000 gallons/day. Phase I EVR and Phase II EVR systems may also be required based on District rules; however, staff is not recommending the expansion of District rules for Phase I and Phase II applicability.

VII. ALTERNATIVES

In accordance with Government Code Section 11346.5, subdivision (a)(13), ARB must determine that no reasonable alternative it considered or that has been identified would be more effective or as effective and less burdensome to affected private persons than the proposal for carrying out the purpose of the proposal. This section discusses alternatives to the proposal.

A. Tank Pressure Management

An alternative to staff's proposal is to adopt certification and test procedures specifically designed for ASTs that incorporate performance standards and specifications that could reduce emissions up to 2.98 tons per day by reducing the leak rates and managing tank pressure. This alternative would include the inclusion of a Phase II negative pressure requirement and necessitate the use of a vapor processor and the annual cost per tank would be approximately $2,478. This does not include the cost of securing and use of electricity to operate the processor. Table VII-1 compares this alternative to staff's proposal.

Table VII-1
Comparison of Tank Pressure Management Alternative to Staff Proposal

	Emission Reductions (TPD)	Cost Effectiveness ($/lbs.)
Alternative	2.98	$8.14
Staff Proposal	1.98	$1.47

B. 0.57 lbs./1000 gallons/day Standing Loss Control Level (90 percent)

An alternative to staff's proposed regulation is to adopt certification and test procedures for retrofitting existing ASTs to a Standing Loss Control level of 0.57 lbs/1000 gallons/day. Under this alternative, Phase I EVR and Phase II EVR performance standards and specifications will be incorporated into the proposed regulation to ensure vapor recovery system durability and consistency. This alternative will reduce standing loss emissions up to 2.65 TPD and transfer emissions by 0.21 TPD. The total emission reductions for this alternative will be 2.86 TPD compared to 1.98 TPD for staff's proposal. Control technologies such as foam insulation along with a P/V relief valve can achieve this level of emission reduction and can be used to retrofit existing ASTs. The retrofit cost of insulating an AST with foam type material depends on several factors, including the tank condition, location, number of tanks on site, and preparation (e.g. sandblasting, pre-coating, two-component mixing, overspray) of the AST as well as the area surrounding the AST (e.g. environmental conditions, geography, physical obstructions, power supply). These variables were discussed at a meeting between ARB, agricultural stakeholders, and foam insulation contractors in Fresno, California in March 2007. Due to these variables, many foam insulation contractors are unable to estimate the cost and are unwilling to provide cost estimates to retrofit existing ASTs in the field. Agricultural stakeholders have also expressed concerns that this technology has not been durability tested and may be cost prohibitive because of the variables that affect the retrofit cost. Staff does not recommend this alternative because of the high degree of uncertainty of the cost.

C. 1.34 lbs/1000 gallons/day Standing Loss Control Level (76 percent)

An alternative to staff's proposed regulation is to adopt certification and test procedures for retrofitting existing ASTs to Standing Loss Control of 1.34 lbs/1000 gallons/day. Under this alternative, Phase I EVR and Phase II EVR performance standards and specifications would be incorporated into the proposed regulation to ensure vapor recovery system durability and consistency. This alternative will reduce standing loss emissions up to 2.24 TPD of ROG and transfer emissions by 0.21 TPD of ROG. The total emission reductions for this alternative will be 2.45 TPD of ROG. The annual cost per tank associated with this alternative will be $377. Control technologies used to achieve this level of emission reduction include passive purge carbon canisters. Carbon canisters mounted on the top of an AST vent are open to the atmosphere to allow air to flow in and out resulting in the capture of hydrocarbons on the carbon and the purge of hydrocarbons back into the AST. A majority of ASTs are used in agricultural operations. Under these environmental conditions dust and debris may restrict the airflow through the carbon canister. Staff has no information on how the carbon canister will perform over 15 years (assumed lifetime used in cost effectiveness calculations) under these environmental conditions. Routine inspections and maintenance may be required to achieve maximum performance potentially driving up the cost of this control technology. Districts have expressed concerns related to the proper operation of this technology based on experiences with carbon canisters in other applications. Cost of in-use compliance of carbon canisters is unknown and could substantially affect the viability of this alternative. Staff will monitor the progress of this technology if stakeholders choose the optional level for existing installations to take advantage of emission credits. Table VII-2 compares this alternative to staff's proposal. While this option has reasonable cost effectiveness, there are significant stakeholder and staff concerns about the long term effectiveness of the carbon canister in this environment and cost of in-use compliance. Staff is not recommending this alternative.

Table VII-2
Comparison of 1.34 lbs/1000 gallons/day Standing Loss Control Alternative to Staff Proposal

	Emission Reductions (TPD)	Cost Effectiveness ($/lbs.)
Alternative	2.45	$1.68
Staff Proposal	1.98	$1.47

D. No Adoption of Proposed Standard

Staff has considered this option. Without the adoption of the proposed regulation, some emission reductions may be achieved as Districts enforce current rules on ASTs used in agricultural operations. A majority of these tanks have not been permitted, and thus not inspected for compliance with District rules. The passing of Senate Bill 700 (Florez, 2003) gave Districts the authority to permit tanks used in agricultural operations. With more resources available to enforce District rules, it is estimated that an additional 4,032 tanks would be required to have Phase I vapor recovery systems installed. These tanks already are required to have vapor recovery per District rule, but are not likely in compliance. The annual cost for this alternative will be $448 with associated emission reductions of approximately 0.13 TPD, if 100 percent compliance with District rules is assumed. Table VII-3 compares this alternative to staff's proposal. Staff does not recommend this alternative because it is not reduce significant emissions and is not cost effective.

Table VII-3
Comparison of No Adoption Alternative to Staff Proposal

	Emission Reductions (TPD)	Cost Effectiveness ($/lbs.)
Alternative	0.13	$17.02
Staff Proposal	1.98	$1.47

E. Staff Proposal

Staff recommends that its proposal be adopted, since it is cost effective as compared to recently adopted regulations, achieves substantial emission reductions, and is amenable to industry and agricultural stakeholders. In addition, the advances made in the EVR systems for the UST program appear to be transferable to this program making components for ASTs more durable. Since EVR equipment is being certified for UST programs it would also be appropriate to keep the EVR standards and specifications similar for the AST program.

VIII. OUTSTANDING ISSUES

This section discusses issues associated with the proposed regulation and is intended to clarify staff's recommendation.

A. Cost of AST EVR Proposal

Stakeholders from the retailer to agricultural sectors have expressed concerns with the cost of the proposal. These stakeholders indicate that it would be difficult to pass through any significant increase in cost and still remain competitive. Raising the necessary capital to retrofit and/or install new EVR equipment has also been identified as an issue. In Section V, Staff estimated the annualized cost of the proposed regulation would be as much as $1,148 per tank, based on a tank that is single wall with no vapor recovery that would be required to retrofit with Standing Loss Control equipment and install Phase I and Phase II EVR systems (Appendix J). The cost effectiveness of the proposed regulation is $1.87 per pound of ROG emission reduction, which compares favorably with other control measures recently adopted by the Board. This does not include gasoline cost savings which is approximately $0.40 per pound of gasoline saved. The net cost effectiveness of the proposed regulation including the cost saving from gasoline is approximately $1.47 per pound of ROG.

B. Applicability of Bulk Plants/Terminals

The AST proposed regulation (CP-206) will not apply to bulk plants and terminals. At multiple workshops there was some confusion whether the proposed regulation would affect bulk plants and terminals. Bulk plants are intermediate gasoline distribution facilities that receive and deliver gasoline via cargo trucks. Terminals are primary distribution facilities for the loading of cargo trucks that deliver gasoline to bulk plants, service stations, and other distribution points. ARB certifies bulk plants under CP-202, *Certification for Vapor Recovery Systems of Bulk Plants*, and certified terminals under CP-203, *Certification of Vapor Recovery Systems of Terminals*. The bulk plant and terminal certification testing determine whether the transfer efficiencies to and from the cargo tank meet the performance standards and specifications. Some bulk plants and terminals have dispensers that refuel motor vehicles. The refueling is done with fuel stored in bulk plant tanks which may be underground or aboveground storage tanks. Districts have adopted rules requiring such bulk plants and terminals to install Phase II vapor recovery systems. Currently, staff is considering a new rulemaking for bulk plants to incorporate Phase II system certification into CP-202. There are currently no plans to incorporate Phase II system certification for terminals into CP-203.

C. Availability of Electricity for ASTs in Remote Areas

Electricity is not available in remote areas and bringing in electricity would be a substantial cost. Electricity is needed to operate certain Phase II systems, especially those that are equipped with processors or are vacuum assist. Staff understands that significant cost would be incurred with bringing electricity to remote areas and recommends using Standing Loss Control technologies that use no electricity instead of more costly and electricity dependent vapor recovery systems. Districts are also in a better place to determine on a case-by-case basis whether vapor recovery is needed for certain areas. Any cost with bringing electricity into remote areas would be considered by Districts in their rulemaking.

D. District Permitting Costs

Staff recognizes that there are additional District permitting costs associated with the installation, retrofitting, and operation of GDF with ASTs. Stakeholders have stated that District permitting costs should be incorporated into the cost analysis sections of the proposed regulation. Staff has surveyed the District permitting costs and has summarized these costs from four Districts in Table VIII-1.

Table VIII-1
District AST Permitting Fees

District	Authority to Construct	Permit to Operate
San Joaquin Valley APCD	$60	$28/nozzle
Sacramento Metropolitan AQMD	$600	$85/nozzle
Siskiyou County APCD	$200	$90 (if < 10 dispensers)
Shasta County APCD	$75	$30 (if < 50,000 gallons throughput

Based on the District permitting cost survey, the permitting costs are small in comparison to the costs of compliance and do not significantly change the cost effectiveness of the proposed regulation.

E. Certification of Paint

Agricultural stakeholders expressed a concern about the certification of paint for the control of standing loss emissions. White paint is available in many retail facilities with a wide range of reflective properties. Stakeholders requested ARB certify the paint used during the field study for retrofitting existing ASTs. The HSC requires ARB to test, or contract for testing, gasoline vapor recovery systems for the purpose of determining whether those systems may be certified. At the time of the field study no certification and/or test procedures were adopted for the certification of paint as a Standing Loss Control technology. Staff recommends that paint be certified after the adoption of the proposed regulation, in accordance with State law and the administrative requirements in CP-206. White paint will be tested using proposed TP-206.1 for a minimum duration of 30 days.

IX. CONCLUSION AND RECOMMENDATION

The staff's goal is to achieve ROG emission reductions using technologies that are technically feasible and cost effective. The emissions from dispensing facilities using ASTs are significant and can be further reduced. ASTs are the only part of the gasoline dispensing facility that has not already been brought up to EVR performance standards and specifications. Staff believes that the proposed regulation is achievable using current vapor recovery control technologies and incorporating new technologies that can control standing loss emissions. The proposed regulations will help make progress toward achieving the ozone ambient air quality standard.

Staff recommends that the Board approve the proposed regulation to adopt Sections 94016 and 94168, and amend Sections 94010 and 94011, Title 17, California Code of Regulations. This would incorporate by reference changes to D-200, *Definitions for Vapor Recovery Procedures* and TP-201.2, *Efficiency and Emission Factor for Phase II Systems*, add a new certification procedure for aboveground storage tanks, CP-206, *Certification Procedures for Vapor Recovery Systems for Gasoline Dispensing Facilities Using Aboveground Storage Tanks*, and add three new test procedures, TP-206.1, *Determination of Emission Factor for Standing Loss Control Vapor Recovery Systems Using Temperature Attenuation Factor at Gasoline Dispensing Facilities with Aboveground Storage Tanks*, TP-206.2, *Determination of Emission Factor for Standing Loss Control Vapor Recovery Systems Using Processors at Gasoline Dispensing Facilities with Aboveground Storage Tanks*, and TP-206.3, *Determination of Static Pressure Performance of Vapor Recovery Systems at Gasoline Dispensing Facilities with Aboveground Storage Tanks*.

X. REFERENCES

1 "STAFF REPORT: Enhanced Vapor Recovery Technology Review and Proposed Amendments of Vapor Recovery System Certification and Test Procedures for Gasoline Marketing Operations at Service Stations," October 25, 2002

2. "STAFF REPORT: Enhanced Vapor Recovery Certification and Testing Procedures for Gasoline Loading and Motor Vehicle Gasoline Refueling at Service Stations," February 4, 2000

3. "CP-201: Certification Procedure for Vapor Recovery Systems at Gasoline Dispensing Facilities," Amended May 25, 2006

4. "CP-205: Certification Procedures for Vapor Recovery Systems at Novel Facilities," Amended March 17, 1999

5. "San Joaquin Valley Air Pollution Control District – Rule 4621," Amended June 18, 1998

6. "San Joaquin Valley Air Pollution Control District – Rule 4622," Amended September 19, 2002

7. "1994 California State Implementation Plan Volume I: Overview of the California Ozone SIP," Approved September 25, 1996

8. "Air Resources Board's Proposed State Strategy for California's 2007 State Implementation Plan, Section 4 – Proposed New SIP measures, page 108." Released January 31, 2007

9. Senate Bill 700 (Florez, 2003)

10. "TP-201.3B: Determination of Static Pressure Performance of Vapor Recovery Systems at Gasoline Dispensing Facilities with Aboveground Storage Tanks," Adopted April 12, 1996

11. MLD survey of companies who supply gasoline fuel to owners of ASTs across the state, 2004 (Included in ISOR as Appendix H)

12. MLD survey of local air districts for data on permitted ASTs, 2006 (Included in ISOR as Appendix H)

13. Temperature response data of fuel temperature in ASTs to changing ambient temperatures (attenuation factors) from several MLD tests (Included in ISOR as Appendix I)

14. Evaporation rates of fuel for open AST systems (tanks without any pressure/vacuum valve) from several MLD tests (Included in ISOR as Appendix D)

15. Monthly average ambient temperatures for 15 California cities from U.S. EPA's AP-42 methodology (Included in ISOR as Appendix I)

16. AST emissions equation model from U.S. EPA's AP-42 (Included in ISOR as Appendix I)

XI. APPENDIX

Appendix A. **Vapor Recovery Health and Safety Code Statute, Division 26, Section 41954**

Appendix B. **Proposed Amendments of the California Code of Regulations**

Appendix C. **District Rule Vapor Recovery Applicability Summary**

Appendix D. **Test Report for Control Technology Feasibility Study on Aboveground Storage Tanks**

Appendix E. **Summary of Aboveground Storage Tank Pressure Decay and Efficiency Testing**

Appendix F. **Proposed Amendments of the Vapor Recovery Definitions, Certification, and Test Procedures for Aboveground Storage Tanks**

Appendix G. **Temperature Attenuation Field Study Correlation**

Appendix H. **AST Population Survey**

Appendix I. **AST Emission Inventory**

Appendix J. **Cost Analysis**

APPENDIX A
Vapor Recovery Health and Safety Code

SECTION 41954

(a) The state board shall adopt procedures for determining the compliance of any system designed for the control of gasoline vapor emissions during gasoline marketing operations, including storage and transfer operations, with performance standards that are reasonable and necessary to achieve or maintain any applicable ambient air quality standard.

(b) The state board shall, after a public hearing, adopt additional performance standards that are reasonable and necessary to ensure that systems for the control of gasoline vapors resulting from motor vehicle fueling operations do not cause excessive gasoline liquid spillage and excessive evaporative emissions from liquid retained in the dispensing nozzle or vapor return hose between refueling events, when used in a proper manner. To the maximum extent practicable, the additional performance standards shall allow flexibility in the design of gasoline vapor recovery systems and their components.

(c) (1) The state board shall certify, in cooperation with the districts, only those gasoline vapor control systems that it determines will meet the following requirements, if properly installed and maintained:

(A) The systems will meet the requirements of subdivision (a).

(B) With respect to any system designed to control gasoline vapors during vehicle refueling, that system, based on an engineering evaluation of that system's component qualities, design, and test performance, can be expected, with a high degree of certainty, to comply with that system's certification conditions over the warranty period specified by the board.

(C) With respect to any system designed to control gasoline vapors during vehicle refueling, that system shall be compatible with vehicles equipped with onboard refueling vapor recovery (ORVR) systems.

(2) The state board shall enumerate the specifications used for issuing the certification. After a system has been certified, if circumstances beyond the control of the state board cause the system to no longer meet the required specifications or standards, the state board shall revoke or modify the certification.

(d) The state board shall test, or contract for testing, gasoline vapor control systems for the purpose of determining whether those systems may be certified.

(e) The state board shall charge a reasonable fee for certification, not to exceed its actual costs therefor. Payment of the fee shall be a condition of certification.

(f) No person shall offer for sale, sell, or install any new or rebuilt gasoline vapor control system, or any component of the system, unless the system or component has been certified by the state board and is clearly identified by a permanent identification of the certified manufacturer or rebuilder.

(g) (1) Except as authorized by other provisions of law and except as provided in this subdivision, no district may adopt, after July 1, 1995, stricter procedures or performance standards than those adopted by the state board pursuant to subdivision (a), and no district may enforce any of those stricter procedures or performance standards.

(2) Any stricter procedures or performance standards shall not require the retrofitting, removal, or replacement of any existing system, which is installed and operating in compliance with applicable requirements, within four years from the effective date of those procedures or performance standards, except that existing requirements for retrofitting, removal, or replacement of nozzles with nozzles containing vapor-check valves may be enforced commencing July 1, 1998.

(3) Any stricter procedures or performance standards shall not be implemented until at least two systems meeting the stricter performance standards have been certified by the state board.

(4) If the certification of a gasoline vapor control system, or a component thereof, is revoked or modified, no district shall require a currently installed system, or component thereof, to be removed for a period of four years from the date of revocation or modification.

(h) No district shall require the use of test procedures for testing the performance of a gasoline vapor control system unless those test procedures have been adopted by the state board or have been determined by the state board to be equivalent to those adopted by the state board, except that test procedures used by a district prior to January 1, 1996, may continue to be used until January 1, 1998, without state board approval.

(i) With respect to those vapor control systems subject to certification by the state board, there shall be no criminal or civil proceedings commenced or maintained for failure to comply with any statute, rule, or regulation requiring a specified vapor recovery efficiency if the vapor control equipment which has been installed to comply with applicable vapor recovery requirements meets both of the following requirements:

(1) Has been certified by the state board at an efficiency or emission factor required by applicable statutes, rules, or regulations.

(2) Is installed, operated, and maintained in accordance with the requirements set forth in the document certification and the instructions of the equipment manufacturer.

APPENDIX B
Proposed Amendments of the California Code of Regulations

PROPOSED REGULATION ORDER

Note: ~~Strikeout~~ indicates deleted text; underline indicates inserted text.

Amend Sections 94010 and 94011, Article 1, Subchapter 8, Chapter 1, Division 3, Title 17, California Code of Regulations to read as follows:

§ 94010. Definitions.

The definitions of common terms and acronyms used in the certification and test procedures specified in Sections 94011, 94012, 94013, 94014, ~~and~~ 94015, and 94016 are listed in D-200, "Definitions for Vapor Recovery Procedures", adopted April 12, 1996, as last amended ~~May 25, 2006~~ [insert date of last amendment], which are incorporated herein by reference.

NOTE: Authority cited: Sections 39600, 39601, 39607 and 41954, Health and Safety Code. Reference: Sections 25290.1.2, 39515, 41954, 41959, 41960 and 41960.2, Health and Safety Code.

§ 94011. Certification of Vapor Recovery Systems of Dispensing Facilities.

The certification of gasoline vapor recovery systems at dispensing facilities (service stations) shall be accomplished in accordance with the Air Resources Board's CP-201, "Certification Procedure for Vapor Recovery Systems at Gasoline Dispensing Facilities" which is herein incorporated by reference. (Adopted: December 9, 1975, as last amended May 25, 2006).

The following test procedures (TP) cited in CP-201 are also incorporated by reference.

TP-201.1 – "Volumetric Efficiency for Phase I Systems" (Adopted: April 12, 1996, as last amended October 8, 2003)

TP-201.1A – "Emission Factor For Phase I Systems at Dispensing Facilities" (Adopted: April 12, 1996, as last amended February 1, 2001)

TP-201.1B – "Static Torque of Rotatable Phase I Adaptors" (Adopted: July 3, 2002, as last amended October 8, 2003)

TP-201.1C – “Leak Rate of Drop Tube/Drain Valve Assembly” (Adopted: July 3, 2002, as last amended October 8, 2003)

TP-201.1D – “Leak Rate of Drop Tube Overfill Prevention Devices” (Adopted: February 1, 2001, as last amended October 8, 2003)

TP-201.1E – “Leak Rate and Cracking Pressure of Pressure/Vacuum Vent Valves” (Adopted: October 8, 2003)

TP-201.1E CERT – “Leak Rate and Cracking Pressure of Pressure/Vacuum Vent Valves” (Adopted: May 25, 2006)

TP-201.2 – “Efficiency and Emission Factor for Phase II Systems” (Adopted: April 12, 1996, as last amended ~~October 8, 2003~~ [insert date of last amendment])

TP-201.2A – “Determination of Vehicle Matrix for Phase II Systems” (Adopted: April 12, 1996, as last amended February 1, 2001)

TP-201.2B – “Flow and Pressure Measurement of Vapor Recovery Equipment” (Adopted: April 12, 1996, as last amended October 8, 2003)

TP-201.2C – “Spillage from Phase II Systems” (Adopted: April 12, 1996, as last amended February 1, 2001)

TP-201.2D – “Post-Fueling Drips from Nozzle Spouts” (Adopted: February 1, 2001, as last amended October 8, 2003)

TP-201.2E – “Gasoline Liquid Retention in Nozzles and Hoses” (Adopted: February 1, 2001)

TP-201.2F – “Pressure-Related Fugitive Emissions” (Adopted: February 1, 2001, as last amended October 8, 2003)

TP-201.2G – “Bend Radius Determination for Underground Storage Tank Vapor Recovery Components” (Adopted: October 8, 2003, as last amended May 25, 2006)

TP-201.2H – “Determination of Hazardous Air Pollutants from Vapor Recovery Processors” (Adopted: February 1, 2001)

TP-201.2I – “Test Procedure for In-Station Diagnostic Systems” (Adopted: October 8, 2003, as last amended May 25, 2006)

TP-201.2J – “Pressure Drop Bench Testing of Vapor Recovery Components” (Adopted: October 8, 2003)

TP-201.3 – “Determination of 2 Inch WC Static Pressure Performance of Vapor Recovery Systems of Dispensing Facilities” (Adopted: April 12, 1996, as last amended March 17, 1999)

TP-201.3A – “Determination of 5 Inch WC Static Pressure Performance of Vapor Recovery Systems of Dispensing Facilities” (Adopted: April 12, 1996)

TP-201.3B – "Determination of Static Pressure Performance of Vapor Recovery Systems of Dispensing Facilities with Above-Ground Storage Tanks" (Adopted: April 12, 1996)

TP-201.3C – “Determination of Vapor Piping Connections to Underground Gasoline Storage Tanks (Tie-Tank Test)” (Adopted: March 17, 1999)

TP-201.4 – “Dynamic Back Pressure” (Adopted: April 12, 1996, as last amended July 3, 2002)

TP-201.5 – “Air to Liquid Volume Ratio” (Adopted: April 12, 1996, as last amended February 1, 2001)

TP-201.6 – “Determination of Liquid Removal of Phase II Vapor Recovery Systems of Dispensing Facilities” (Adopted: April 12, 1996, as last amended April 28, 2000)

TP-201.6C – "Compliance Determination of Liquid Removal Rate" (Adopted: July 3, 2002)

TP-201.7 – “Continuous Pressure Monitoring” (Adopted: October 8, 2003)

NOTE: Authority cited: Sections 25290.1.2, 39600, 39601, 39607 and 41954, Health and Safety Code. Reference: Sections 25290.1.2, 39515, 41952, 41954, 41956.1, 41959, 41960 and 41960.2, Health and Safety Code.

Adopt new Section 94016, Article 1, Subchapter 8, Chapter 1, Division 3, Title 17, California Code of Regulations to read as follows:

<u>§ 94016. Certification of Vapor Recovery Systems at Gasoline Dispensing Facilities Using Aboveground Storage Tanks</u>

The certification of gasoline vapor recovery systems at dispensing facilities using aboveground storage tanks shall be accomplished in accordance with the Air Resources Board's CP-206, "Certification Procedure for Vapor Recovery Systems at Gasoline Dispensing Facilities Using Aboveground Storage Tanks," adopted [insert adoption date], which is herein incorporated by reference.

The following test procedures (TP) cited in CP-206 are also incorporated by reference.

> TP-206.1 – "Determination of Emission Factor for Standing Loss Control Vapor Recovery Systems Using Temperature Attenuation Factor at Gasoline Dispensing Facilities with Aboveground Storage Tanks" (Adopted: [insert adoption date])
>
> TP-206.2 – "Determination of Emission Factor for Standing Loss Control Vapor Recovery Systems Using Processors at Gasoline Dispensing Facilities with Aboveground Storage Tanks" (Adopted: [insert adoption date])
>
> TP-206.3 – "Determination of Static Pressure Performance of Vapor Recovery Systems at Gasoline Dispensing Facilities with Aboveground Storage Tanks" (Adopted: [insert adoption date]).

The following certification and test procedures cited in certification procedure CP-206 and adopted in section 94011 by incorporation by reference are also incorporated by reference herein: CP-201, TP-201.1, TP-201.1A, TP-201.1B, TP-201.1C, TP-201.1D, TP-201.1E, TP-201.1E CERT, TP-201.2, TP-201.2A, TP-201.2B, TP-201.2C, TP-201.2D, TP-201.2E, TP-201.2H, TP-201.2I, TP-201.2J, TP-201.4, TP-201.5, TP-201.6, and TP-201.7.

Note: Authority cited: Sections 39600, 39601, 39607, and 41954, Health and Safety Code. Reference: Sections 39515, 39605, 41954, 41956.1, 41959, 41960 and 41960.2, Health and Safety Code.

Adopt new Section 94168, Article 2, Subchapter 8, Chapter 1, Division 3, Title 17, California Code of Regulations to read as follows:

§ 94168. Test Method for Determining the Static Pressure Performance of Phase II Vapor Recovery Systems at Gasoline Dispensing Facilities with Aboveground Storage Tanks

The test method for determining the static pressure performance of Phase II vapor recovery systems of dispensing facilities at gasoline dispensing facilities with aboveground storage tanks is adopted in Section 94016 by incorporation by reference and is set forth in the Air Resources Board's TP-206.3 "Determination of Static Pressure

Performance of Vapor Recovery Systems at Gasoline Dispensing Facilities with Aboveground Storage Tanks," which are incorporated herein by reference.

Note: Authority cited: Sections 39600, 39601, 39607, and 41954, Health and Safety Code. Reference: Section 39515, 39605, 41954, 41956.1, 41959, 41960 and 41960.2, Health and Safety Code.

APPENDIX C
DISTRICT RULE VAPOR RECOVERY APPLICABLITY SUMMARY

San Joaquin Valley APCD	Rules
Phase I (Rule 4621)	Permitted tanks: ≥ 250 gallons and <19,800 gallons
	Exemption: Agricultural tanks ≤ 550 gallons
	Exemption: tanks ≤ 2,000 installed before July 1, 1975
Phase II (Rule 4622)	Tanks < 24,000 gallons throughput/year
	Exemption: Tanks ≤ 10,000 gallon throughput/30 consecutive days
Sacramento Metropolitan AQMD	**Rules**
Phase I (Rule 448)	Permitted Tanks ≥ 250 gallons
	Exemption: Agricultural tanks
Phase II (Rule 449)	Permitted Tanks > 250 gallons
	Exemption: Agricultural tanks
South Coast AQMD	**Rules**
Phase I (Rule 461)	Permitted Tanks ≥ 250 gallons
	Exemption: Agricultural tanks used ≥ 75% until 7/1/2007
	Exemption: Agricultural Wind Machines until 7/1/2007
Phase II (rule 462)	Permitted Tanks ≥ 120 gallons
	Exemption: Agricultural tanks used ≥ 75% until 7/1/2007
	Exemption: Agricultural Wind Machines until 7/1/2007

APPENDIX D

California Environmental Protection Agency

Air Resources Board

TEST REPORT FOR CONTROL TECHNOLOGY FEASIBILITY STUDY ON ABOVEGROUND STORAGE TANKS

Engineering Development & Testing Section
Stationary Source Testing Branch
Monitoring and Laboratory Division

July 27, 2006

APPENDIX D

Draft - Test Report for Control Technology Feasibility Study on Aboveground Storage Tanks

I. Introduction

Aboveground Storage Tanks (ASTs) are used to store gasoline throughout California. These tanks are typically used in agriculture, construction, maintenance and emergency response operations. Emissions from ASTs vary depending on their type, size and configuration. A significant amount of emissions from ASTs is caused by evaporation. These losses are known as standing storage (evaporative) loss or breathing loss. Heating of the tank by the sun causes fuel to volatilize and vent to the atmosphere. These evaporative losses increase with higher temperatures. Evaporative losses from ASTs are a significant source of hydrocarbons that contribute to the formation of ozone throughout the state. However, control technology exists that can limit evaporative losses from ASTs.

Air Resources Board (ARB) staff is developing a control measure to reduce evaporative emissions from ASTs. To support this measure, Engineering Development and Testing Section (EDTS) staff conducted a field study on ASTs in summer 2005. The purpose of this study was to evaluate potential emission reductions from ASTs when retrofitted with some simple control technologies. Control technologies evaluated in various combinations include pressure relief valves, reflecting white paint, shade structure, foam insulation, and carbon canisters on various tank sizes. Different emission quantification techniques like U.S. EPA approved AP-42 methodology and gravimetric measurements were used to calculate emissions from ASTs. This report summarizes the field study testing and the staff's evaluation of the feasibility of using control technologies on ASTs. The results show that the use of these control technologies, either singly or in combination, can reduce AST evaporative losses from 43 to 97 percent.

II. Field Study Testing

Field study was conducted at a fuel distribution facility located in Firebaugh, Fresno County. Testing was done in summer (May – October) 2005, when emissions are at the highest level due to high ambient temperatures. Two identical sets of common sizes (350, 550 and 1000 gallon) ASTs were tested. Each size category included an uncontrolled tank and a test tank.

- Uncontrolled Tank: This was a fuel storage tank open to the atmosphere through a flip top cap on the vent, i.e. no control. This is also referred to as baseline or control tank and was used to measure the uncontrolled emissions.

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- <u>Test Tank:</u> This was a closed fuel storage tank retrofitted with various combinations of control technologies listed below:

    - Pressure Vacuum Vent Valve (PV Valve)
    - Reflective White Paint
    - Shade structure
    - Polyurethane Foam Insulation
    - Carbon Canister (CC)

Due to limited number of summer months with higher temperatures, it was not possible to evaluate all the controls singly or in combinations on each AST. Therefore, initial testing was done for a period of two to three weeks to evaluate simple controls like PV valve, paint and shade on all three AST sizes. PV Valve was tested by itself and paint and shade were added on incrementally. Controls like carbon canister, polyurethane foam insulation, along with other controls were tested for two to three months, till the end of summer, and were identified as the final configuration of ASTs. Carbon canister and polyurethane foam insulation were tested and evaluated for the first time on ASTs in this field study. The different control configurations tested on all three AST sizes are shown in Table 1. The detailed matrix of AST field study is shown in Attachment 1.

Table 1

Test Tank Configuration	350 Gallon AST	550 Gallon AST	1000 Gallon AST
PV	x	x	x
PV + Paint	x	x	x
PV + Paint + Shade	x	x*	x
Carbon Canister (CC)	NA	x*	NA
PV + Insulation	x*	x*	NA
PV + Paint + Shade + CC	NA	NA	x*

x* represents the final configurations that were tested for 2-3 months
NA – Not Applicable (Not Tested)

Emission Quantification techniques used in the field study:

- <u>AP-42 Methodology</u>, approved by U.S. EPA, calculates emissions based on fuel surface temperature in the tanks. AP-42 methodology can be viewed under section “Organic Liquid Storage Tanks” (Background Document) on the U.S EPA’s website at http://www.epa.gov/ttn/chief/ap42/ch07/index.html.
  However, this method applies to single wall storage tanks with some pressure setting i.e. closed systems and likely underestimates emissions from open systems (tanks with just a flip top cap on the vent).

  - o Thermocouples were used to measure the daily fuel surface temperatures and ambient temperatures. Each tank configuration was equipped with its own thermocouple.
  - o Data Loggers were used to download all the temperature data from the respective thermocouples.

- <u>Gravimetric measurement</u> measured the changes in AST fuel weight and was made using load cells. This was a direct measurement of emissions from tanks based on weight changes. Both uncontrolled and test tanks, in each size category were weighed before, during and after the test period. The difference in the weights determined the weight of gasoline emitted.
  - o Load Cells, with a capacity of 10,000 lbs., were used for weighing the tanks.
  - o Load cells were available only when tanks were tested in their final configurations.

All three size ranges of ASTs were tested in the field simultaneously. Both test and control tanks were filled with fresh gasoline before testing each control configuration. Tanks were half filled with gasoline and therefore the volume of the vapor space in the AST was equal to half of the tank size. Gasoline samples were tested in ARB laboratory to determine Reid Vapor Pressure (RVP). Most samples tested had RVP values in the range of 6-7 psi. An RVP value of 7 was used in AP-42 calculations for consistency.

III. <u>Field Study Test Results</u>

Figure 1 shows a comparison between AP-42 methodology and load cell measurements of emissions from uncontrolled tanks i.e. open systems with a flip top cap on the vent. This field study documented that AP-42 methodology underestimates emissions from uncontrolled tanks by about 40% (a factor of 1.6). An example of AP-42 method calculations is in Attachment 2. Figure 2 shows the calculated evaporative emissions, using AP-42 and Load cells, from two uncontrolled tanks. The load cell measurements indicate that the 1000 gallon uncontrolled tank lost about 32 gallons of gasoline in three months and the 350 gallon uncontrolled tank lost about 5 gallons of gasoline in two months.

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Figure 1

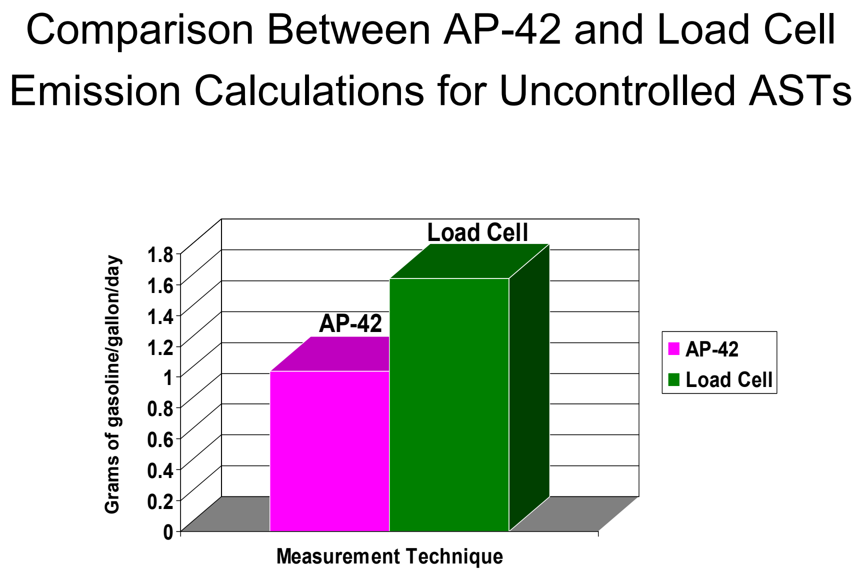
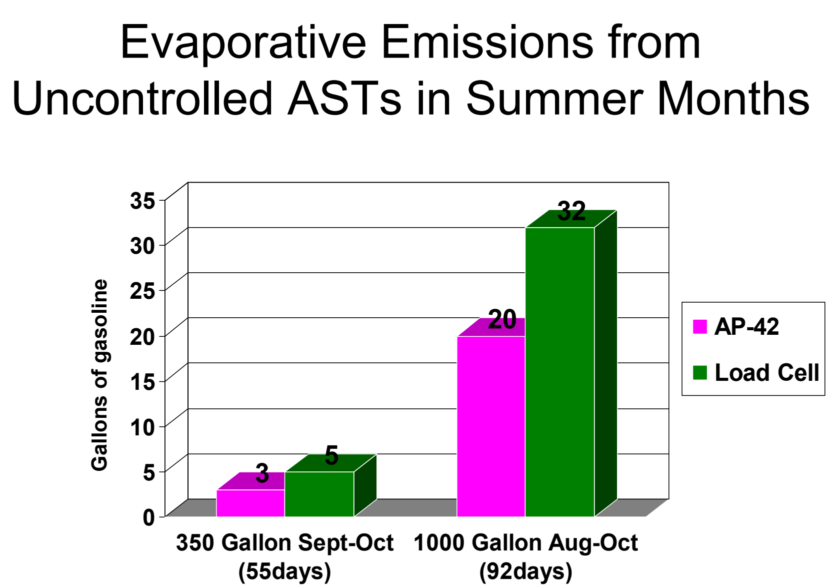


Figure 2

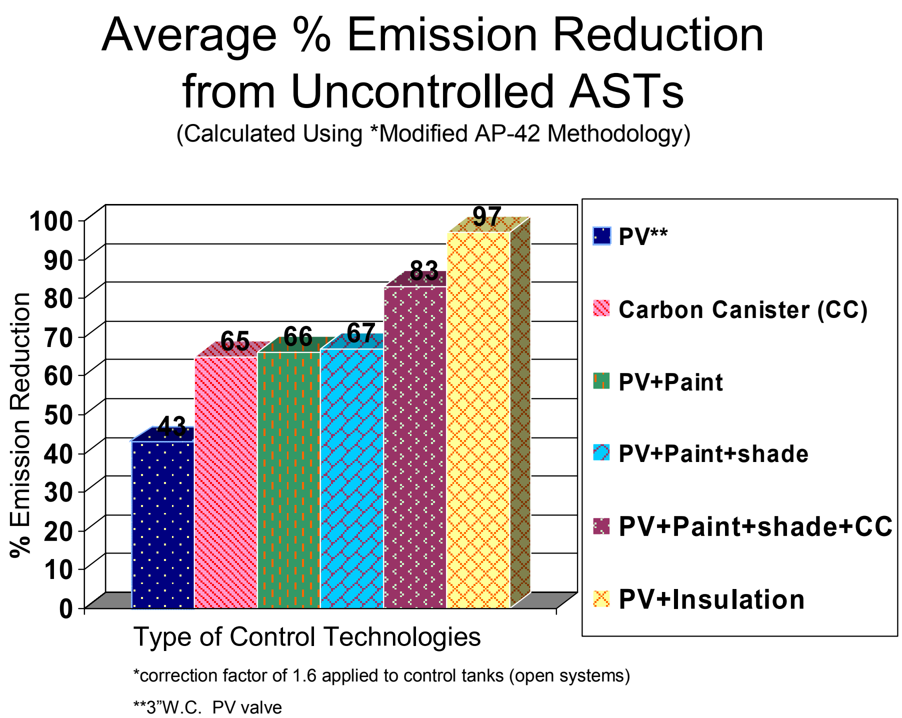


IV. Control Technologies Evaluated

Evaporative emissions from ASTs are controlled by controlling the vapor released from the tank using components such as PV valve and carbon canister and by reducing the temperature of the fuel in the tank using technologies such as white paint, shade and insulation.

Figure 3 shows the emission reduction as a percentage when compared to emissions from an uncontrolled tank. All the emission reductions achieved using different control technologies are calculated using modified AP-42 methodology, which means that a correction factor of 1.6 is applied to emissions from uncontrolled tanks.

Figure 3



PV Valve (pressure vent setting +2.5" to +3" water column and vacuum vent setting of -6" to -10" water column). This control was tested on all three tank sizes and controlled an average of 43% of the evaporative emissions as compared to an uncontrolled tank. The PV valve remains closed and keeps the vapors in the tank until the vapor pressure exceeds the pressure vent setting, causing it to open and release the vapors. It has no effect on the temperature of the fuel in the tank.

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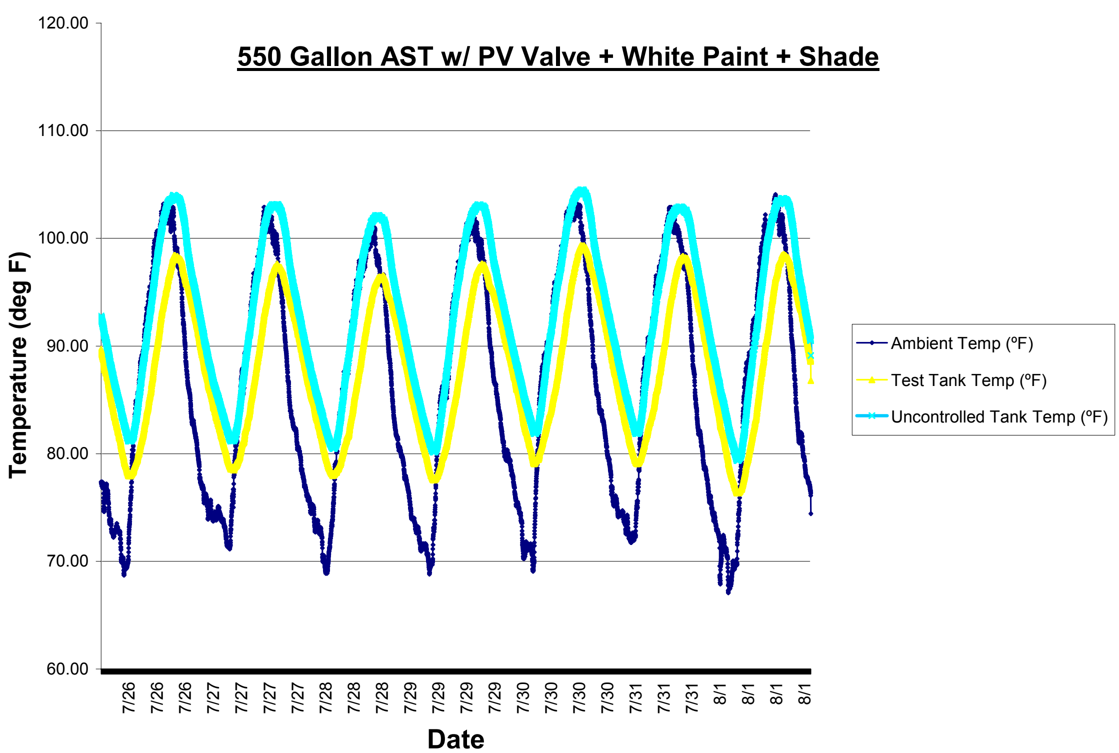
PV Valve + White Paint
This control configuration was tested on all three tank sizes and controlled an average of 66% of the evaporative emissions as compared to an uncontrolled tank. PV valve controlled the vapor release and white paint reduced the fuel surface temperature in the tank by reflecting back the direct sunlight hitting on the tank surface.

PV Valve + White Paint + Shade
This control configuration was tested on all three tank sizes and controlled an average of 67% of the evaporative emissions as compared to an uncontrolled tank. PV valve controlled the vapor release and paint and shade reduced the fuel surface temperature in the tank by reducing the impact of direct sunlight hitting on the tank surface. It appears that adding the shade structure cancelled the effect of paint on the fuel surface temperature. Therefore the percent emissions controlled with this control configuration is very similar to PV + Paint. Figure 4 shows the effect of paint and shade on fuel surface temperature in the tank. The paint and shade reduced the maximum fuel surface temperature in test tank by 5-6 ºF as compared to fuel surface temperature in the uncontrolled tank.

Figure 4



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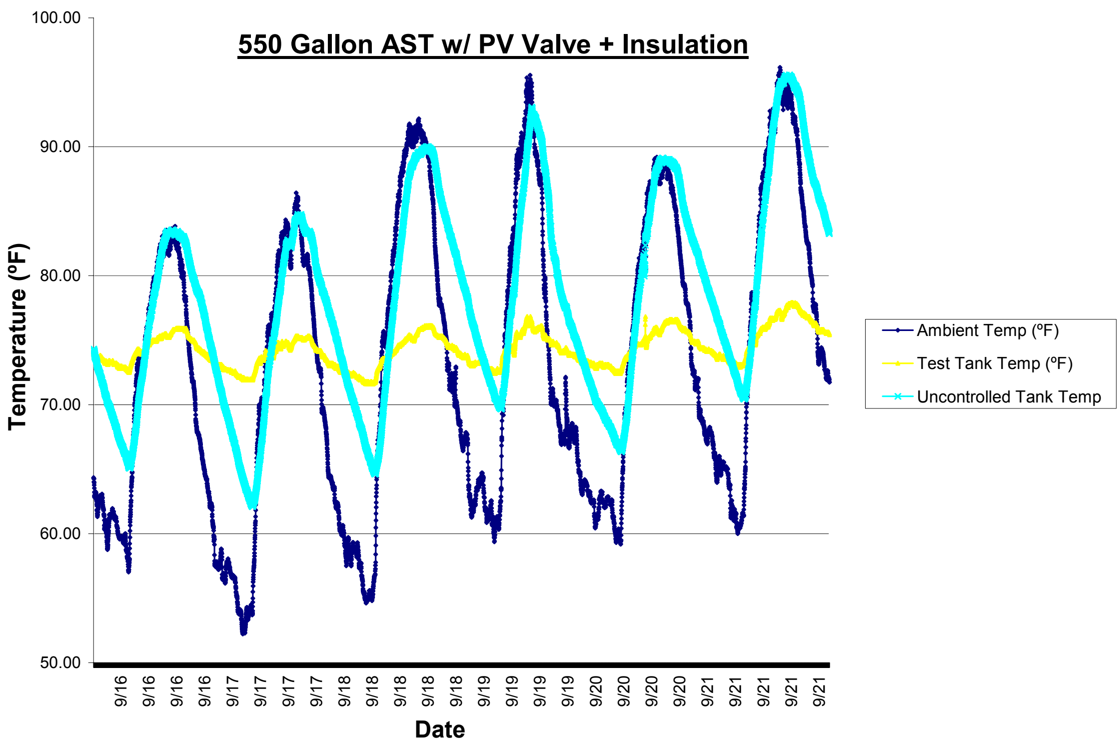
PV Valve + Insulation
This control configuration was tested in the final configuration on the 350 and 550 gallon ASTs and controlled an average of 97% of the evaporative emissions as compared to an uncontrolled tank. PV valve controlled the vapor release and insulation reduced the fuel surface temperature in the tank by significantly reducing the impact of direct sunlight hitting on the tank surface. Figure 5 shows the effect of insulation on fuel surface temperature in the tank. Insulation reduced the maximum fuel surface temperature in the test tank by approximately 10-15 ºF as compared to fuel surface temperature in the uncontrolled tank.

Figure 5



Carbon Canister
This control was tested as a final configuration on the 550 gallon AST and controlled approximately 65% of the evaporative emissions as compared to an uncontrolled tank. A passively purged carbon canister is filled with activated carbon which contains billions of pores. This porous structure provides for high efficiency adsorption and desorption of organic compounds from gases and liquids. A diurnal change in ambient temperatures causes air and vapors in the AST to expand and contract. Increase in temperature volatilizes the fuel in the tank and causes adsorption of vapors onto the carbon whereas a decrease in temperature brings cool air in the canister i.e. back purge and causes desorption of the vapors back in the tank. The carbon canister controlled the vapor release

from the tank up to the point of saturation and is then regenerated for the next diurnal cycle. It had no control on the fuel surface temperature in the tank. The difference in the weight of carbon canister before and after the test determined the amount of vapor (emissions) trapped in it.

PV Valve + White Paint + Shade + Carbon Canister
This control configuration was tested as a final configuration on the 1000 gallon AST and controlled approximately 83% of the evaporative emissions as compared to an uncontrolled tank. PV valve and carbon canister controlled the vapor release from the tank. Paint and shade reduced the fuel surface temperature in the tank by reducing the impact of direct sunlight hitting on the tank surface. The difference in the weight of carbon canister before and after the test determined the amount of vapor (emissions) trapped in it.

V. Quality Control

To ensure good quality of data, all the measurement devices were pre-calibrated and in some cases, periodic calibration checks were performed. Following is a list of devices used in collecting the field study data and their respective accuracies:

1. Thermocouples Omega® - K-type (CHROMEGA®-ALOMEGA®) bimetallic thermocouples were used to measure the daily fuel surface temperatures and daily ambient temperatures. Each tank configuration was equipped with a sealed cork float that incorporated a 36–gauge wire K-type thermocouple. The thermocouple was insert into the cork float so that its tip protruded from the side of the sealed float just below the surface. Calibration checks were done on all the thermocouples before, during and after the test period. Calibration checks were done using ice water. Room temperature tap water and boiling water. Thermocouple readings were compared to a temperature standard. Excellent correlations were found with r > 0.9999. According to the manufacturer specifications, thermocouples have accuracy of ± 1.1º C or 0.4% of the reading, whichever is greater.

2. Data Loggers Campbell Scientific Model CR10X data loggers were used to download and store in one minute increments of all the temperature data from the respective thermocouples. According to the manufacturer specifications, CR10X data logger has an accuracy of ± 0.05% of Full Scale Range (0º - 40º C).

3. Load Cells Sentran Model# ZB1-10K load cells were used in this field study for gravimetric measurements of tanks. Load Cell is a transducer which converts force into a measurable electrical output. These S-beam load cells have a capacity of 10,000 lbs. According to the manufacturer specifications, the accuracy is within 0.02% of full scale (± 2lbs.).

4. Other Measurements were made but assumed to be a certain value for consistency purposes and are as follows:

    - **RVP = 7 psi**
      Each tank was filled with fresh summer-time gasoline. The gasoline samples were tested in the ARB lab in El Monte to determine their actual RVPs. Most samples tested had RVP values in the range 6-7.
    - **M_V = 68 lb/lb-mole**
      This vapor molecular weight of gasoline is based on the corresponding RVP value of 7.
    - **V_V = 1/2 Tank Capacity**
      Each tank was half filled with gasoline. The volume of the vapor is equal to half the respective tank size.

Testing of each control technology combination on ASTs was done over a period of several days to see the repeatability of the test. The final configurations of the three tank sizes were tested for 2-3 months. The testing was done in summer months (May – October) with high ambient temperatures in the range of 90 ºF – 106 ºF which directly influence the fuel surface temperature in the ASTs. The ambient temperatures measured during the field study in 2005 are in the same range as ambient temperatures measured in the region over a period of ten years (1995-2005) as shown in Attachment 3.
Since insulating the tank seemed to provide maximum emission control, this control technology combination of PV + Insulation was tested on two different tanks (350 and 550 gallon) for verification purposes. In both cases, greater than 90% emission reductions were achieved as compared to emissions from an uncontrolled tank with just a flip top cap. Overall the emission measurements in all the tests were highly reproducible.

VI. Conclusion

The field study conducted in summer 2005 successfully evaluated the different control technology combinations. All control technologies tested were technologically feasible and effective in controlling evaporative losses also known as standing or storage losses from ASTs. Control configuration with PV valve + Insulation provided the maximum emission reduction of ~97% as compared to an uncontrolled AST. Retrofitting ASTs with these controls will prevent the loss of gasoline into the atmosphere, hence protect public health, environment and save money.

APPENDIX D

Attachment 1

AST Field Study Test Plan

Summer 2005

350 gallon AST Test Plan

*Test Tank Configuration	Tank ID#	Start Date	End Date	Test Duration
P/V valve	1	3-May	23-May	21 days
P/V valve + White Paint	1	11-Jun	27-Jun	17 days
P/V valve + White Paint + Shade	1	20-Jul	2-Aug	13 days
P/V valve + White Paint + Shade + Insulation	1	3-Aug	27-Aug	23 days
P/V valve + Insulation (Final Configuration)	1	1-Sep	26-Oct	~2months

*Each test tank configuration is tested with an uncontrolled tank (Tank ID# 2, open system with a flip top cap)
*Both test and uncontrolled tanks are refueled with fresh gasoline before the test of each tank configuration

550 gallon AST Test Plan

*Test Tank Configuration	Tank ID#	Start Date	End Date	Test Duration
P/V valve	3	3-May	23-May	21 days
P/V valve + White Paint	3	11-Jun	27-Jun	17 days
P/V valve + White Paint + Shade (Final Configuration)	7	26-Jul	26-Oct	3months
Carbon Canister (Final Configuration)	3	26-Jul	26-Oct	3months
P/V valve + Insulation (Final Configuration)	8	1-Sep	26-Oct	~2months

*Each test tank configuration is tested with an uncontrolled tank (Tank ID# 4, open system with a flip top cap)
*Both test and uncontrolled tanks are refueled with fresh gasoline before the test of each tank configuration

1000 gallon AST Test Plan

*Test Tank Configuration	Tank ID#	Start Date	End Date	Test Duration
P/V valve	5	1-May	23-May	23 days
P/V valve + White Paint	5	23-May	27-Jun	35 days
P/V valve + White Paint + Shade + Carbon Canister (Final Configu	5	26-Jul	26-Oct	3months

*Each test tank configuration is tested with an uncontrolled tank (Tank ID# 6, open system with a flip top cap)
*Both test and uncontrolled tanks are refueled with fresh gasoline before the test of each tank configuration

APPENDIX D

Attachment 2

350 Gallon ASTs Field Study, Fresno (Summer 2005)
PV Valve + Insulation Configuration
AP-42 Calculated Emissions (Using Fuel Surface Temperature)

Assumptions and Factors

AST Size =	350 Gallons	47	cuft.
Vv =	23		
RVP =	7		
Mv =	68		
R =	10.73		

P_B:

No Vapor Recovery	0" of H_2O=	0	psi		
Phase I &II Vapor Recovery	WC-(-8"WC)	0.396	psi	1"WC=	0.036 psi

Test Tank with P/V Valve + Insulation

Date	T_{LN}	T_{LX}	T_{LA}	ΔT_V	ΔP_V	P_{VA}	W_V	K_E	Ls
9/1/2005	538.98	545.43	542.20	6.45	0.65	5.39	0.0630	0.0392	0.06
9/2/2005	539.37	545.53	542.45	6.15	0.62	5.41	0.0633	0.0358	0.05
9/3/2005	539.08	544.53	541.81	5.46	0.55	5.35	0.0626	0.0262	0.04
9/4/2005	537.79	543.34	540.56	5.56	0.55	5.23	0.0613	0.0262	0.04
9/5/2005	537.29	544.44	540.86	7.15	0.71	5.26	0.0616	0.0461	0.07
9/6/2005	537.89	543.34	540.61	5.46	0.54	5.23	0.0613	0.0250	0.04
9/7/2005	536.69	541.06	538.88	4.37	0.42	5.06	0.0595	0.0105	0.01
9/8/2005	533.42	538.68	536.05	5.26	0.48	4.80	0.0567	0.0186	0.02
9/9/2005	532.13	536.00	534.06	3.87	0.34	4.62	0.0548	0.0022	0.00
9/10/2005	529.82	535.11	532.46	5.29	0.46	4.48	0.0533	0.0161	0.02
9/11/2005	528.62	534.91	531.76	6.29	0.54	4.42	0.0526	0.0259	0.03
9/12/2005	528.73	535.01	531.87	6.28	0.54	4.43	0.0527	0.0259	0.03
9/13/2005	528.73	535.21	531.97	6.48	0.56	4.43	0.0528	0.0280	0.03
								Average (lb	**0.03**
								Std Dev	**0.02**

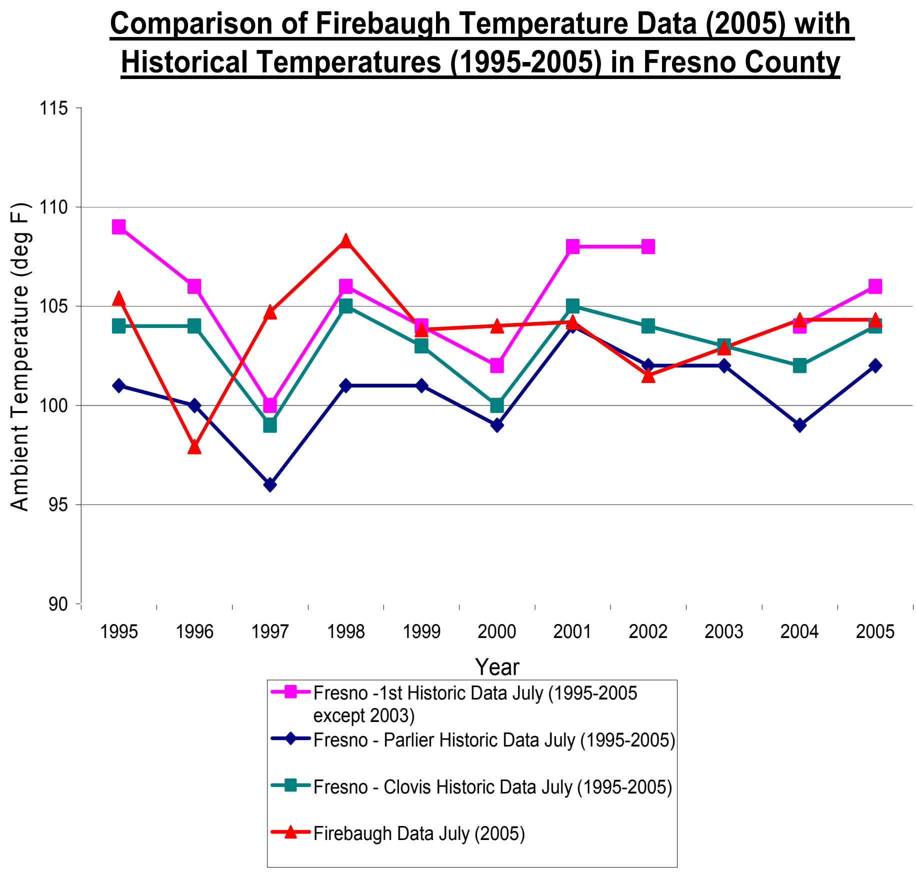
Uncontrolled Tank with Flip Top Cap

Date	T_{LN}	T_{LX}	T_{LA}	ΔT_V	ΔP_V	P_{VA}	W_V	K_E	Ls
9/1/2005	531.21	557.64	544.43	26.42	2.77	5.62	0.0654	0.3530	0.54
9/2/2005	531.90	556.85	544.38	24.95	2.61	5.61	0.0653	0.3328	0.51
9/3/2005	529.18	554.49	541.84	25.31	2.55	5.35	0.0626	0.3193	0.47
9/4/2005	527.26	553.61	540.44	26.35	2.60	5.21	0.0611	0.3225	0.46
9/5/2005	529.99	557.05	543.52	27.06	2.80	5.52	0.0644	0.3543	0.53
9/6/2005	528.89	553.32	541.10	24.43	2.43	5.28	0.0618	0.3032	0.44
9/7/2005	526.56	549.39	537.97	22.83	2.17	4.98	0.0586	0.2651	0.36
9/8/2005	523.42	546.64	535.03	23.21	2.11	4.70	0.0557	0.2539	0.33
9/9/2005	521.57	541.92	531.74	20.35	1.75	4.41	0.0526	0.2086	0.26
9/10/2005	520.29	543.39	531.84	23.10	2.00	4.42	0.0527	0.2374	0.29
9/11/2005	519.87	545.46	532.66	25.59	2.24	4.49	0.0535	0.2674	0.33
9/12/2005	520.97	544.77	532.87	23.80	2.09	4.51	0.0537	0.2496	0.31
9/13/2005	520.49	545.56	533.02	25.07	2.21	4.53	0.0538	0.2637	0.33
								Average (lb	**0.40**
								Std Dev	**0.10**

RVP: Reid Vapor Pressure
Vv: Vapor Space (cu ft)
Mv: Vapor Molecular wt.(lb/lb-mole)
Tamb.avg: Daily Average Ambient Temperature (ºF)
Tamb.range: Daily Ambient Temperature Range(ºF or ºR)
T_{LA}: Daily Average Liquid Surface Temperature (ºR)
T_{LN}: Daily Minimum Liquid Surface Temperature (ºR)
T_{Lx}: Daily Maximum Liquid Surface Temperature (ºR)
R: Ideal Gas Constant (psia cuft/lb-mol-ºR)
P_{VA}: Vapor Pressure @Daily Average Liquid Surface Temperature (psi)
P_B: Breather Vent Pressure Setting (psi)
W_V: Vapor Density (lb/cu ft)
$\Delta T_{V:}$ Daily Vapor Temperature Range (ºR)
$\Delta P_{V:}$ Daily Vapor Pressure Range (psi)
K_E: Vapor Space Expansion Factor (dimensionless)
L_S: Standing Losses (lb)
L_W: Working Losses (Deliveries, Dispenses) (lb)

APPENDIX D

Attachment 3



APPENDIX E
SUMMARY OF ABOVEGROUND STORAGE TANK PRESSURE DECAY AND EFFICIENCY TESTING

Aboveground storage tanks (AST) were tested to evaluate currently adopted test procedures (TP) and proposed TPs. From 2001 to 2003, adopted TPs were used to determine the current level of efficiency and leak-tightness of ASTs. Many of the ASTs tested failed the static pressure performance test in as-found conditions and required repairs in order to meet the performance criteria. All of the ASTs passed the Phase I and Phase II efficiency testing performance standards currently in place (90 percent). Additional testing was conducted in 2007 to evaluate proposed TPs to determine the static pressure performance of ASTs and emission factor from processors for standing loss controls. The following tests were conducted on ASTs:

Test Procedures Conducted

- **TP-201.3B:** Determination of Static Pressure Performance of Vapor Recovery Systems of Gasoline Dispensing Facilities with Aboveground Storage Tanks (April 12, 1996)

- **TP-205.1:** Determination of Efficiency of Phase I Vapor Recovery Systems of Novel Facilities (March 17, 1999)

- **TP-205.2:** Determination of Efficiency of Phase II Vapor Recovery Systems of Novel Facilities (March 17, 1999)

- **TP-206.2:** Determination of Emission Factor for Standing Loss Control Vapor Recovery Systems Using Processors at Gasoline Dispensing Facilities with Aboveground Storage Tanks

- **TP-206.3:** Determination of Static Pressure Performance of Vapor Recovery Systems at Gasoline Dispensing Facilities with Aboveground Storage Tanks

The following table summarizes the results of the test procedures:

APPENDIX E
SUMMARY OF ABOVEGROUND STORAGE TANK PRESSURE DECAY AND EFFICIENCY TESTING

<table>
<tr><td><u>TP 201.3B</u>
26-Feb-02

15-Mar-02

26-Mar-02

2-Apr-02

19-Jun-02

9-July-02</td><td>Natomas - Balance - Protected - 1K gallons
failed run one - prior to run lubricated primary vent o-ring.
failed run two - prior to run tightened vapor adaptor and cleaned poppet face.
failed run three - again prior to run, tightened vapor adaptor and cleaned poppet face. Observed tears in fuel coaxial hose. Pressure leaking at tear.

passed Coaxial hose was replaced prior to run due to tears. Also conducted 2" WC steady state leak decay test. Introduced enough N2 to hold pressure @ 2" WC for 2 minutes. Leak rate was 1.6 SCFH.

passed both - however, observed fuel in vapor side of coaxial hose; during first run noted leakage from fuel gage; prior to second run hand tightened locking nut on fuel gage. Followed with monitoring from 3-27-02 to 4-1-02.
failed run one - prior to first run attempted repair of broken locking ring on tank gage. Test failed.
failed run two - prior to run replaced tank gage. Post test ran several steady state flow test @ various pressures.
passed run one however, noted fuel gage leaking. Post test removed gage and noted crack at base. Replaced gage.
passed run two

Pressure decay testing performed before monitoring started. System monitored from July 10 to 21.
failed run one - noted leakage at vapor poppet and auxiliary 2" bung. Cleaned poppet and tightened bung (bung was hand tight. Delivery driver possibly used bung as stick port).
passed run two - however, noticed spill bucket drain valve loose. Cleaned lubed and hand tightened.
passed run three</td><td><u>TP 205.1</u>
08-Aug-02
Trailer tank recovery efficiency 100%
<u>TP 205.2</u>
07-Aug-02
Fueling for drums avg 99.8%
Fueling for vehicles avg 99.4%</td></tr>
<tr><td>TP 201.3B
16-Oct-02
two runs

27-Aug-02
two runs

20-Feb-03
one run</td><td>Stockton - Balance - Protected - 6K gallons
failed run one - breakaway was loose. Tightened post test.
passed run two
failed both - during first run observed substantial leakage from drop tube seal. Bagged fill adaptor and conducted 2nd run. Still did not pass test.
failed - back of clock gage was leaking</td><td></td></tr>
</table>

APPENDIX E
SUMMARY OF ABOVEGROUND STORAGE TANK PRESSURE DECAY AND EFFICIENCY TESTING

TP 201.3B *20-Aug-02* one run *22-Aug-02* one run	**Folsom - Processor – Single Wall - 4K gallons** passed *passed*	TP 205.1 ***21-22-Aug-02*** Trailer tank recovery efficiency 100% **TP 205.2** *21-22-Aug-02* Fueling for drums avg 97.2% Fueling for vehicles avg 97.9%
TP 201.3B *8-Jan-03*	**Dixon - Balance 2 point – Single Wall - 1K gallons** *failed* run one. P/V valve found on tank was a 3" +/- 0.5" and was replaced with a +8 ounce/ -0.5 ounce P/V valve prior to run one and two. Ran test with fill cap on and introduced N2 thru auxiliary fitting on P/V 2" coupler. *run two has no pass/fail*. It was run as a 10" decay test for informational purposes. Following run, lubricated emergency vent o-ring, downloaded data and put a +8 ounce/ -8" WC P/V on because the pressure profile of tank kept dropping, showing ingestion of air throughout the evening when the original 3" WC P/V was installed, causing venting throughout the day. Even with it being a cold and foggy morning (8:30 a.m.) the tank pressure was growing slowly.	
TP 201.3B *13-Aug-02* *14-Aug-02* *15-Aug-02* post TP 205.2	**Rocklin - Balance - Protected - 12K gallons** *failed* -couldn't pressurize tank *passed* this was pre-test to TP 205.2. Replaced defective P/V valve prior to run. *failed* run one- leaking at threaded joint on P/V. Tightened and used Teflon tape *failed* run two - leaking from emergency vent. Applied vacuum grease on brass-brass seat. *passed* run three of post-test **Note re: 205.1**: After starting 205.1, (truck tank offload) noted new out-of-the –box P/V vent hissing and evidence of vapors however, roots meter not measuring flow. After 2nd tank offloading began (trailer tank), removed P/V valve and rush of vapors came out of vent. P/V valve replaced and leakage con't. as noted before. Roots meter was now measuring a slow flow rate indicative of previously noted P/V valve leakage. Therefore two VR efficiencies calculated for venting during offloads. Both failed the 95% regulatory limit.	TP 205.1 *19-May-03* tank on trailer recovery efficiency 93.1% tank closest to cab recovery efficiency 93.0% (See Note re: 205.1) TP 205.2 *14-Aug-02* fueling for drums avg 93.1% fueling for vehicles avg 98.7%

APPENDIX E
SUMMARY OF ABOVEGROUND STORAGE TANK PRESSURE DECAY AND EFFICIENCY TESTING

TP 201.3B	**Carmichael - Balance - Protected - 1K gallon**	
10-SeP-01	*failed* ; could not pressurize due to defective P/V valve	
11-SeP-01	*failed* ; could not pressurize due to defective tank gage	
14-SeP-01	*failed* run one - prior to test replaced fuel gage cap and o-ring. *passed* run two - prior to running test lubed o-ring on emergency vent	
28-SeP-01	*passed*	
19-Oct-01	*passed* all three	
2-Nov-01	*passed* both	
16-Nov-01	*passed*	
30-Nov-01	*passed*	
14-Dec-01	*failed* run one in as-found condition *passed* run two when tank gage bagged	
20-Dec-01	*passed*	
3-Jan-02	*passed*	
18-Jan-02	*passed*	
TP 201.3B	**Folsom - Balance - Protected - 6K gasoline, 4Kdiesel**	
19-Mar-02	*passed*	
8-Apr-02	*passed*	
23-May-02	A. passed. Followed with monitoring from 5-24-02 to 5-29-02.	
31-Oct-02	*failed* run one in as-found condition. Leakage noted from back of clock gage. *passed* run two when clock gage bagged	
	Folsom - Balance - Protected - 3K gasoline, 1K diesel	
19-Mar-02	*passed*	
8-Apr-02	*passed. Followed with monitoring from 4-09-02 to 5-22-02.*	
23-May-02	*passed*	
TP 201.3B	**Sacramento - Balance - Protected - 500 gallons split** (two 250 gallon tank)	
10-May-02	Tank #1 ullage too small to conduct decay test. Bobtail truck just filled. Tank #2 ullage too small to conduct decay test. Bobtail truck just filled.	
15-May-02	*Tank #1* Based on leak rate criteria from TP the allowable final pressure at an ullage of 400 gallons is 0.30 "WC. Tank appears to have met this allowable pressure during testing. Its final pressure after 5 minutes was 0.30"WC **Tank #2 ullage too small to conduct decay test.**	
3-Jun-02	Tank #1 run one. Vapor test cap left on. Based on leak rate criteria from TP the allowable final pressure at an ullage of 400 gallons is 0.3 "WC. Tank appears to have met this allowable pressure during testing. Its final pressure after 5 minutes was 0.30" WC. *run two-- Vapor test cap removed and final pressure after 5 minutes was 0.07" WC* *run three -- Left vapor system cap on and introduced N2 and measured pressure at coupler. Final pressure after 5 minutes was 0.50" WC.*	

APPENDIX E
SUMMARY OF ABOVEGROUND STORAGE TANK PRESSURE DECAY AND EFFICIENCY TESTING

TP 201.3B	**Stockton - Balance - Protected - 2K gallon**	
14-Jan-03 *31-Jan-03* *18-Feb-03* *20-Feb-03* *6-Mar-03* *11-Apr-03* *19-Jun-03*	*passed* Initial seal of emergency vent had to be obtained by stepping onto vent, then stepping off, after which we began test. (Previously maint tech had used pipe sealant on emergency vent to get system to pass.) *failed* run one due to leaking vapor poppet *passed* run two after cleaning vapor poppet *passed* *passed* (following test it was noticed that the flow restrictor was loose. Restrictor was tightened) *failed* run one due to leaky poppet (vapor adaptor and leaky nozzle) Expanded bellows on nozzle and leak stopped, cleaned poppet. *passed* run two But poppet still leaking, and unable to stop leak. Engaged the nozzle check valve multiple times and nozzle still leaked. Contacted maintenance to replace nozzle and vapor adaptor. *passed* *failed* system leaking thru emergency vent. Maintenance contacted regarding need to clean and lube emergency vent.	
TP 201.3B	**Stockton - Balance - Protected - 10K gallon**	
6-Feb-03 *20-Feb-03* *6-Mar-03*	*passed* Final pressure was equal to Allowable Final Pressure *passed* *passed* However, smelled vapors at P/V valve	
	Bakersfield - Vacuum Assist-Processor - Vaulted	
13-Nov-03	Pressure monitoring beginning 13 Nov 03	
TP-206.2	**Folsom – Hirt Processor – 4K gallon**	
TP-206.2	**ARB – Carbon Canister – 300 gallon**	

APPENDIX F
Proposed Vapor Recovery Definitions, Certification, and Test Procedures for Aboveground Storage Tanks

Available separately are the following:

D-200, Vapor Recovery Definitions

CP-206, Certification Procedure for Vapor Recovery Systems at Gasoline Dispensing Facilities Using Aboveground Storage Tanks

TP-201.2, Efficiency and Emission Factor for Phase II Systems

TP-206.1, Determination of Emission Factor for Standing Loss Control Vapor Recovery Systems Using Temperature Attenuation Factor at Gasoline Dispensing Facilities with Aboveground Storage Tanks

TP-206.2, Determination of Emission Factor for Standing Loss Control Vapor Recovery Systems Using Processors at Gasoline Dispensing Facilities with Aboveground Storage Tanks

TP-206.3, Determination of Static Pressure Performance of Vapor Recovery Systems at Gasoline Dispensing Facilities with Aboveground Storage Tanks

APPENDIX G
Temperature Attenuation Field Study Correlation

I. INTRODUCTION

The goal of the Field Study is to determine the relationship between the fuel surface temperature:ambient temperature ratio (attenuation factor) and standing loss emissions to define the performance standard for Standing Loss Control vapor recovery systems. Standing loss emissions can be controlled by minimizing the effect ambient temperature change has on fuel surface temperature of the gasoline in the AST.

II. EXPERIMENTAL

Standing losses are emissions during periods of no gasoline transfer. These are evaporative emissions through open vent pipes and leaks in the AST caused by increased internal tank pressure as a result of diurnal temperature changes. Ambient temperature changes throughout a day change the fuel surface temperature. As fuel surface temperature increases so does the internal tank pressure. When the internal tank pressure increases, gasoline volatilizes and is released into the atmosphere.

a. STUDY

There are two components associated with the determination of proposed performance standard: temperature ratio and emissions.

During the summer of 2005, ARB staff conducted a field study to evaluate various technologies to control standing loss emissions. In the field study, three sizes of single wall ASTs were retrofitted with technologies to control standing loss emissions by attenuating the ambient temperature effects on fuel surface temperatures. Controlling the fuel surface temperature controls the internal tank pressure and reduces emissions through the vent pipe and leaks in the system. Emissions were both measured directly through fuel weight losses and calculated theoretically using empirical equations.

<u>Temperature Ratio</u>

Each retrofitted tank was installed with a thermocouple attached to a cork float on a stainless steel rod. The rod was placed inside the tank through a cam lock fitting at the top of the tank. The thermocouple was connected to a data logger and temperature data was collected at second intervals and stored as one minute averages. An ambient temperature probe was also collocated within 10 feet of the ASTs, connected to a data logger, which collected temperature data at second intervals and stored one minute averages. Each sized AST was collocated with a same sized AST without retrofits (control tank). Each control tank was configured with a thermocouple and connected to a data logger. Temperature data for the control tanks was collected at the same time averaged interval as the test tanks.

Emissions

Emissions from the ASTs were determined theoretically using U.S. EPA Method AP-42, developed by the American Petroleum Institute. Method AP-42 calculates emissions from single wall storage tanks based on ambient temperatures by region and can be found on the U.S. EPA website at:

http://www.epa.gov/ttn/chief/ap42/ch07/indes.html

Emissions were also measured gravimetrically using a load cell at the beginning, middle and end of the test duration for each technology. Each tank was weighed empty at the beginning of the study and then filled with gasoline to half ullage and weighed again. The tank was re-weighed during the study to provide preliminary data. Finally the AST was weighed at the end of the study to determine the amount of gasoline lost.

b. TEMPERATURE ATTENUATION

The ratio of the fuel surface temperature range to the ambient temperature range is defined as the attenuation factor (A_f). The range of temperature is the difference between the daily maximum and daily minimum temperature during a 24-hour period. The attenuation factor is calculated using Equation II-1, as follows:

$$A_f = \frac{(\sum_{1}^{n} T_f^{Range} / n)}{(\sum_{1}^{n} T_a^{Range} / n)} \qquad \text{[Equation II-1]}$$

Where:

$\sum_{1}^{n} T_f^{Range}$ = The sum of daily fuel surface temperature range

$\sum_{1}^{n} T_a^{Range}$ = The sum of daily ambient temperature range

n = number of data sets (days)

c. DATA

Equation II-1 was used to calculate the attenuation factor associated with the different control technologies. The attenuation factor for each control technology was determined from a minimum 30 days of daily fuel surface and ambient temperature minimums and maximums, a minimum seven days during which the temperature was greater than 90°F. Table II-1 summarizes the data for each tank size and control technology.

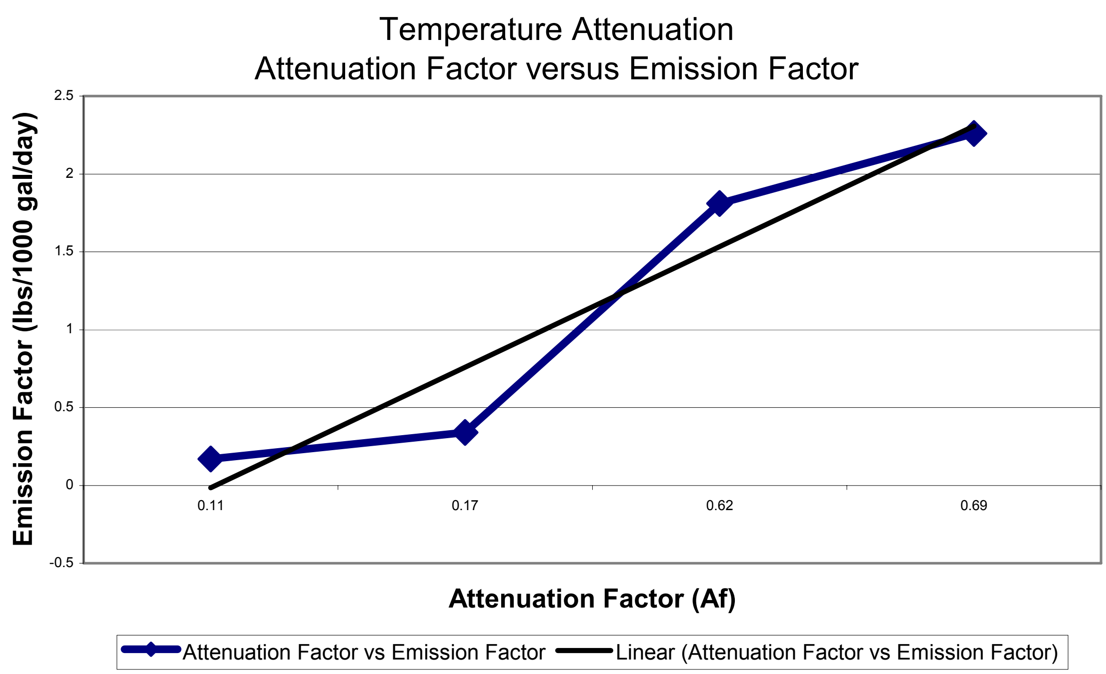
Table II-1
Attenuation Factor and Emissions

AST Size (gal.)	Control Technology	Attenuation Factor	Percent Reductions	Emission Factor (lbs/1000 gal/day)
550	insulation	0.11	97%	0.17
350	insulation	0.17	94%	0.34
550	paint/shade	0.62	68%	1.81
350	paint/shade	0.69	60%	2.26

III. RESULTS AND DISCUSSION

The comparison of the temperature attenuation to the AST emission factor is graphically displayed in Figure III-1. A linear correlation was determined and the "best fit" relationship was determined, as shown by the black line.

Figure III-1



The relationship between the attenuation factor for a particular Standing Loss Control technology and the associated emission factor can be expressed as a linear function with a correlation of 0.993 and standard error of $\pm$0.11. The emission factor can be calculated using the attenuation factor (A_f) from Equation III-1, as follows:

Emission Factor (lbs/1000 gal/day) = $3.48 \times A_f - 0.23$ [Equation III-1]

IV. RECOMMENDATIONS

Staff recommends that the relationship between temperature attenuation factor and emission factor be used to develop a test procedure (TP-206.1) to evaluate Standing Loss Control technologies.

V. REFERENCES

1. “Test Report for Control Technology Feasibility Study on Aboveground Storage Tanks,” July 27, 2006

APPENDIX H
AST POPULATION SURVEY

I. INTRODUCTION

Determining emission reductions associated with the proposed AST controls is dependent on knowing the statewide population of AST. In addition to knowing the statewide population, an estimate of the number of tanks in regions of the state for which daily temperature data is available in AP-42 is also needed.

The goal of the population estimate was also to estimate the distribution of tanks by size, type and level of control. The following discussion takes the reader on a step-by-step journey through the process of making the estimate.

II. SURVEY DECISION

Staff explored several ways to estimate the population of ASTs in California. For example in 2003 staff collected databases used for district permitting activities as well as information from the State Water Resources Control Board, tank manufacturers and fuel carriers. The results from the various sources reviewed in 2003 are summarized in Table H-1 below.

Table H-1
AST Population Survey Summary

Source	Protected Tank	Single Wall Tank	Total Reported (in CA)
Districts	-	-	1,892
Water Board	-	-	3,899
AST Manufacturers	3,598	2,407	6,005
Fuel Carriers	2,873	4,760	7,633

Staff decided to resurvey the fuel carriers again because of the following reasons:

1. The recognition that the previous survey of fuel carriers did not ask questions about the type of AST or the level of vapor recovery controls, and
2. Fuel carriers are currently in a State-owned database, and
3. A belief that carriers possessed information that would provide an estimate of the number of AST in California as well as the type of AST (single wall or insulated) and the level of vapor recovery control on the AST.

Staff obtained a copy of the database of fuel carriers from the Enforcement Division's cargo tank program. Staff contacted each of the listed carriers by phone to determine if the carrier delivered gasoline to ASTs. Ultimately, of the approximately 475 carriers in the cargo tank program, 188 carriers were surveyed because they said they deliver gasoline to AST in California. While fuel carriers were being identified, staff worked with the California Independent Oil Marketers Association (CIOMA) to develop a survey that would get the information that was needed to make an estimate of the California AST population without creating an undue hardship on the fuel carrier filling out the survey. In addition to seeking population information, the survey asked questions about type of tank and level of vapor recovery controls. See attachment H-1

APPENDIX H
AST POPULATION SURVEY

In cooperation with CIOMA, 32 fuel carriers were chosen to participate in a pilot survey. A pilot survey is used to determine if the survey asks the questions necessary to obtain the information needed. Fourteen surveys (≈ 44%) were returned identifying 466 ASTs. Based on responses to the pilot, the survey was revised and then sent to the remaining 156 fuel carriers.

Table H-2 summarizes the survey results.

Table H-2
Summary of Survey Respondents

	Combined Survey Results	Pilot Survey	Final Survey
Number of surveys sent out	188	32	156
Number of surveys returned	62	14	48
Number of surveys respondents that deliver gasoline to AST	44	7	37
Number of surveys respondents that do not deliver gasoline to AST	18	7	11
Number of tanks reported	3,160	466	2,694
Average number of tanks per reporting company	72	67	73
Estimated number of companies that deliver to AST	133		
Estimated number of AST in state	9,582		

After the surveys were returned staff performed an analysis on the responses.

III. SURVEY RESULTS

The following information was reported in the surveys and was used to analyze the survey data:

- 188 Number of companies surveyed
- 62 Number of survey respondents
- 44 Number of survey respondents that deliver gasoline to AST
- 18 Number of survey respondents that do not deliver gasoline to AST
- 3,160 Number of tanks reported in the survey

The following information was derived from the survey responses:

- 71% Percentage of survey respondents that deliver gasoline to AST [(44/62)X100]
- 72 Average number of AST per reporting company (3160/44)
- 133 Estimated number of fuel carriers that deliver to ASTs (71% X 188)
- 9,582 Estimated number of ASTs in California (72 X 133)

IV. ESTIMATION EXTRAPOLATION METHODOLOGY

Based on the responses to the survey and the information derived from the responses staff was able to make an estimate of the number of tanks in each of 15 regions of the state that have temperature data contained in AP-42.

The following assumption was made with respect to making an estimate of the population:

- **<u>Survey non-respondents look like the survey respondents for the purpose of determining the statewide population estimate</u>**

Bakersfield will be used for illustrating the methodology used to estimate the number of tanks in each of the 15 regions and then the size distribution in each region and then the type of tank and level of control for AST in each region.

Staff started with the number of tanks reported in the survey for the state and for the Bakersfield region

- 3,160 Number of tanks reported in survey statewide
- 262 Number of tanks reported in survey in Bakersfield.

This information was used to determine the approximate percentage of tanks statewide located in the Bakersfield region.

- 8.3% Percentage of tanks in the Bakersfield region [(262/3160) X 100]

This percentage and the number of tanks estimated to be in the state enabled an estimate of the total number of tanks in the Bakersfield region.

- 794 Total number of tanks in the Bakersfield region (0.083 X 9,582).

After the number of tanks in Bakersfield was estimated a size distribution was estimated based on the distribution in the survey returns as follows:

- 262 Number of tanks reported in survey in the Bakersfield region.
- 57 Number of tanks reported in survey in the Bakersfield region ≤ 350 gallons.
- 22% Approximate percentage of tanks in the Bakersfield region ≤ 350 gallons [(57/262) X 100]
- 173 Estimated number of tanks in the Bakersfield region ≤ 350 gallons (0.22 X 794)

The methodology for extrapolating the numbers for type of tank and for vapor recovery controls for the Bakersfield region and for the rest of the state is the same as for the previous exercises.

APPENDIX H
AST POPULATION SURVEY

Attachment H-1
AST Population Survey

An Aboveground Storage Tank (AST) is a tank not covered by dirt or other fill. An AST can have many different looks and configurations. But the common factor in all AST's is that they are not buried, the sides and tops have air touching them not dirt or other types of fill. **This survey applies to gasoline deliveries only.**

Fuel Carrier:	**Number of gallons of gasoline you delivered to all AST's between:**
Contact Name:	
Phone Number:	**April 2003 & October 2003**
FAX:	**November 2003 & March 2004**
email:	**Or the total gallons delivered in 2003**

The following information is needed for gasoline deliveries only to aboveground storage tanks (AST)

City (or county) where the AST(s) is/are located[1]	Tank size in gallons	Number of ASTs	Single Wall Steel Tank (on the ground or on a stand)				Insulated[2] or double wall (such as concrete)				Tank Location		
			Unknown vapor recovery	No vapor recovery	Phase I vapor recovery only	Phase I & Phase II vapor recovery	Unknown vapor recovery	No vapor recovery	Phase I vapor recovery only	Phase I & Phase II vapor recovery	farm	marina	other
	350 or less												
	351 to 500												
	501 to 750												
	751 to 1000												
	1001 to 2000												
	2001 to 6000												
	6001 or greater												
	350 or less												
	351 to 500												
	501 to 750												
	751 to 1000												
	1001 to 2000												
	2001 to 6000												
	6001 or greater												

[1]You can use a block on the form to group the AST(s) by the city or county where they are located or use a separate block for each tank.

[2]For this survey a tank encased in concrete is an insulated tank.

APPENDIX H
AST POPULATION SURVEY
TABLE H-3

AST FUEL CARRIER SURVEY (2004)

			Single Wall Steel Tank				Insulated Tank				Location		
AP-42 Cities	Tank size in gallons	number of ASTs	Unknown vapor recovery	No vapor recovery	Phase I vapor recovery only	Phase I & Phase II vapor recovery	Unknown vapor recovery	No vapor recovery	Phase I vapor recovery only	Phase I & Phase II vapor recovery	farm	marina	other
Bakersfield	0350 or less	173		132	38				3		139	9	24
Bakersfield	0351 to 500	12		9		3					12		
Bakersfield	0501 to 750	409		209	173					27	315	18	76
Bakersfield	0751 to 1000	143		27	61	39			3	12	91	18	33
Bakersfield	1001 to 2000	36			3	18				15	6		30
Bakersfield	2001 to 6000	21			6	6				9	9		12
Bishop	0350 or less												
Bishop	0351 to 500												
Bishop	0501 to 750												
Bishop	0751 to 1000												
Bishop	1001 to 2000												
Bishop	2001 to 6000	6				3				3			6
Bishop	6001 or greater	3				3							3
Eureka	0351 to 500	155		155							106		49
Eureka	1001 to 2000	6		6									6
Eureka	2001 to 6000	3		3									3
Eureka	350 or less	79		79							45		33
Eureka	501 to 750	112		106				6			67		45
Eureka	6001 or greater	15		6	6					3	6		9
Eureka	751 to 1000	27		21				6			3		24
Fresno	0350 or less	188		153	34						188		
Fresno	0351 to 500	197		158	31	8					176		21
Fresno	0501 to 750	306		219	60					27	294		12
Fresno	0751 to 1000	115		82	21	12					115		
Fresno	1001 to 2000	45		3	21					21	30		15
Fresno	2001 to 6000	64			42	13				9	52		12
Fresno	6001 or greater	0											
Long Beach	1001 to 2000	12								12			12
Long Beach	2001 to 6000	6								6			6
Long Beach	350 or less	6		6									6
Los Angeles C.O.	0350 or less	52		3	9			9	6	24	9		42
Los Angeles C.O.	0351 to 500	118		21	21	3				73	42		76
Los Angeles C.O.	0501 to 750	64		39		9		3		12	21		42
Los Angeles C.O.	0751 to 1000	91		18	6					67	12		79
Los Angeles C.O.	1001 to 2000	12								12			12
Los Angeles C.O.	2001 to 6000	12		3						9	3		9
Los Angeles C.O.	6001 or greater	15								15			15
Mount Shasta	0350 or less	303		288				12		3	158		146
Mount Shasta	0351 to 500	97		79				4	7	7	45	3	49
Mount Shasta	0501 to 750	355		309				45			194		161
Mount Shasta	0751 to 1000	91		49				35	7		30		61
Mount Shasta	1001 to 2000	55		27				19		8	9	9	36
Mount Shasta	2001 to 6000	36		6				30			6	9	21
Mount Shasta	6001 or greater	52		30				7	7	7	36	6	9
Redding	0350 or less	139		139							112		27
Redding	0351 to 500	67		36				3	27		21		45
Redding	0501 to 750	294		291				3			221		73
Redding	0751 to 1000	85		76					9		64		21
Redding	1001 to 2000	39		18					14	7	24		15
Redding	2001 to 6000	36		12				12	6	6	12		24
Redding	6001 or greater	24		6	6				12		18	3	3
Sacramento	0350 or less	497		481	7				9		376	15	106
Sacramento	0351 to 500	39		30	7			3			12		27
Sacramento	0501 to 750	1177		579	324			6	18	249	764	12	400
Sacramento	0751 to 1000	124		70				6	6	42	64	3	58
Sacramento	1001 to 2000	494		200	97			3		194	318	27	149
Sacramento	2001 to 6000	273		55		6		12		200	176	33	64
Sacramento	6001 or greater	6			6						6		
San Diego	0350 or less	82		48	10			3	18	3	27		55
San Diego	0351 to 500	88		3	30			7	31	17	27		61
San Diego	0501 to 750	152		139	3				3	6	118		33
San Diego	0751 to 1000	85		38	4				11	32	42		42
San Diego	1001 to 2000	45		3	6	15		3	9	9	6		39
San Diego	2001 to 6000	33		3					15	15	3		30
San Diego	6001 or greater	9		9							9		
San Francisco AP	0350 or less	45		39					6		36		9
San Francisco AP	0351 to 500	49		42					6		42		6
San Francisco AP	0501 to 750	182		124					12	45	127		55
San Francisco AP	0751 to 1000	58		36					9	12	36		21
San Francisco AP	1001 to 2000	39							15	24			39
San Francisco AP	2001 to 6000	9							9				9
San Francisco AP	6001 or greater	3							3				3
San Francisco CO	0501 to 750	24		3						21	3		21
San Francisco CO	1001 to 2000	15								15			15
San Francisco CO	351 to 500	3							3				3
San Francisco CO	751 to 1000	6								6			6
Santa Barbara	0351 to 500	76			73				3		73		3
Santa Barbara	0501 to 750	3			3						3		
Santa Barbara	6001 or greater	6			6								6
Santa Maria	0350 or less	45		45							45		
Santa Maria	0351 to 500	139		133					3	3	133		6
Santa Maria	0751 to 1000	91		82						9	82		9
Santa Maria	1001 to 2000	12						12			9		3
Santa Maria	2001 to 6000	12		3					9		12		
Santa Maria	501 to 750	182		69	114						182		
Stockton	0350 or less	476		321	118	36					449		27
Stockton	0351 to 500	215		106	45	24			39		176		39
Stockton	0501 to 750	385		252	112			3	18		285		100
Stockton	0751 to 1000	130		27	73	3		3	18	6	91		39
Stockton	1001 to 2000	24		6	15				3		21		3
Stockton	2001 to 6000	18			12	3			3		12		6
Stockton	6001 or greater	49			6	27		6		9			49
	Column Totals	**9582**	**0**	**5777**	**1610**	**233**	**0**	**263**	**383**	**1315**	**6465**	**167**	**2950**

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			Phase I Controls				Phase I and Phase II Controls				Non Permitted/ No Controls
AP-42 Districts	Tank size in gallons	Total number of ASTs	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	All Tanks
Amador	0350 or less	4	0	0	0	0	0	0	4	0	Unknown
Amador	0351 to 500	0	0	0	0	0	0	0	0	0	Unknown
Amador	0501 to 750	1	0	0	0	0	0	0	1	0	Unknown
Amador	0751 to 1000	5	0	0	0	0	0	0	5	0	Unknown
Amador	1001 to 2000	6	0	0	0	0	0	0	6	0	Unknown
Amador	2001 to 6000	1	0	0	0	0	0	0	1	0	Unknown
Amador	6001 or greater	1	0	0	0	0	0	0	1	0	Unknown
Antelope Valley	0350 or less	0	0	0	0	0	0	0	0	0	Unknown
Antelope Valley	0351 to 500	9	0	0	0	0	0	0	9	0	Unknown
Antelope Valley	0501 to 750	1	0	0	1	0	0	0	0	0	Unknown
Antelope Valley	0751 to 1000	5	0	0	0	0	0	0	5	0	Unknown
Antelope Valley	1001 to 2000	6	0	0	0	1	0	0	5	0	Unknown
Antelope Valley	2001 to 6000	4	0	0	0	0	0	0	4	0	Unknown
Antelope Valley	6001 or greater	1	0	0	0	0	0	0	1	0	Unknown
Bay Area	350 or less	1	0	0	0	0	0	0	1	0	Unknown
Bay Area	351 to 500	70	2	2	3	0	0	0	63	0	Unknown

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DISTRICT PERMITTED AST SURVEY (2006)											
			Phase I Controls				Phase I and Phase II Controls				Non Permitted/ No Controls
AP-42 Districts	Tank size in gallons	Total number of ASTs	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	All Tanks
Bay Area	501 to 750	10	0	0	0	0	0	0	10	0	Unknown
Bay Area	751 to 1000	85	0	0	3	0	0	0	82	0	Unknown
Bay Area	1001 to 2000	40	0	0	1	0	0	0	39	0	Unknown
Bay Area	2001 to 6000	41	0	0	7	0	2	0	32	0	Unknown
Bay Area	6001 or greater	38	0	0	4	0	3	0	31	0	Unknown
Butte*	0350 or less	0	0	0	0	0	0	0	0	0	Unknown
Butte*	0351 to 500	0	0	0	0	0	0	0	0	0	Unknown
Butte*	0501 to 750	1	0	0	0	0	1	0	0	0	Unknown
Butte*	0751 to 1000	12	9	0	0	0	3	0	0	0	Unknown
Butte*	1001 to 2000	6	3	0	0	0	3	0	0	0	Unknown
Butte*	2001 to 6000	8	4	0	0	0	4	0	0	0	Unknown
Butte*	6001 or greater	16	14	0	0	0	2	0	0	0	Unknown
Calaveras	350 or less	0	0	0	0	0	0	0	0	0	0
Calaveras	351 to 500	0	0	0	0	0	0	0	0	0	0
Calaveras	501 to 750	0	0	0	0	0	0	0	0	0	0
Calaveras	751 to 1000	12	2	0	0	0	0	0	0	0	10
Calaveras	1001 to 2000	0	0	0	0	0	0	0	0	0	0

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			Phase I Controls				Phase I and Phase II Controls				Non Permitted/ No Controls
AP-42 Districts	Tank size in gallons	Total number of ASTs	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	All Tanks
Calaveras	2001 to 6000	4	4	0	0	0	0	0	0	0	0
Calaveras	6001 or greater	3	2	0	0	0	0	0	1	0	0
Colusa	0350 or less	0	0	0	0	0	0	0	0	0	Unknown
Colusa	0351 to 500	0	0	0	0	0	0	0	0	0	Unknown
Colusa	0501 to 750	0	0	0	0	0	0	0	0	0	Unknown
Colusa	0751 to 1000	0	0	0	0	0	0	0	0	0	Unknown
Colusa	1001 to 2000	1	1	0	0	0	0	0	0	0	Unknown
Colusa	2001 to 6000	5	2	0	0	0	3	0	0	0	Unknown
Colusa	6001 or greater	15	7	0	0	0	8	0	0	0	Unknown
El Dorado	0350 or less	3	0	0	1	0	0	0	2	0	Unknown
El Dorado	0351 to 500	5	0	0	2	0	0	0	3	0	Unknown
El Dorado	0501 to 750	0	0	0	0	0	0	0	0	0	Unknown
El Dorado	0751 to 1000	9	0	0	8	0	0	0	1	0	Unknown
El Dorado	1001 to 2000	4	0	0	1	0	0	0	3	0	Unknown
El Dorado	2001 to 6000	9	0	0	3	0	0	0	6	0	Unknown
El Dorado	6001 or greater	16	0	0	6	0	0	0	10	0	Unknown
Feather River	0350 or less	6	1	0	5	0	0	0	0	0	Unknown

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DISTRICT PERMITTED AST SURVEY (2006)											
			Phase I Controls				Phase I and Phase II Controls				Non Permitted/ No Controls
AP-42 Districts	Tank size in gallons	Total number of ASTs	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	All Tanks
Feather River	0351 to 500	12	8	0	4	0	0	0	0	0	Unknown
Feather River	0501 to 750	2	0	0	2	0	0	0	0	0	Unknown
Feather River	0751 to 1000	10	4	0	4	0	0	0	2	0	Unknown
Feather River	1001 to 2000	10	4	0	4	0	0	0	2	0	Unknown
Feather River	2001 to 6000	9	1	0	1	0	0	0	7	0	Unknown
Feather River	6001 or greater	18	1	0	11	0	0	0	6	0	Unknown
Glenn	0350 or less	1	1	0	0	0	0	0	0	0	0
Glenn	0351 to 500	3	3	0	0	0	0	0	0	0	0
Glenn	0501 to 750	2	2	0	0	0	0	0	0	0	0
Glenn	0751 to 1000	0	0	0	0	0	0	0	0	0	0
Glenn	1001 to 2000	4	1	0	0	0	0	0	0	0	3
Glenn	2001 to 6000	10	7	0	0	0	3	0	0	0	0
Glenn	6001 or greater	11	0	0	0	0	9	0	2	0	0
Great Basin	0350 or less	4	4	0	0	0	0	0	0	0	Unknown
Great Basin	0351 to 500	0	0	0	0	0	0	0	0	0	Unknown
Great Basin	0501 to 750	0	0	0	0	0	0	0	0	0	Unknown
Great Basin	0751 to 1000	13	0	0	13	0	0	0	0	0	Unknown

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DISTRICT PERMITTED AST SURVEY (2006)											
			Phase I Controls				Phase I and Phase II Controls				Non Permitted/ No Controls
AP-42 Districts	Tank size in gallons	Total number of ASTs	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	All Tanks
Great Basin	1001 to 2000	8	0	0	8	0	0	0	0	0	Unknown
Great Basin	2001 to 6000	10	0	0	10	0	0	0	0	0	Unknown
Great Basin	6001 or greater	11	0	0	11	0	0	0	0	0	Unknown
Imperial	0350 or less	0	0	0	0	0	0	0	0	0	0
Imperial	0351 to 500	14	7	0	0	0	1	0	6	0	0
Imperial	0501 to 750	54	3	0	0	0	0	0	1	0	50
Imperial	0751 to 1000	7	3	0	0	0	0	0	4	0	0
Imperial	1001 to 2000	3	1	0	0	0	0	0	2	0	0
Imperial	2001 to 6000	13	7	0	0	0	4	0	1	0	1
Imperial	6001 or greater	40	17	0	0	0	19	0	4	0	0
Kern	350 or less	0	0	0	0	0	0	0	0	0	Unknown
Kern	351 to 500	5	5	0	0	0	0	0	0	0	Unknown
Kern	501 to 750	3	3	0	0	0	0	0	0	0	Unknown
Kern	751 to 1000	16	0	0	2	0	1	0	13	0	Unknown
Kern	1001 to 2000	5	0	0	2	0	1	0	2	0	Unknown
Kern	2001 to 6000	8	0	0	0	0	1	0	7	0	Unknown

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DISTRICT PERMITTED AST SURVEY (2006)											
			Phase I Controls				Phase I and Phase II Controls				Non Permitted/ No Controls
AP-42 Districts	Tank size in gallons	Total number of ASTs	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	All Tanks
Kern	6001 or greater	0	0	0	0	0	0	0	0	0	Unknown
Lake*	350 or less	0	0	0	0	0	0	0	0	0	Unknown
Lake*	351 to 500	3	3	0	0	0	0	0	0	0	Unknown
Lake*	501 to 750	0	0	0	0	0	0	0	0	0	Unknown
Lake*	751 to 1000	7	7	0	0	0	0	0	0	0	Unknown
Lake*	1001 to 2000	2	2	0	0	0	0	0	0	0	Unknown
Lake*	2001 to 6000	6	5	0	0	0	1	0	0	0	Unknown
Lake*	6001 or greater	21	16	0	0	0	5	0	0	0	Unknown
Lassen	0350 or less	0	0	0	0	0	0	0	0	0	0
Lassen	0351 to 500	0	0	0	0	0	0	0	0	0	0
Lassen	501 to 750	0	0	0	0	0	0	0	0	0	0
Lassen	0751 to 1000	0	0	0	0	0	0	0	0	0	0
Lassen	1001 to 2000	0	0	0	0	0	0	0	0	0	0
Lassen	2001 to 6000	0	0	0	0	0	0	0	0	0	0
Lassen	6001 or greater	0	0	0	0	0	0	0	0	0	0
Mariposa	0350 or less	3	0	0	0	0	3	0	0	0	Unknown
Mariposa	0351 to 500	2	1	0	0	0	1	0	0	0	Unknown

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DISTRICT PERMITTED AST SURVEY (2006)											
			Phase I Controls				Phase I and Phase II Controls				Non Permitted/ No Controls
AP-42 Districts	Tank size in gallons	Total number of ASTs	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	All Tanks
Mariposa	0501 to 750	0	0	0	0	0	0	0	0	0	Unknown
Mariposa	0751 to 1000	5	2	0	0	0	3	0	0	0	Unknown
Mariposa	1001 to 2000	2	1	0	0	0	1	0	0	0	Unknown
Mariposa	2001 to 6000	4	0	0	0	0	4	0	0	0	Unknown
Mariposa	6001 or greater	2	0	0	0	0	2	0	0	0	Unknown
Mendocino	350 or less	0	0	0	0	0	0	0	0	0	0
Mendocino	351 to 500	1	0	0	0	0	0	0	0	0	1
Mendocino	501 to 750	0	0	0	0	0	0	0	0	0	0
Mendocino	751 to 1000	18	0	14	0	0	0	0	0	0	4
Mendocino	1001 to 2000	4	0	2	0	0	0	0	0	0	2
Mendocino	2001 to 6000	3	0	0	0	0	0	0	0	2	1
Mendocino	6001 or greater	17	0	0	0	0	0	0	0	3	14
Modoc	350 or less	2	0	0	2	0	0	0	0	0	Unknown
Modoc	351 to 500	4	0	0	4	0	0	0	0	0	Unknown
Modoc	501 to 750	0	0	0	0	0	0	0	0	0	Unknown
Modoc	751 to 1000	2	0	0	0	0	0	0	2	0	Unknown
Modoc	1001 to 2000	4	0	0	0	0	0	0	4	0	Unknown

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DISTRICT PERMITTED AST SURVEY (2006)											
			Phase I Controls				Phase I and Phase II Controls				Non Permitted/ No Controls
AP-42 Districts	Tank size in gallons	Total number of ASTs	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	All Tanks
Modoc	2001 to 6000	0	0	0	0	0	0	0	0	0	Unknown
Modoc	6001 or greater	0	0	0	0	0	0	0	0	0	Unknown
Mojave Desert*	350 or less	0	0	0	0	0	0	0	0	0	Unknown
Mojave Desert*	351 to 500	20	0	0	0	0	0	0	20	0	Unknown
Mojave Desert*	501 to 750	0	0	0	0	0	0	0	0	0	Unknown
Mojave Desert*	751 to 1000	36	0	0	0	0	0	0	36	0	Unknown
Mojave Desert*	1001 to 2000	14	0	0	0	0	0	0	14	0	Unknown
Mojave Desert*	2001 to 6000	16	0	0	0	0	0	0	16	0	Unknown
Mojave Desert*	6001 or greater	14	0	0	0	0	0	0	14	0	Unknown
Monterey Bay	350 or less	2	0	0	0	0	0	0	2	0	Unknown
Monterey Bay	351 to 500	157	0	0	4	0	0	0	153	0	Unknown
Monterey Bay	501 to 750	3	0	0	0	0	0	0	3	0	Unknown
Monterey Bay	751 to 1000	47	0	0	0	0	0	0	47	0	Unknown
Monterey Bay	1001 to 2000	21	0	0	0	0	0	0	21	0	Unknown
Monterey Bay	2001 to 6000	12	2	0	0	0	0	0	10	0	Unknown
Monterey Bay	6001 or greater	10	8	0	0	0	0	0	2	0	Unknown

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DISTRICT PERMITTED AST SURVEY (2006)

			Phase I Controls				Phase I and Phase II Controls				Non Permitted/ No Controls
AP-42 Districts	Tank size in gallons	Total number of ASTs	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	All Tanks
North Coast	350 or less	0	0	0	0	0	0	0	0	0	0
North Coast	351 to 500	0	0	0	0	0	0	0	0	0	0
North Coast	501 to 750	0	0	0	0	0	0	0	0	0	0
North Coast	751 to 1000	3	0	0	1	0	0	0	0	0	2
North Coast	1001 to 2000	8	0	0	1	0	0	0	3	0	4
North Coast	2001 to 6000	4	0	0	0	0	0	0	0	0	4
North Coast	6001 or greater	5	0	0	0	0	2	0	1	0	2
North Sierra	350 or less	0	0	0	0	0	0	0	0	0	0
North Sierra	351 to 500	0	0	0	0	0	0	0	0	0	0
North Sierra	501 to 750	5	5	0	0	0	0	0	0	0	0
North Sierra	751 to 1000	19	5	0	0	0	0	0	10	0	4
North Sierra	1001 to 2000	6	3	0	0	0	0	0	0	0	3
North Sierra	2001 to 6000	0	0	0	0	0	0	0	0	0	0
North Sierra	6001 or greater	3	0	0	0	0	0	0	0	0	3
North Sonoma	350 or less	1	0	1	0	0	0	0	0	0	Unknown
North Sonoma	351 to 500	1	0	0	0	0	0	0	1	0	Unknown
North Sonoma	501 to 750	1	0	1	0	0	0	0	0	0	Unknown
North Sonoma	751 to 1000	2	0	0	0	0	0	0	2	0	Unknown

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DISTRICT PERMITTED AST SURVEY (2006)

			Phase I Controls				Phase I and Phase II Controls				Non Permitted/ No Controls
AP-42 Districts	Tank size in gallons	Total number of ASTs	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	All Tanks
North Sonoma	1001 to 2000	4	0	0	1	0	0	0	3	0	Unknown
North Sonoma	2001 to 6000	5	0	0	1	0	0	0	4	0	Unknown
North Sonoma	6001 or greater	0	0	0	0	0	0	0	0	0	Unknown
Placer	350 or less	0	0	0	0	0	0	0	0	0	Unknown
Placer	351 to 500	32	0	0	4	0	0	0	28	0	Unknown
Placer	501 to 750	0	0	0	0	0	0	0	0	0	Unknown
Placer	751 to 1000	65	0	0	2	0	0	0	63	0	Unknown
Placer	1001 to 2000	7	0	0	0	0	0	0	7	0	Unknown
Placer	2001 to 6000	11	0	0	3	0	0	0	8	0	Unknown
Placer	6001 or greater	18	0	0	0	0	0	0	18	0	Unknown
Sacramento	350 or less	4	0	0	0	0	0	0	4	0	Unknown
Sacramento	351 to 500	1	0	0	1	0	0	0	0	0	Unknown
Sacramento	501 to 750	30	0	0	0	0	0	0	30	0	Unknown
Sacramento	751 to 1000	51	0	0	0	0	0	0	51	0	Unknown
Sacramento	1001 to 2000	6	0	0	2	0	0	0	4	0	Unknown
Sacramento	2001 to 6000	5	0	0	1	0	0	0	4	0	Unknown
Sacramento	6001 or greater	8	0	0	3	0	0	0	5	0	Unknown

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DISTRICT PERMITTED AST SURVEY (2006)											
			Phase I Controls				Phase I and Phase II Controls				Non Permitted/ No Controls
AP-42 Districts	Tank size in gallons	Total number of ASTs	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	All Tanks
San Diego	350 or less	16	1	0	0	0	0	0	0	0	15
San Diego	351 to 500	91	0	0	0	0	1	0	0	0	90
San Diego	501 to 750	8	4	0	0	0	0	0	0	0	4
San Diego	751 to 1000	50	33	0	0	0	17	0	0	0	0
San Diego	1001 to 2000	20	8	0	0	0	12	0	0	0	0
San Diego	2001 to 6000	21	5	0	0	0	16	0	0	0	0
San Diego	6001 or greater	9	2	0	0	0	7	0	0	0	0
San Joaquin	350 or less	9	6	0	0	0	0	0	3	0	Unknown
San Joaquin	351 to 500	191	31	1	41	0	0	0	118	0	Unknown
San Joaquin	501 to 750	42	33	1	0	0	0	0	8	0	Unknown
San Joaquin	751 to 1000	333	55	9	35	0	3	0	231	0	Unknown
San Joaquin	1001 to 2000	113	14	4	0	0	0	0	95	0	Unknown
San Joaquin	2001 to 6000	87	17	5	2	0	3	0	60	0	Unknown
San Joaquin	6001 or greater	118	11	1	5	0	44	0	57	0	Unknown
San Luis Obispo	350 or less	0	0	0	0	0	0	0	0	0	0
San Luis Obispo	351 to 500	4	0	0	0	0	0	0	0	0	4
San Luis Obispo	501 to 750	0	0	0	0	0	0	0	0	0	0
San Luis Obispo	751 to 1000	7	0	0	0	0	0	0	0	0	7

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AST POPULATION SURVEY
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DISTRICT PERMITTED AST SURVEY (2006)											
			Phase I Controls				Phase I and Phase II Controls				Non Permitted/ No Controls
AP-42 Districts	Tank size in gallons	Total number of ASTs	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	All Tanks
San Luis Obispo	1001 to 2000	6	0	0	0	0	0	0	6	0	0
San Luis Obispo	2001 to 6000	6	0	0	0	0	0	0	6	0	0
San Luis Obispo	6001 or greater	4	0	0	0	0	0	0	4	0	0
Santa Barbara	350 or less	19	0	0	0	0	0	0	1	0	18
Santa Barbara	351 to 500	19	1	0	0	0	0	0	10	0	8
Santa Barbara	501 to 750	7	0	0	0	0	0	0	0	0	7
Santa Barbara	751 to 1000	32	0	0	0	0	0	0	12	0	20
Santa Barbara	1001 to 2000	17	0	1	0	0	0	0	13	0	3
Santa Barbara	2001 to 6000	4	0	0	0	0	0	0	4	0	0
Santa Barbara	6001 or greater	15	0	0	0	0	9	0	2	0	4
Shasta	350 or less	0	0	0	0	0	0	0	0	0	0
Shasta	351 to 500	1	0	0	1	0	0	0	0	0	0
Shasta	501 to 750	0	0	0	0	0	0	0	0	0	0
Shasta	751 to 1000	5	2	0	0	0	0	0	2	0	1
Shasta	1001 to 2000	1	0	0	1	0	0	0	0	0	0
Shasta	2001 to 6000	8	0	0	4	0	0	0	0	0	4

APPENDIX H
AST POPULATION SURVEY
TABLE H-4

DISTRICT PERMITTED AST SURVEY (2006)

			Phase I Controls				Phase I and Phase II Controls				Non Permitted/ No Controls
AP-42 Districts	Tank size in gallons	Total number of ASTs	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	All Tanks
Shasta	6001 or greater	21	0	0	8	0	7	0	0	0	6
Siskiyou	350 or less	0	0	0	0	0	0	0	0	0	0
Siskiyou	351 to 500	0	0	0	0	0	0	0	0	0	0
Siskiyou	501 to 750	0	0	0	0	0	0	0	0	0	0
Siskiyou	751 to 1000	0	0	0	0	0	0	0	0	0	0
Siskiyou	1001 to 2000	0	0	0	0	0	0	0	0	0	0
Siskiyou	2001 to 6000	1	0	0	0	0	0	0	1	0	0
Siskiyou	6001 or greater	11	5	0	0	0	2	0	2	0	2
South Coast	350 or less	11	0	0	0	0	0	0	11	0	Unknown
South Coast	351 to 500	74	0	0	0	0	0	0	73	1	Unknown
South Coast	501 to 750	15	0	0	0	0	0	0	15	0	Unknown
South Coast	751 to 1000	118	0	0	0	0	0	0	118	0	Unknown
South Coast	1001 to 2000	99	0	0	0	0	0	0	99	0	Unknown
South Coast	2001 to 6000	74	0	0	0	0	0	0	74	0	Unknown
South Coast	6001 or greater	46	0	0	0	0	0	0	46	0	Unknown
Tehama	350 or less	0	0	0	0	0	0	0	0	0	Unknown

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AST POPULATION SURVEY
TABLE H-4

DISTRICT PERMITTED AST SURVEY (2006)

			Phase I Controls				Phase I and Phase II Controls				Non Permitted/ No Controls
AP-42 Districts	Tank size in gallons	Total number of ASTs	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	All Tanks
Tehama	351 to 500	0	0	0	0	0	0	0	0	0	Unknown
Tehama	501 to 750	0	0	0	0	0	0	0	0	0	Unknown
Tehama	751 to 1000	0	0	0	0	0	0	0	0	0	Unknown
Tehama	1001 to 2000	1	0	0	0	0	0	0	1	0	Unknown
Tehama	2001 to 6000	0	0	0	0	0	0	0	0	0	Unknown
Tehama	6001 or greater	3	1	0	0	0	2	0	0	0	Unknown
Tuolumne	350 or less	0	0	0	0	0	0	0	0	0	Unknown
Tuolumne	351 to 500	0	0	0	0	0	0	0	0	0	Unknown
Tuolumne	501 to 750	0	0	0	0	0	0	0	0	0	Unknown
Tuolumne	751 to 1000	0	0	0	0	0	0	0	0	0	Unknown
Tuolumne	1001 to 2000	0	0	0	0	0	0	0	0	0	Unknown
Tuolumne	2001 to 6000	0	0	0	0	0	0	0	0	0	Unknown
Tuolumne	6001 or greater	7	2	0	0	0	5	0	0	0	Unknown
Ventura*	350 or less	0	0	0	0	0	0	0	0	0	Unknown
Ventura*	351 to 500	4	0	0	4	0	0	0	0	0	Unknown
Ventura*	501 to 750	2	0	0	1	0	0	0	1	0	Unknown
Ventura*	751 to 1000	28	0	0	13	0	0	0	15	0	Unknown

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TABLE H-4

DISTRICT PERMITTED AST SURVEY (2006)

			Phase I Controls				Phase I and Phase II Controls				Non Permitted/ No Controls
AP-42 Districts	Tank size in gallons	Total number of ASTs	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	Single Wall Tanks	Single Wall Ag Tanks	Protected Tanks	Protected Ag Tanks	All Tanks
Ventura*	1001 to 2000	14	0	0	2	0	0	0	12	0	Unknown
Ventura*	2001 to 6000	11	0	0	1	0	0	0	10	0	Unknown
Ventura*	6001 or greater	2	0	0	0	0	0	0	2	0	Unknown
Yolo-Solano*	350 or less	0	0	0	0	0	0	0	0	0	Unknown
Yolo-Solano*	351 to 500	19	6	0	0	0	13	0	0	0	Unknown
Yolo-Solano*	501 to 750	0	0	0	0	0	0	0	0	0	Unknown
Yolo-Solano*	751 to 1000	23	8	0	0	0	15	0	0	0	Unknown
Yolo-Solano*	1001 to 2000	6	4	0	0	0	2	0	0	0	Unknown
Yolo-Solano*	2001 to 6000	9	4	0	0	0	5	0	0	0	Unknown
Yolo-Solano*	6001 or greater	11	3	0	0	0	8	0	0	0	Unknown
	Total	**3412**	**449**	**42**	**265**	**1**	**261**	**0**	**208 7**	**6**	**301**
			491		**266**		**261**		**209 3**		
Total Permitted ASTs		**=**	**3111**								
* District does not distinguish between single wall and protected tanks.											

APPENDIX I

AST Emissions Inventory

1. Emissions Inventory

Monitoring and Laboratory Division (MLD) with the assistance of Planning Technical and Support Division (PTSD) has developed the statewide emissions inventory to support the enhanced vapor recovery rulemaking on ASTs. The inventory was developed using the population estimates and emission factors calculated for different types of ASTs. Based on this data, there are approximately 9,582 ASTs in California with annual average emissions of approximately 3.31 tons/day. Emissions from ASTs vary depending on their size, type and vapor recovery configuration. Appendix H contains the detail information on population estimates of ASTs. Attachment A contains a detailed report that describes the development of regional tank specific emission factors. The fully detailed spreadsheets used in the calculations are available from ARB upon request.

A. AST Population Distribution

The number of ASTs in California was determined through regional surveys of Districts, Fuel Carriers, AST manufacturers, and the State Water Resources Control Board. The surveys identified AST categories that included single wall and protected tanks. The survey data is summarized in Table 1.

Table 1
AST Population Survey Summary

Source	Year	Single Wall	Protected	Total
AST Manufacturer	2002	2,407	3,398	6,005
Districts*	2003	n/a	n/a	1,892
Districts*	2006	752	2,359	3,111
Fuel Carriers	2003	4,760	2,873	7,633
Fuel Carriers**	2004	7,620	1,962	9,582
Water Board	2003	n/a	n/a	3,899

*District survey data only included permitted tanks; all other surveys included both permitted and non permitted tanks.
**Raw data from the 2004 Fuel Carrier survey was extrapolated based on the percentage of respondents to the survey (approximately 33 percent).

The 2002 AST Manufacturer, 2003 District, Fuel Carrier, and Water Board surveys were not comprehensive enough to quantify the number of tanks in California. Specific categories had to be identified. The 2004 Fuel Carrier and 2006 District surveys addressed this deficiency and further categorized single wall and protected ASTs into ASTs with no vapor recovery, Phase I vapor recovery, and Phase I and Phase II vapor recovery. These breakdowns are summarized in Table 2.

Table 2
Vapor Recovery Categories of Single Wall and Protected ASTs

Survey	Single Wall Tanks			Protected Tanks		
	No VR	Phase I	Phase I/II	No VR	Phase I	Phase I/II
Fuel Carriers	5777	1610	233	264	383	1315
Districts*	301	491	261	0	266	2093

*Permitted tanks only, except for the 301 single wall tanks with no vapor recovery.

Appendix H contains the table titled "AST Fuel Carrier Survey (2004)" with the complete breakdown of this survey and also contains the table titled "District Permitted AST Survey (2006)" with detail information on the population data collected for all the tanks permitted by the districts. The 2004 Fuel Carrier Survey also identified ASTs by location and application: farm (agriculture), marina, and other (retail gasoline dispensing facility and municipalities). Staff assumed that ASTs in the marina (167) and other (2,950) categories are District permitted tanks and that the farm (6465) category includes District non-permitted tanks due to California Health and Safety Code exemptions since removed by Senate Bill 700 (Florez, 2003). Therefore the number of ASTs permitted by Districts according to the 2004 Fuel Carrier Survey was 3117, and the number of permitted ASTs identified by the 2006 District Survey was 3111. The average percent difference of permitted tanks between the two surveys is approximately 0.2%.

Based on the survey data compiled from Fuel Carriers (2004) and Districts (2006), staff estimates that there are 9,582 ASTs in California. Of these tanks, 3117 ASTs are District permitted and 6465 ASTs are not permitted by Districts.

B Emission Factors

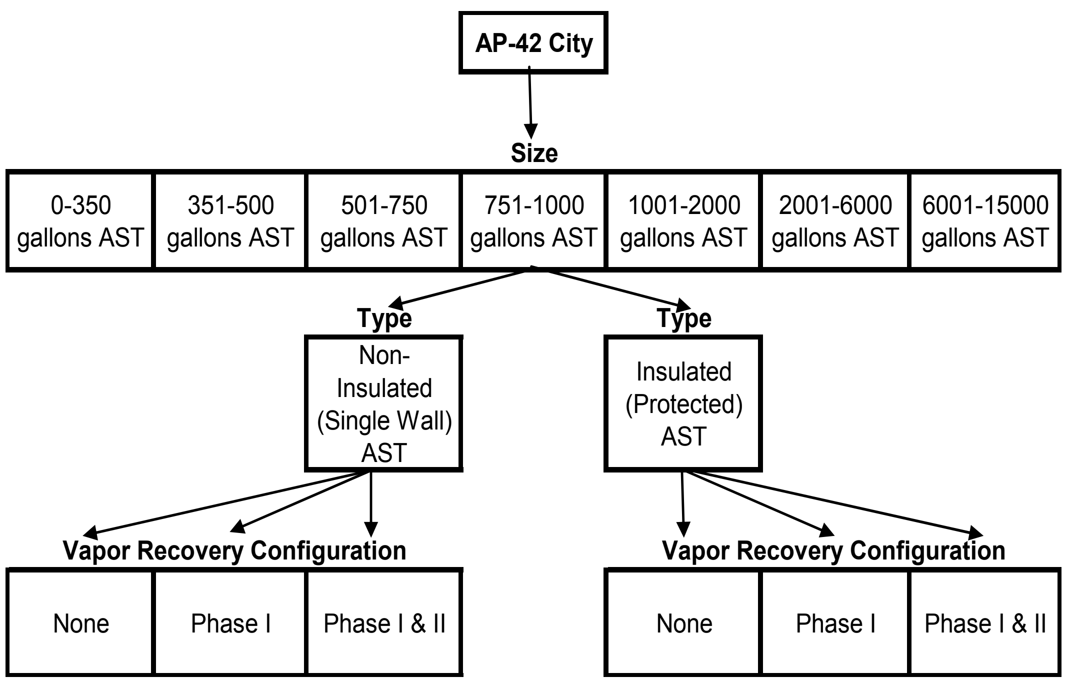
AP-42 Methodology, developed by American Petroleum Institute and approved by US Environmental Protection Agency (EPA), was used to calculate the emission factors for ASTs. This methodology consists of detailed method of calculating emissions from single wall storage tanks and can be found on the U.S EPA website:

http://www.epa.gov/ttn/chief/ap42/ch07/index.html

This document also consists of monthly ambient temperature profiles for 15 cities in California. These ambient temperature profiles are tabulated in Attachment B. Each AST, identified in the 2004 Fuel Carrier Survey discussed in the previous section, was linked to the closest AP-42 city and the corresponding temperature data was used to calculate the emissions. However, some equations in the original AP-42 methodology were modified based on the AST configurations being evaluated. Attachment A contains a detailed report titled “Air Resources Board’s Approach to Estimating Aboveground Storage Tank Emission Factors using the AP-42 Method” that describes these modifications and the assumptions made in performing the calculations. Emission factors for ASTs were calculated based on their location, size, type, and vapor recovery configurations as shown in Figure 2.

Figure 2

Emission Factors Calculated for Each Region, Size, Type and Vapor Recovery Configuration of ASTs



As described in detail earlier, there are three main types of emissions from ASTs. Emission factors were calculated for all types of emissions or losses from ASTs:

Standing Losses: Emission factors for these losses were calculated using AP-42 methodology for all the sizes, types and vapor recovery configurations as shown in figure 2. Standing losses contribute to 2.95 tons/day out of the total statewide emissions from ASTs as shown in Table 3. Some equations in AP-42 methodology were modified based on data obtained from studies conducted by staff at Air Resources Board (ARB) as described below.

- Attenuation Factors: In 2004, ARB staff collected almost four months of daily ambient temperature and daily fuel surface temperature data for various single wall and protected tanks located in the greater Sacramento region. Attenuation factors were derived using this data and applied in the AP-42 calculations of emission factors for these types of tanks (see Attachment A). The average attenuation factor was calculated to be 0.11 for a single wall AST and 0.90 for a protected AST.

- Correction Factor: U.S. EPA approved AP-42 Methodology applies to a closed system i.e. tank with a pressure vacuum vent (PV) valve. The 2004 AST Fuel Carrier Survey (Table 2) indicated that there are several tanks which had no vapor recovery or PV valve and are open to the atmosphere. Results from a field study, conducted by ARB staff in 2005 (see Appendix D), concluded that AP-42 methodology underestimates emissions from an open system (AST with no PV valve) by a factor of 1.6 as compared to a closed system (AST with a PV valve). Therefore, a correction factor of 1.6 was applied to emission factors calculated using AP-42 methodology for ASTs with no PV valve.

Working (Phase I) Losses and Vapor Displacement (Phase II) Losses: These emissions depend on the fuel throughput which was assumed to be four tank fillings each year with each refilling amounting to 80% of the tank volume (Attachment A). These emissions are much smaller (~10%) than the standing loss emissions (~90%). Moreover, ASTs with Phase I and Phase II vapor recovery systems have even smaller emissions. Phase I vapor recovery controls about 95% of the working loss emissions and Phase II vapor recovery controls about 90% of the vapor displacement emissions. The population survey indicated that the majority of the ASTs did not have any vapor recovery systems. Emission factors were calculated for ASTs with no vapor recovery, with Phase I and with Phase I & Phase II vapor recovery systems.

Working losses and vapor displacement losses contribute to 0.14 tons/day and 0.20 tons/day respectively out of the total statewide emissions from ASTs as shown in Table 3.

Spillage Losses: These losses occur during pre-fueling, fueling and post fueling operations. The emission factor used for spillage losses was 0.64lb/1000 gallon for ASTs with no vapor recovery and ASTs with only Phase I vapor recovery systems and 0.42 lb/1000 gallon for ASTs with Phase II vapor recovery systems. Spillage losses contribute to only 0.02 tons/day out of the total statewide emissions from ASTs as shown in Table 3.

Emission factors were calculated for all the above listed emission types and applied to ASTs located statewide. As stated earlier in this section, each AST was linked to the nearest AP-42 city due to the availability of daily ambient temperature data that was used to calculate the emissions. Therefore, emission factors calculated for each AP-42 city actually represent a particular region in the state. Combination of all these regional emissions contributes to the statewide emissions inventory for ASTs as shown in Table 3.

Table 3
Statewide AST Emissions Inventory (2004)

AP-42 City/Region	Throughput (1000 gal)	Breathing Losses (tons/day)	Working Losses (tons/day)	Vapor Displacement Losses (tons/day)	Spillage Losses (tons/day)	Total AST Emissions (tons/day)
Bakersfield*	1,778	0.25	0.01	0.01	0.00	0.27
Bishop	180	0.02	0.00	0.00	0.00	0.02
Eureka	1,133	0.06	0.01	0.01	0.00	0.08
Fresno*	2,342	0.37	0.01	0.02	0.00	0.40
Long Beach	139	0.00	0.00	0.00	0.00	0.00
Los Angeles C.O.	1,295	0.04	0.00	0.00	0.00	0.05
Mount Shasta	3,727	0.32	0.02	0.03	0.00	0.37
Redding	2,466	0.33	0.02	0.02	0.00	0.37
Sacramento	9,106	0.82	0.04	0.05	0.01	0.92
San Diego	1,658	0.11	0.01	0.01	0.00	0.13
San Francisco AP	1,025	0.05	0.00	0.01	0.00	0.06
San Francisco C.O.	142	0.00	0.00	0.00	0.00	0.00
Santa Barbara	313	0.03	0.00	0.00	0.00	0.03
Santa Maria	1,050	0.13	0.01	0.01	0.00	0.14
Stockton*	3,675	0.42	0.01	0.02	0.00	0.46
Statewide	***30,029***	***2.95***	**0.14**	**0.20**	***0.02***	**3.31**

* San Joaquin Valley region = 1.13 tons/day

APPENDIX I

Attachment A
Air Resources Board's Approach to Estimating
Aboveground Storage Tank Emission Factors using the AP-42 Method

Introduction

The California Air Resources Board (ARB) has developed a statewide emission inventory of Aboveground Storage Tanks (AST) as part of its Enhanced Vapor Recovery Rulemaking. ARB staff used the equations in AP-42, developed by the American Petroleum Institute, to determine AST emission factors from single-wall and protected ASTs with different sizes and configurations. The statewide AST emission inventory is based on these emission factors.

AP-42, a document published by the U.S. Environmental Protection Agency (EPA), consists of a detailed method for calculating emissions losses from single-wall storage tanks. AP-42 can be viewed under section "Organic Liquid Storage Tanks" (Background Document) on the U.S EPA's website at http://www.epa.gov/ttn/chief/ap42/ch07/index.html. To use AP-42 for protected tanks, fuel surface temperatures are required. In 2004, ARB staff monitored several protected ASTs of various sizes (see the November 3, 2004 presentation on the AST vapor recovery website at http://www.arb.ca.gov/vapor/ast/ast.htm for more information). The purpose of monitoring these tanks was to acquire the fuel surface temperature information needed for the AP-42 equations.

This document presents the stepwise approach used in calculating the emission factors for single-wall (Non-Insulated) and protected (Insulated) ASTs, using AP-42 methodology. However, some equations used in AP-42 methodology were modified based on the AST configurations being evaluated. These modifications were based on some assumptions which are listed along with the respective equation.

Total Losses from Storage Tanks

The following equations apply to horizontal aboveground storage tanks (ASTs) that store organic liquids i.e. gasoline. These tanks must be substantially liquid and vapor-tight and must operate at atmospheric pressure. Total losses from ASTs, equal to the sum of the standing storage loss and working loss (including vapor displacement loss), are calculated for each month:

$$\mathbf{L_T = L_S + L_W}$$

Where:
L_T = total losses, lb/month
L_S = standing storage loss, lb/month

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L_W = working loss and vapor displacement loss, lb/month

Standing Storage or Breathing Loss

$$L_S = nVvWvK_EK_S$$

Where:
L_S = Standing storage losses, lb/month
n = number of days in the respective month
Vv = vapor space volume of the ullage, ft^3
Wv = vapor density, lb/ft^3
K_E = vapor space expansion factor, dimensionless
K_S = vented vapor saturation factor, dimensionless

- **Tank vapor space volume, V_V**, is considered to be equal to the ullage volume and was estimated as:

  Assumption: The ASTs being considered in this evaluation are horizontal with no roof outage or vapor space outage factor. The AST is half-full so therefore V_v is half the AST capacity. When a range of tank capacities are considered, the average tank capacity is used and divided by 7.481 to convert gallons into ft^3. The following equation is a modified version of the AP-42 equation.

$$V_V = \tfrac{1}{2} \text{ tank capacity } (ft^3)$$

Example: Tank capacity range = 751-1000 gallons
Average tank capacity = 875.5 gallons = 875.5/7.481 = 117 ft^3
V_v = 1/2*117=58.5 ft^3

- **Vapor Density, W_V**, is the density of the vapor and was calculated using the following equation:

$$W_V = M_V P_{VA} / RT_{LA}$$

Where:
W_V = vapor density, lb/ft^3
M_V = vapor molecular weight, lb/lb-mole
R = the ideal gas constant, 10.731 psia·ft^3/lb-mole·°R
P_{VA} = vapor pressure at daily average liquid-surface temperature, psia
T_{LA} = daily average liquid (gasoline) surface temperature, °R

  - **Molecular weight of the vapor (M_V)** was obtained from the Table 3-2 in AP-42, listing the physical properties of gasoline. The molecular weight of gasoline changes with the change in Reid Vapor Pressure (RVP).

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***Assumption**:* The RVP of gasoline for the summer months (April to October) is 7.0 psi, for the winter months (November to February) is 11.0 psi and for the month of March is 9.0 psi.
Listed below are the molecular weights of gasoline for each corresponding RVP:

April-October – RVP = 7 psi, $M_V = 68$
November-February – RVP = 11 psi, $M_V = 65$
March – RVP = 9 psi, $M_V = 67$

- **True vapor pressure (P_{VA})** of gasoline stocks, at the daily average liquid surface temperature, can be determined using the following equation:

$$P_{VA} = \exp\,[A - (B/T_{LA})]$$

Where:
exp = exponential function
T_{LA} = daily average liquid (gasoline) surface temperature, °R
Figure 3-5 in AP-42 shows the equations used to determine vapor pressure constants, A (dimensionless) and B (°R) for each corresponding RVP of gasoline:

RVP = 7 psi, A = 11.83 and B = 5500.90 °R
RVP = 9 psi, A = 11.75 and B = 5314.31 °R
RVP = 11 psi, A = 11.69 and B = 5166.94 °R

- **Daily average liquid (gasoline) surface temperature (T_{LA})** was calculated using the following equation:

$$T_{LA} = (T_{LN} + T_{LX})/2$$

Where:
T_{LN} = daily minimum liquid (gasoline) surface temperature, °R
T_{LX} = daily maximum liquid (gasoline) surface temperature, °R

These values were obtained from the ambient temperature data available in the AP-42 “TANKS” software. This software has ambient temperature data in (°F) for sixteen cities in California. Using this data, the following was determined for ASTs within each of the sixteen cities (Attachment B):

Tamb.avg = daily ambient average temperature, °F
Tamb.range = daily ambient temperature range, °F or ºR

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Study conducted to determine the effect of daily ambient temperatures on gasoline surface temperatures (T_{LN} and T_{LX}):

In 2004, ARB staff conducted a four-month study to measure ambient temperatures and gasoline surface temperatures for existing single wall (non-insulated) and protected (insulated) ASTs in the greater Sacramento region. Daily maximum and minimum temperature data was collected for ambient and gasoline surface inside both types of ASTs. The difference between the daily maximum and daily minimum temperature determined the change in the daily temperature. This data was used to derive an attenuation factor, as shown below, which determines the correlation between ambient and gasoline surface temperatures for a particular type of AST.

$$\text{*Attenuation Factor} = \frac{\text{delta Ambient} - \text{delta Fuel Surface}}{\text{delta Ambient}}$$

Where,

delta Ambient = Change in Daily Ambient Temperature

delta Fuel Surface = Change in Daily Fuel Surface Temperature

*Note that this formula is different from the one used in Appendix G where
Attenuation Factor = delta Fuel Surface/delta Ambient
However, when applied to AP-42 equations for calculating the minimum (T_{LN}) and the maximum (T_{LX}) temperatures as shown below,
it comes out to be the same as the formula used in Appendix G.

<u>Single Wall (Non-Insulated) ASTs:</u>

The attenuation factor was determined to be **0.11**, which means that the ambient temperature was attenuated by only a small amount in a single wall or non-insulated AST. This study concluded that the diurnal changes in ambient temperature have the same diurnal effect on the gasoline surface temperature inside a single wall AST, as shown in Figure 1.

<u>Protected (Insulated) ASTs:</u>

The average attenuation factor was determined to be **0.90**, which means that the ambient temperature was attenuated significantly in a protected or insulated AST. This study concluded that the diurnal changes in ambient temperature have a very small effect on the gasoline surface temperature inside a protected AST, as shown in Figure 2.

Using the above attenuation factors and ambient temperature data, the daily minimum and maximum liquid (gasoline) surface temperatures were estimated for both non-insulated and insulated ASTs as follows:
Please note that amb.avg temperature is converted from ºF to ºR by adding 460.

The daily minimum liquid (gasoline) surface temperature (T_{LN}) was calculated as:

$$\mathbf{T_{LN} = [Tamb.avg+460] - [(1\text{-}Attenuation\ factor)*(Tambrange/2)]}$$

The daily maximum liquid (gasoline) surface temperature (T_{LX}) was calculated as:

$$\mathbf{T_{LX} = [Tamb.avg+460] + [(1\text{-}Attenuation\ factor)*(Tambrange/2)]}$$

- **<u>Vapor Space Expansion Factor, K_E</u>**- the vapor space expansion factor was calculated using the following equation:

$$\mathbf{K_E = [(\Delta T_V/T_{LA})] + [(\Delta P_V\text{-}\Delta P_B)/(14.7\text{-}P_{VA})]}$$

Where:
K_E = dimensionless factor
ΔT_V = daily vapor temperature range, °R
ΔP_V = daily vapor pressure range, psi
ΔP_B = breather vent pressure setting range, psi
14.7 = atmospheric pressure, psi
P_{VA} = vapor pressure at daily average liquid surface temperature, psi (derived earlier)
T_{LA} = daily average liquid (gasoline) surface temperature, °R (derived earlier)

- **The daily vapor temperature range, ΔT_V**, was calculated below using the daily maximum and daily minimum liquid (gasoline) surface temperatures (derived earlier):

  ***Assumption**:* <u>The vapor temperature range is equal to the liquid (gasoline) surface temperature range.</u>

$$\mathbf{\Delta T_V = T_{LX} - T_{LN}}$$

- **The daily vapor pressure range, ΔP_V**, was calculated using the following equation:

$$\mathbf{\Delta P_V = P_{VX} - P_{VN}}$$

Where:
P_{VX} = vapor pressure P_{VA} at daily maximum liquid (gasoline) surface temperature, psi
P_{VN} = vapor pressure P_{VA} at daily minimum liquid (gasoline) surface temperature, psi

Using the daily maximum and daily minimum liquid (gasoline) surface temperatures, the respective vapor pressures were calculated as:

$$\mathbf{P_{VX} = exp[A-(B/T_{LX})]}$$

$$\mathbf{P_{VN} = exp[A-(B/T_{LN})]}$$

Where:
RVP = 7 psi, A = 11.83 and B = 5500.90 ºR
RVP = 9 psi, A = 11.75 and B = 5314.31 ºR
RVP = 11psi, A = 11.69 and B = 5166.94 °R

- **The breather vent pressure setting range, delta P_B**, was calculated using the following equation:

$$\Delta \mathbf{P_B = P_{BP} - P_{BV}}$$

Where:
ΔP_B = breather vent range (psi)
P_{BP} = breather vent pressure setting (psi)
P_{BV} = breather vent vacuum setting (psi)

For ASTs with a pressure/vacuum vent valve
P_{BP} = 3 inH_2O ≅ 0.108 psi
P_{BV} = -8 inH_2O ≅ - 0.288 psi

For ASTs with no pressure/vacuum vent valve
P_{BP} = 0 inH_2O ≅ 0 psi
P_{BV} = 0 inH_2O ≅ 0 psi

- **The vapor pressure at daily average liquid (gasoline) surface temperature, P_{VA}**, was calculated as shown earlier.

- **The daily average liquid (gasoline) surface temperature, T_{LA}**, was calculated as shown earlier.

♦ **Vented Vapor Saturation Factor, K_S** – The vented vapor saturation factor was calculated using the following equation:

$$Ks = \frac{1}{1+(0.053*P_{VA}*H_{VO})} = 1$$

Where:
Ks = dimensionless factor
P_{VA} = vapor pressure at daily average fuel surface temperature, psi
H_{VO} = vapor space outage = 0 ft
(As mentioned earlier, the ASTs being considered in this evaluation are horizontal with no roof outage or vapor space outage factor)

Working Loss and Vapor Displacement Loss

Working loss is the mass of vapors emitted during the transfer of gasoline from the cargo tank to the AST (Deliveries).

Vapor displacement loss occurs during the transfer of gasoline from the AST to the vehicle (Dispenses).

The general equation for working loss is as follows:

$$L_W = L_{W\ (Deliveries)} + L_{W\ (Dispenses)}$$

Where:
L_w = total working loss, lb/month
$L_{W\ (Deliveries)}$ = working loss due to deliveries made into an AST, lb/month
$L_{W\ (Dispenses)}$ = vapor displacement loss due to dispenses from an AST into vehicle tank, lb/month

Working loss and vapor displacement losses can be minimized by controlling displaced vapors during gasoline deliveries into AST (Phase I) or during gasoline dispenses into a vehicle (Phase II). In California, the air quality districts regulate whether or not an AST is required to have Phase I and/or Phase II controls. Therefore, the ASTs may have no vapor recovery controls, Phase I vapor recovery control only, or both Phase I and Phase II vapor recovery controls. The total loss from working loss and vapor displacement loss will be different for each of these three configurations.

Assumptions: The AST is 80% empty when the cargo tank delivers gasoline into it. The number of deliveries per year is 4. The volume of gasoline delivered to the AST is equal to the volume of gasoline dispensed from the AST into vehicle tanks. The volume of gasoline delivered to the AST was calculated as follows:

$$V_{(Delivered)} = N_{(Deliveries)} * (\text{AST Capacity} * 0.80)$$

Where:

$V_{(Delivered)}$ = volume of the gasoline delivered to AST
$N_{(Deliveries)}$ = number of deliveries made per year to AST
AST capacity, ft^3 (derived earlier)

- **<u>No Vapor Recovery Control,</u> Phase I = 0, Phase II = 0**

For ASTs with no Phase I and Phase II vapor recovery control, the volume of vapors displaced during a delivery and dispensing is equal to the volume of gasoline delivered to the AST and dispensed to a vehicle tank respectively. All the vapors displaced during the delivery and dispensing are lost to the atmosphere. The loss due to dispenses is equal to the loss due to deliveries.

$$L_{W\ (Deliveries)} = (V_{(Delivered)} * W_V)/12$$
$$L_{W\ (Dispenses)} = (V_{(Delivered)} * W_V)/12$$

Where:
W_V = vapor density, lb/ft^3 (derived earlier)
12 = number of months in a year

Phase I Vapor Recovery Control, Phase I = 0.95, Phase II = 0

For ASTs with only Phase I vapor recovery control, 95% of the volume of vapors displaced during a delivery is returned to the cargo tank. The remaining 5% is lost to the atmosphere. Due to no Phase II control, volume of vapors displaced during a dispense is equal to the volume of gasoline dispensed to the vehicle. Therefore, all the vapors displaced during a dispense are lost to the atmosphere.

$$L_{W\ (Deliveries)} = [V_{(Delivered)} * W_V)/12](1- 0.95)$$
$$L_{W\ (Dispenses)} = (V_{(Delivered)} * W_V)/12$$

Phase I and Phase II Vapor Recovery Control, Phase I = 0.95, Phase II = 0.90

For ASTs with Phase I and Phase II vapor recovery control, 95% of the volume of vapors displaced during a delivery are returned to the cargo tank and 90% of the volume of vapors displaced during a dispense are returned to the AST respectively. The remaining percent of vapors are lost to the atmosphere.

$$L_{W\ (Deliveries)} = (V_{(Delivered)} * W_V)/12] * [1- 0.95]$$
$$L_{W\ (Dispenses)} = (V_{(Delivered)} * W_V)/12] * [1- 0.90]$$

Conclusion

The above described AP-42 method of calculating emission factors for aboveground storage tanks (ASTs) accounted for two significant factors:

Seasonal Variation – **Emissions from ASTs were higher during summer months than during winter months. This is as expected because temperatures are higher and have a greater range in the summer months.**

Tank Characteristics **– An insulated (protected) tank generated lower emissions than a non-insulated (single wall) tank. Figures 1 and 2 clearly show that the influence of diurnal swings in ambient temperature has less effect on gasoline surface temperature in an insulated tank vs. a non-insulated tank. The gasoline surface temperature remains very stable in an insulated tank and therefore causes much lower emissions.**

ARB staff applied this approach to various categories of ASTs by size, type, vapor recovery configuration, and location for determining the various emission factors. This approach was presented at AST workshops to get comments from the different stakeholders. Some comments were received and were incorporated in the calculations. The statewide emissions inventory was developed using these emission factors and tank population estimates.

APPENDIX I

Figure 1- Ambient Temperature Compared to Gasoline Surface Temperature in a Single-Wall (Non-Insulated)Tank

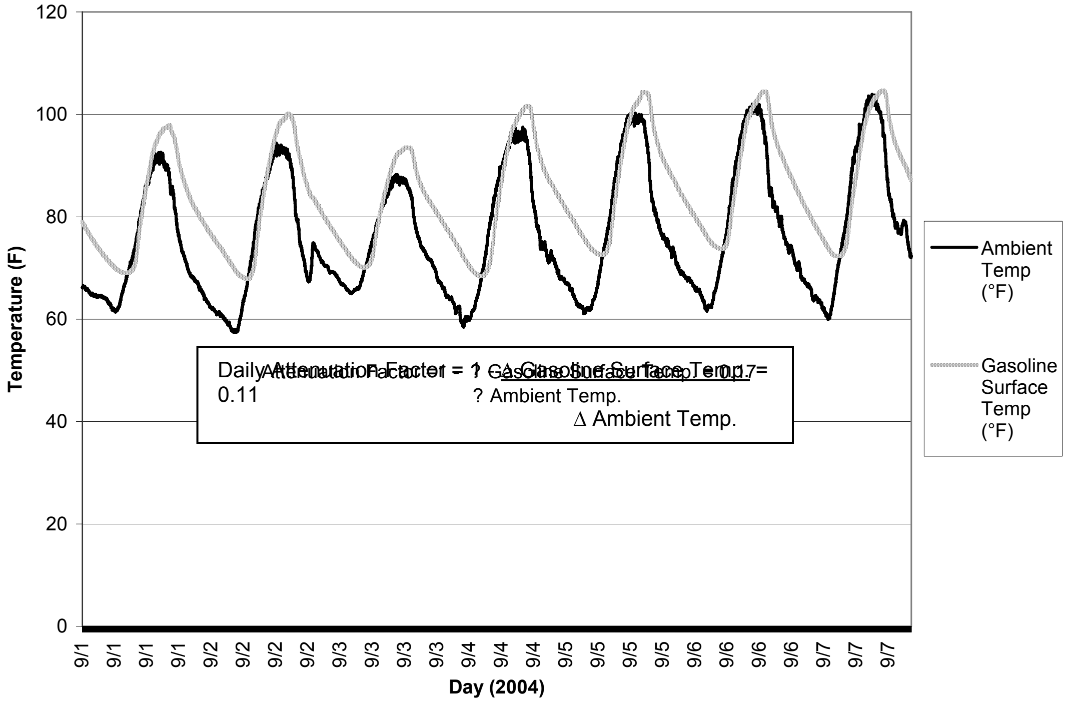
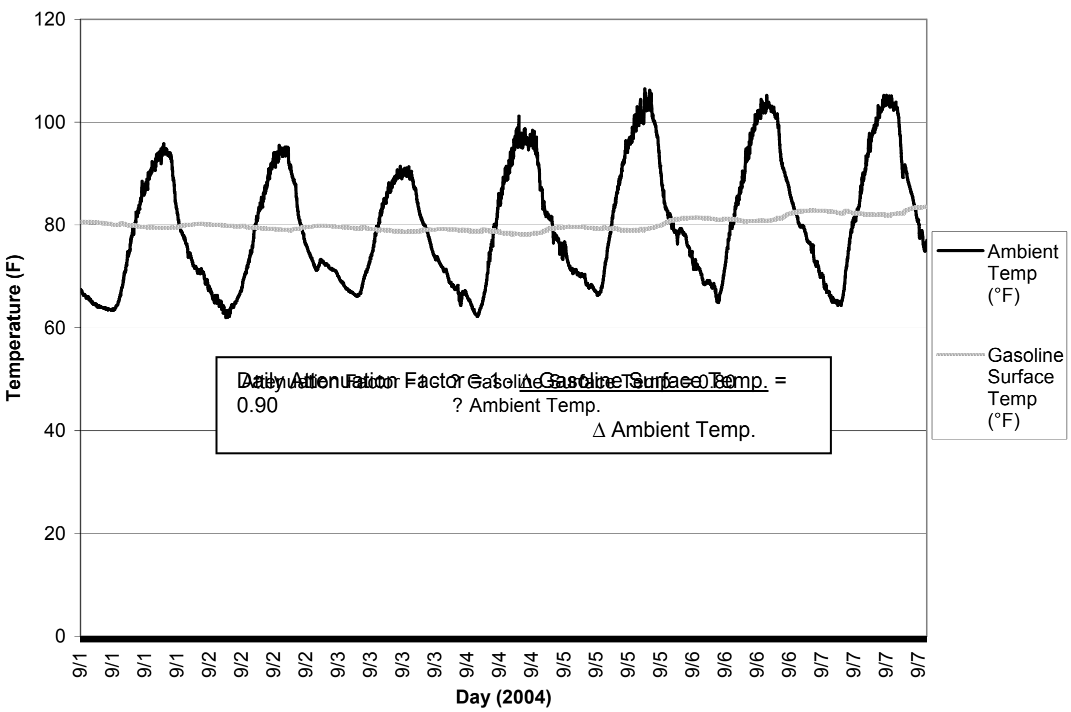


Figure 2- Ambient Temperature Compared to Gasoline Surface Temperature in a Protected (Insulated)Tank



APPENDIX I

Attachment B
Ambient Temperature Data For AP-42 Cities

AP-42 City	Month	Average Ambient Temp (F)	Ambient Temp (F) Range
Bakersfield	January	47.75	18.30
Bakersfield	February	53.25	21.30
Bakersfield	March	57.35	23.10
Bakersfield	April	63.00	25.80
Bakersfield	May	70.95	27.30
Bakersfield	June	78.20	28.40
Bakersfield	July	84.05	28.90
Bakersfield	August	82.55	28.10
Bakersfield	September	76.80	26.60
Bakersfield	October	67.75	25.90
Bakersfield	November	55.75	22.10
Bakersfield	December	47.40	18.20
Bishop	January	37.75	31.50
Bishop	February	42.40	32.20
Bishop	March	46.80	33.20
Bishop	April	53.40	35.40
Bishop	May	62.20	36.80
Bishop	June	70.85	39.30
Bishop	July	76.65	41.10
Bishop	August	74.55	40.70
Bishop	September	66.80	40.00
Bishop	October	56.85	38.90
Bishop	November	45.10	34.60
Bishop	December	37.75	32.10
Eureka	January	47.95	12.90
Eureka	February	49.25	12.70
Eureka	March	49.40	12.00
Eureka	April	50.10	11.60
Eureka	May	52.70	10.40
Eureka	June	55.45	9.70
Eureka	July	57.05	9.50
Eureka	August	57.85	9.50
Eureka	September	57.30	11.40
Eureka	October	54.70	12.20
Eureka	November	51.65	12.90
Eureka	December	48.40	12.80
Fresno	January	45.75	16.70
Fresno	February	51.10	21.20
Fresno	March	55.00	23.20
Fresno	April	61.20	27.80
Fresno	May	68.95	30.50
Fresno	June	76.55	32.30
Fresno	July	81.85	33.50
Fresno	August	80.25	32.90

APPENDIX I

AP-42 City	Month	Average Ambient Temp (F)	Ambient Temp (F) Range
Fresno	September	74.45	31.30
Fresno	October	65.20	29.00
Fresno	November	53.60	22.20
Fresno	December	45.40	16.60
Los Angeles C.O.	January	58.30	18.80
Los Angeles C.O.	February	60.00	18.80
Los Angeles C.O.	March	60.65	17.70
Los Angeles C.O.	April	63.25	18.10
Los Angeles C.O.	May	65.80	16.20
Los Angeles C.O.	June	69.70	17.20
Los Angeles C.O.	July	74.25	19.50
Los Angeles C.O.	August	75.10	18.80
Los Angeles C.O.	September	73.65	18.10
Los Angeles C.O.	October	69.65	18.70
Los Angeles C.O.	November	62.95	18.90
Los Angeles C.O.	December	58.30	19.00
Mount Shasta	January	34.45	17.90
Mount Shasta	February	38.10	19.20
Mount Shasta	March	40.65	21.50
Mount Shasta	April	45.85	25.30
Mount Shasta	May	53.50	28.00
Mount Shasta	June	61.20	29.60
Mount Shasta	July	67.20	34.40
Mount Shasta	August	66.05	34.50
Mount Shasta	September	59.85	32.70
Mount Shasta	October	50.95	28.10
Mount Shasta	November	40.10	19.40
Mount Shasta	December	34.60	17.40
Redding	January	45.50	19.60
Redding	February	50.65	21.30
Redding	March	52.10	20.80
Redding	April	57.95	23.90
Redding	May	66.40	28.20
Redding	June	76.10	28.60
Redding	July	81.50	33.60
Redding	August	79.40	32.60
Redding	September	74.05	30.50
Redding	October	63.40	28.40
Redding	November	51.75	20.70
Redding	December	44.95	19.50
Sacramento	January	45.20	15.00
Sacramento	February	50.70	18.60
Sacramento	March	53.60	20.80
Sacramento	April	58.30	25.60
Sacramento	May	65.30	30.00
Sacramento	June	71.55	32.50
Sacramento	July	75.65	35.10

APPENDIX I

AP-42 City	Month	Average Ambient Temp (F)	Ambient Temp (F) Range
Sacramento	August	75.05	34.10
Sacramento	September	71.50	31.60
Sacramento	October	64.15	27.50
Sacramento	November	53.25	19.70
Sacramento	December	45.25	14.90
San Diego	January	57.40	17.00
San Diego	February	58.60	15.80
San Diego	March	59.55	13.50
San Diego	April	62.00	12.80
San Diego	May	64.10	10.00
San Diego	June	66.75	9.70
San Diego	July	70.95	10.50
San Diego	August	72.55	10.50
San Diego	September	71.35	11.50
San Diego	October	67.75	13.70
San Diego	November	61.90	16.00
San Diego	December	57.45	17.30
San Francisco AP	January	48.70	13.80
San Francisco AP	February	52.20	14.40
San Francisco AP	March	53.30	15.00
San Francisco AP	April	55.55	16.70
San Francisco AP	May	58.10	16.80
San Francisco AP	June	61.45	17.70
San Francisco AP	July	62.75	17.70
San Francisco AP	August	63.65	17.30
San Francisco AP	September	64.40	18.40
San Francisco AP	October	60.95	18.30
San Francisco AP	November	54.75	15.30
San Francisco AP	December	49.40	13.40
San Francisco C.O.	January	51.05	10.50
San Francisco C.O.	February	54.35	11.30
San Francisco C.O.	March	54.90	11.80
San Francisco C.O.	April	55.95	12.30
San Francisco C.O.	May	56.60	12.20
San Francisco C.O.	June	58.35	11.50
San Francisco C.O.	July	59.05	11.10
San Francisco C.O.	August	60.10	11.00
San Francisco C.O.	September	62.30	12.80
San Francisco C.O.	October	61.95	13.50
San Francisco C.O.	November	57.15	11.10
San Francisco C.O.	December	51.70	9.40
Santa Barbara	January	52.00	23.40
Santa Barbara	February	53.90	21.40
Santa Barbara	March	55.25	20.10
Santa Barbara	April	57.25	20.30
Santa Barbara	May	59.35	18.50
Santa Barbara	June	62.40	17.60

APPENDIX I

AP-42 City	Month	Average Ambient Temp (F)	Ambient Temp (F) Range
Santa Barbara	July	65.40	17.00
Santa Barbara	August	66.80	17.20
Santa Barbara	September	65.85	18.70
Santa Barbara	October	62.30	21.60
Santa Barbara	November	56.60	23.80
Santa Barbara	December	52.25	24.30
Santa Maria	January	51.05	25.50
Santa Maria	February	52.55	24.30
Santa Maria	March	52.75	22.90
Santa Maria	April	54.70	24.40
Santa Maria	May	57.10	21.40
Santa Maria	June	60.65	20.70
Santa Maria	July	63.10	20.40
Santa Maria	August	64.00	20.20
Santa Maria	September	63.55	22.50
Santa Maria	October	60.95	25.90
Santa Maria	November	55.50	26.40
Santa Maria	December	51.00	26.40
Stockton	January	45.00	16.00
Stockton	February	50.50	20.40
Stockton	March	54.05	22.90
Stockton	April	59.30	27.20
Stockton	May	66.70	29.80
Stockton	June	73.30	31.60
Stockton	July	77.65	33.50
Stockton	August	76.80	32.20
Stockton	September	72.70	30.40
Stockton	October	64.55	27.50
Stockton	November	53.05	20.70
Stockton	December	44.95	15.70
Long Beach	January	55.85	21.90
Long Beach	February	57.30	20.80
Long Beach	March	58.50	19.00
Long Beach	April	61.65	19.70
Long Beach	May	64.80	17.00
Long Beach	June	68.40	17.20
Long Beach	July	73.05	19.30
Long Beach	August	74.40	19.20
Long Beach	September	72.40	19.40
Long Beach	October	68.10	20.60
Long Beach	November	61.25	21.70
Long Beach	December	56.00	22.00

APPENDIX J

Cost Analysis

The cost of Phase I, Phase II, and Standing Loss Control vapor recovery were determined separately. For Phase I and Phase II, vapor recovery equipment manufacturers were surveyed for pre-EVR and EVR costs. From these surveys the absolute and incremental costs of the proposed regulation to install and/or upgrade pre-EVR systems to EVR systems was determined over the lifetime of the tank (15 years, assuming five year component lifetime). The costs were annualized using the Capital Recovery Factor assuming a five percent discount rate over the 15 year projected lifetime of the tank to take into consideration the opportunity cost of capital and depreciation. Table J-1 summarizes these costs:

Table J-1
Lifetime and Annual Costs for Phase I/II and Standing Loss Control Vapor Recovery Systems

Standing Loss Control - 60%	Cost		
No VR to EVR	w/o P/V valve	P/V valve	Total
Lifetime	$ 330.00	$ 1,545.00	$ 1,875.00
Annualized	$ 31.79	$ 148.85	$ 180.64
Standing Loss Control - 76%	Cost		
No VR to EVR	w/o P/V valve	P/V valve	Total
Lifetime	$ 2,370.00	$ 1,545.00	$ 3,915.00
Annualized	$ 228.33	$ 148.85	$ 377.18
Standing Loss Control - 90%	Cost		
No VR to EVR	w/o P/V valve	P/V valve	Total
Lifetime	$ 3,660.00	$ 1,545.00	$ 5,205.00
Annualized	$ 352.61	$ 148.85	$ 501.46

Phase I	Cost		
No VR to EVR	w/o P/V valve	P/V valve	Total
Lifetime	$ 4,768.02	—	$ 4,768.02
Annualized	$ 459.36	—	$ 459.36
Phase I	Cost		
Pre-EVR to EVR	w/o P/V valve	P/V valve	Total
Lifetime	$ 121.18	—	$ 121.18
Annualized	$ 11.68	—	$ 11.68

Phase II	Cost		
No VR to EVR	w/o P/V valve	P/V valve	Total
Lifetime	$ 5,275.21	—	$ 5,275.21
Annualized	$ 508.23	—	$ 508.23
Phase II	Cost		
Pre-EVR to EVR	w/o P/V valve	P/V valve	Total
Lifetime	$ 361.88	—	$ 361.88
Annualized	$ 34.86	—	$ 34.86

Additionally, the absolute cost of installing Phase I, Phase II, and Standing Loss Control vapor recovery systems was determined from the survey. Table J-2 summarizes the absolute costs:

Table J-2
Absolute Cost for Phase I/II and Standing Loss Control Vapor Recovery Systems

EVR	Single Wall Tanks			Protected Tanks		
	No VR	**Phase I**	**Phase II**	**No VR**	**Phase I**	**Phase II**
Standing Loss Control	$1,880	$1,880	$1,880	—	—	—
Phase I EVR	$4,770	$120	$120	$4,770	$120	$120
Phase II EVR	$5,280	—	$360	$5,280	—	$360
TOTAL (per tank)	**$11,930**	**$2,000**	**$2,360**	**$10,050**	**$120**	**$480**

*assuming 60 percent control level

These costs were then distributed among the AST population to determine the cost effectiveness of the regulation.

The cost analysis and AST applicability is based on generally conservative assumptions to calculate “worst case” scenarios. The assumptions are described in detail below.

<u>Assumption 1</u>: Existing single wall tanks will need to be retrofitted with Standing Loss Control EVR technologies at the 60 percent emission reduction level.

Staff assumes that upon full implementation, all single wall tanks not exempt by District rules (5226) will need to be retrofitted with Standing Loss Control technologies such as white paint and a P/V relief valve. The annualized cost per tank for 60 percent emission reductions is estimated at $181 per year over the 15 year lifetime of the tank for a total cost of $1,875 per tank. The cost is based on a 550 gallon AST.

<u>Assumption 2</u>: Existing protected tanks will not need to be retrofitted with Standing Loss Control EVR technologies to achieve the 60 percent emission reduction level.

Staff assumes that protected tanks will meet the 60 percent emission reduction level based on testing performed by ARB. Staff met with manufacturers of protected tanks and believes that most of these tanks will meet the 76 percent emission reduction level for retrofits and some will meet the 90 percent emission reduction level for new installations. The cost associated with protected tanks to meet the Standing Loss Control vapor recovery requirements will be the cost of the P/V valve annualized at $149 per year over the 15 year lifetime of the tank for a total cost of $1545 per tank.

Assumption 3: Some single wall and protected tanks that currently have Phase I vapor recovery systems will need to upgrade to Phase I EVR systems.

Staff assumes upon full implementation, single wall (1843) and protected (1698 in California) tanks that currently have Phase I vapor recovery systems required by District rules will need to replace those systems with Phase I EVR systems. The annualized cost per tank for Phase I EVR was estimated to be $12 per year over the 15 year lifetime of the tank for a total cost of $121 per tank. This represents the incremental cost between Phase I and Phase I EVR systems.

Assumption 4: Some single wall and protected tanks that currently do not have vapor recovery systems will be required to install Phase I EVR systems based on District requirements.

Staff assumes upon full implementation, single wall (3383) and protected (225) tanks that currently do not have vapor recovery systems installed, but are required to under current District rules, will need to install Phase I EVR. The annualized cost per tank to install Phase I EVR is estimated to be $459 per year over the 15 year lifetime of the tank for a total cost of $4768 per tank. This represents the absolute cost to purchase a Phase I EVR system. Currently, these tanks may not be in compliance with District rules and only enforcement of those rules by Districts will trigger these costs.

Assumption 5: Some single wall and protected tanks that currently have Phase II vapor recovery systems will need to upgrade to Phase I EVR systems.

Staff assumes upon full implementation, single wall (233) and protected (1315) tanks that currently have Phase II vapor recovery systems required by District rules will be required to replace those systems with Phase II EVR systems. The annualized cost per tank for Phase II EVR is estimated to be $35 per year over the 15 year lifetime of the tank for a total cost of $362 per tank. This represents the incremental cost between Phase II and Phase II EVR.

Assumption 6: Some single wall and protected tanks that currently have no vapor recovery systems will continue to be exempt from vapor recovery requirements per District rules.

Staff assumes upon full implementation, single wall (2394) and protected (39) tanks that currently are not required to have vapor recovery systems (Phase I and/or Phase II) due to District rule exemptions will continue to remain exempt. The annualized cost for Standing Loss Control, Phase I EVR, and Phase II EVR is estimated to be $0 per year. Should District change these rules, Standing Loss Control is estimated to cost $181 per year (Total: $1875), Phase I EVR is estimated to cost $459 per year (Total: $4768), and Phase II EVR is estimated to cost $508 per year (Total: $5275) over the 15 year lifetime of the tank. These costs represent the absolute cost of installing Standing Loss Control, Phase I

EVR, and Phase II EVR and are not included in the cost effectiveness section of the proposed regulation.