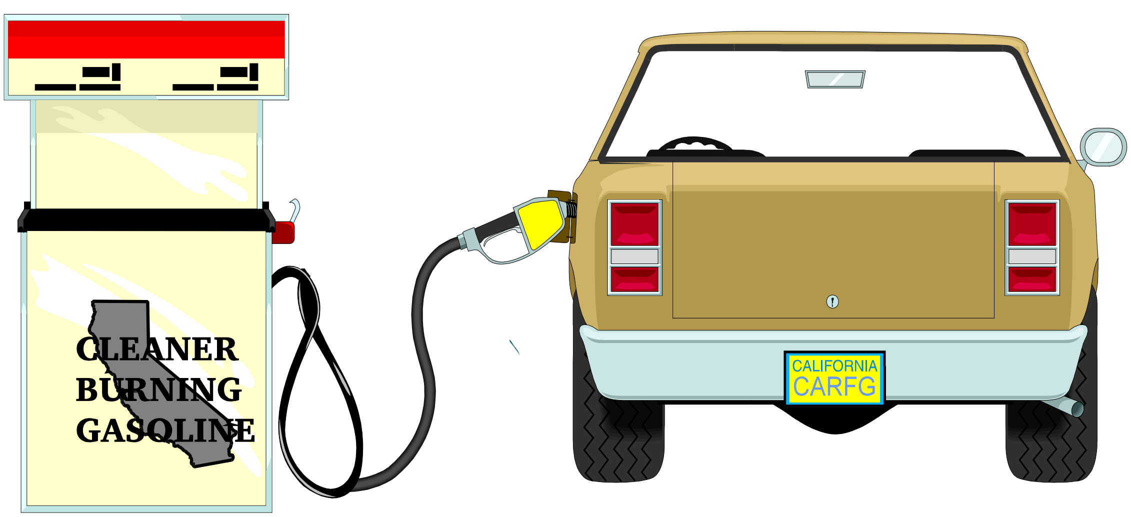
California Environmental Protection Agency

Air Resources Board

Proposed 2011 Amendments to Phase 3 California Reformulated Gasoline Regulations

Staff Report: Initial Statement of Reasons



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State of California

California Environmental Protection Agency
AIR RESOURCES BOARD
Stationary Source Division

STAFF REPORT: INITIAL STATEMENT OF REASONS PROPOSED 2011 AMENDMENTS TO CALIFORNIA PHASE 3 GASOLINE REGULATIONS

Public Hearing to Consider Amendments to the California Reformulated Gasoline Regulations

Date of Release: August 31, 2011
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California Air Resources Board
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1001 I Street
Sacramento, California 95814

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Table of Contents

Tables

Appendices

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Executive Summary

A. Introduction

The Air Resources Board (ARB or Board) approved the Phase 3 Reformulated Gasoline (CaRFG3) regulations at a hearing on December 9, 1999. CaRFG3 banned the use of MTBE in California gasoline. The regulations recently amended in 2007 (2007 CaRFG3 amendments) did several things, the most significant being that they mitigated emissions associated with permeation from on-road vehicles, lowered the sulfur cap of California reformulated gasoline (CaRFG), and updated the Predictive Model.

The Predictive Model is a set of mathematical equations that relate emission rates of exhaust hydrocarbons, oxides of nitrogen (NOx), and combined exhaust toxic species to the values of the eight gasoline properties regulated under CaRFG3. Emissions of each pollutant type are predicted by equations formulated separately for vehicles of different technology classes. Producers of California gasoline use the Predictive Model to identify alternative limits that achieve equal or better emission reductions compared to the use of the flat or averaging limits. The Predictive Model provides flexibility for the producers, while ensuring ARB's emissions reduction goals are met.

The Predictive Model amended by the 2007 CaRFG amendments went into effect on December 31, 2009. These amendments were necessary to preserve the air quality benefits of the Phase 2 CaRFG standards as they existed in 1999, pursuant to Health and Safety Code Section 43013.1. The Predictive Model was also updated to reflect the current motor vehicle fleet and new data on how fuel properties affect motor vehicle emissions.

Staff is now proposing some additional, mainly technical, clean-up amendments to the CaRFG3 regulations. These proposed amendments would: 1) correct some transcription errors in the Predictive Model coefficients; 2) require that gasoline with a Reid vapor pressure (RVP) of 7.2 psi or less be certified as an RVP-controlled gasoline; 3) clarify that no person may add anything to CARBOB other than what is specifically listed in the regulation; 4) remove an outdated provision that only applies to 1992-1996 gasoline; and 5) change the notification requirements relating to test-certified alternative gasoline, 6) modify the definition of racing vehicle, and 7) make additional minor amendments to increase the flexibility, enforceability, and consistency of the regulations.

One purpose of the proposed amendments is to correct transcription errors in the *California Procedures for Evaluating Alternative Specifications for Phase 3 Reformulated Gasoline Using the California Predictive Model* (Procedures Guide or Predictive Model). The Procedures Guide contains the equations and the coefficients of the Predictive Model and is technically considered the Predictive Model. The terms "Procedures Guide" and "Predictive Model" will be used interchangeably throughout this document. There are nine coefficients that are proposed to be amended in the Procedures Guide. The coefficients have a very slight effect on the potency-weighted toxics emission portion of the Predictive Model, which affects the certification of alternative formulation of fuels.

As part of the 2007 CaRFG3 amendments, staff updated the Predictive Model with new emissions studies, emissions associated with permeation, and reactivity factors. Permeation refers to the diffusive process whereby fuel molecules migrate through the materials of a vehicle's fuel system. Eventually, the fuel molecules are emitted into the air where they contribute to evaporative emissions from the vehicle. Reactivity factors are factors that attribute the relative contributions of various hydrocarbons and CO to ozone formation. When updating the Predictive Model, staff typically builds the model into a spreadsheet so that emission outputs of the model can be seen visually while changes are being made to the equations and coefficients. The Predictive Model in its spreadsheet form is finalized first. Then the equations and coefficients are transcribed from the spreadsheet to the Procedures Guide. Prior to the implementation on December 31, 2009, of the most recently amended Predictive Model, staff discovered nine coefficient discrepancies between the Predictive Model spreadsheet and the Procedures Guide.

Upon discovery of the discrepancy of the coefficients between the Predictive Model spreadsheet and the Procedures Guide, ARB's Stationary Source Division and Enforcement Division issued advisories regarding the issue. Stationary Source Division's advisory, which was sent out through ARB's "Fuels" e-mail list serve, identified the incorrect coefficients and provided corrected values for the incorrect coefficients and indicated that ARB would enter into a rulemaking to correct the coefficients. Enforcement Division's advisory indicated that ARB would accept Predictive Model formulations that score a "pass" using either the coefficients in the Procedures Guide or the coefficients in the Predictive Model or California Reformulated Gasoline Blendstocks for Oxygenate Blending (CARBOB) Model spreadsheets found on ARB's website. The advisory was issued in November 2009, prior to the December 31, 2009, start date for use of the new Predictive Model. The full advisory can be found at http://www.arb.ca.gov/enf/advs/advs409.pdf

Staff is proposing to amend the following coefficients in the Procedures Guide:

- Oxides of nitrogen (NOx) Emissions for Tech 3 coefficient for RVP contribution from 0.424915 to 0.0424915;
- Potency Weighted Toxics (PWT) Benzene Emissions for Tech 3 coefficient for benzene contribution from -0.12025037 to 0.12025037;
- PWT Benzene Emissions for Tech 4 coefficient for RVP contribution from 0.07392876 to -0.04782469;
- PWT Benzene Emissions for Tech 5 coefficient for RVP contribution from 0.06514198 to -0.04214049;

- PWT Formaldehyde Emissions for Tech 5 coefficient for T90 contribution from 0.000000 to 0.06037698;
- Tech 5 benzene mean from 1.014259 to 0.969248;
- Tech 5 benzene standard deviation from 0.537392 to 0.504325;
- PWT Acetaldehyde Emissions for Tech 5 coefficient for “oxygen as ethanol” from 0.046699012 to 0.46699012; and
- Tech 4 Reid Vapor Pressure (RVP) standard deviation from 0.8891114 to 0.889114.

The aforementioned coefficients were transcribed incorrectly during the update of the Predictive Model in the 2007 CaRFG3 amendments. Correcting these coefficients is necessary to ensure consistency between the spreadsheet and the Procedures Guide, which is incorporated by reference. These corrections are also necessary to preserve the emissions benefits of the Phase 2 CaRFG standards, pursuant to Health and Safety Code Section 43013.1.

Another purpose of the proposed amendments is to repeal an outdated provision relating to the oxygen content of gasoline during the wintertime for gasoline sold or supplied between November 1, 1992, and February 29, 1996. The currently effective provision relating to the oxygen content of gasoline during the wintertime for gasoline sold or supplied beginning March 1, 1996, remains unchanged. Therefore, this repeal is proposed to eliminate an outdated provision, which no longer applies to gasoline currently produced; to provide clarity; and to eliminate unnecessary provisions.

Staff is also proposing that gasoline with an RVP value equal to or less than 7.20 pounds per square inch (psi) (or, correspondingly, an RVP value equal to or less than 5.99 psi for a final blend of CARBOB), be required to be certified as an RVP-controlled gasoline. In other words, if a refiner is making summer gasoline early, it would need to meet all the summer gasoline specifications, not just the vapor pressure limit. This amendment is proposed to provide the refiners with flexibility in making RVP-controlled gasoline more than 15 days before the start of the RVP control period. It would also require refiners who make a gasoline with an RVP of 7.2 psi or less to use the THC Model of the Predictive Model during the non-RVP regulatory period. In addition, staff determined allowing refiners to make an RVP-controlled gasoline all year round may provide an emission benefit above what the current regulations are achieving and give refiners the flexibility to meet common carrier pipeline specifications outside of the 15-day transition period for the RVP regulatory control period.

Staff also proposes amendments to ensure that any producer or importer intending to sell, offer, or supply a final blend of test-certified alternative gasoline formulation shall notify the Executive Officer sufficiently in advance to allow ARB inspectors an opportunity to sample and test the gasoline.

In addition, staff is proposing amendments to clarify that no person may combine any CARBOB that has been supplied from the facility at which it was produced or imported with anything other than what is specifically listed in the regulation. The current regulation allows for things such as jet fuel to be added to CARBOB and staff is trying to close the loophole on what is allowed to be combined with CARBOB.

Staff is proposing to amend the definition of racing vehicle to clear up ambiguity in the definition and more closely align with the U.S. Environmental Protection Agency's (EPA) definition. The current definition of racing vehicle is not specific and leaves room for interpretation, which makes parts of ARB's regulations difficult to enforce. In order to clear up any ambiguity, ARB staff is aligning the definition of racing vehicle with U.S. EPA's definition.

Staff is also proposing additional amendments to the CaRFG3 regulations to increase the flexibility, enforceability, and consistency of the regulations. The proposed regulatory amendments are in Appendix A.

Staff is proposing that the 2011 proposed amendments would take effect upon the Office of Administrative Law's filing with the Secretary of State. The amendments are considered "clean-up" and would not affect the cost or production of CaRFG3, nor change the estimated benefit of the 2007 CaRFG3 amendments.

B. Economic Impacts of the Proposed Amendments

As mentioned, the current coefficients predicting slightly higher PWT emissions make the Predictive Model slightly stricter than intended. The proposed coefficients would ease the PWT emission standard as compared to the current coefficients in the Predictive Model, but still preserve the emission benefits of CaRFG2. The lone incorrect NOx coefficient has no impact on the Predictive Model, but is still being corrected. All of the fuel formulations submitted by producers who chose to use the 2007 amended Predictive Model before December 31, 2009, passed the Predictive Model under the current coefficients, as well as the proposed coefficients. The difference in the Predictive Model between the current coefficients and the corrected coefficients are slight, and are limited to the toxics portion of the Predictive Model. Because all formulations submitted to date would have passed with either set of coefficients, ARB staff does not expect the proposed coefficients to have any impact on fuel formulations and therefore does not expect there would be any economic impact associated with the proposed changes.

The current regulation allows for a 15-day transition period, where refiners can start to make summer (RVP-controlled) gasoline early. The common carrier pipeline operator is looking for a longer transition period, to ensure their distribution system switches over in time. Allowing RVP-controlled gasoline to be made all year round with the trigger being an RVP of 7.2 psi or less (or, correspondingly, an RVP value equal to or less than 5.99 psi for a final blend of CARBOB) removes the 15-day transition period from the non-RVP-controlled gasoline season to the RVP-controlled gasoline season. ARB's gasoline requirements cap the Reid vapor pressure (RVP) of gasoline at 7.2 psi during the summer RVP-control season to reduce smog formation. Wintertime gasoline does not have an RVP cap. In California, the gasoline sold at the pumps from November through February is almost entirely all winter gasoline. March/April and October/early November are transition (switchover) periods, exact transition deadlines vary by air district. Refiners, and the pipelines that carry CARBOB, start the transition to summer (RVP-controlled) gasoline early to ensure that wintertime gasoline is cleared out of the distribution system in time.

Rather than designating a specific date, staff is proposing that summer gasoline could be made at any time of the year, but that it would need to meet all the summer gasoline requirements. This would give refiners and pipelines flexibility on setting transition dates that work with their schedule, but ensure that any summer (RVP at 7.2 psi or less) gasoline would meet the RVP-controlled specifications. As part of this change, a refiner making a summer gasoline (RVP <=7.2 psi) early would have to use the Total Hydrocarbon (THC) Model of the Predictive Model—and meet the evaporative requirements of summer gasoline. A current, unnecessary requirement in the regulation prevents refiners from using the evaporative part of the Predictive Model in the winter – forcing them to make winter gasoline, a transition gasoline, and a summer gasoline. The proposed changes would eliminate the need to make a special transition gasoline, something which most refiners support. Virtually all gasoline made during the non-RVP-regulatory season has an RVP greater than 7.2 psi and would be unaffected by this change. Therefore, ARB staff believes that there will be no impact to the production or cost of CaRFG3 as a result of the amendments.

The remaining proposed changes do not impose new requirements on producers and importers, but are intended only to clarify certain procedures to ensure the emissions benefits originally intended.

C. Environmental impacts of the Proposed Amendments

Health and Safety Code section 43013.1(b)(1) requires that CaRFG3 preserve the emission benefits of CaRFG2. Although the current coefficients in the Procedures Guide technically provide a slightly stricter standard to certify fuel formulations, the current coefficients exist as a result of transcription errors in transcribing the coefficients from the Predictive Model spreadsheet to the Procedures Guide and are not technically correct. The proposed coefficients are technically correct and would ease the PWT emission standard as compared to the current incorrect coefficients in the Predictive Model, but still preserve the emission benefits of CaRFG2. The lone incorrect NOx coefficient has no impact on the Predictive Model, but is still being corrected. In addition, all fuel formulations submitted to date would have passed with either set of coefficients. Therefore, ARB staff expects there will be no environmental impacts associated with the proposed changes to the coefficients.

Allowing RVP-controlled gasoline to be made all year round will require refiners to use the THC model of the Predictive Model for gasolines with an RVP of 7.2 psi or less that are produced during the non-RVP-regulatory period. In general, RVP-controlled gasoline is likely cleaner than non-RVP-controlled gasoline because refiners have to mitigate the evaporative emissions of gasoline in RVP-controlled gasoline. Therefore, allowing refiners to make RVP-controlled gasoline all year round may provide some emissions benefits.

Repealing the outdated section relating to oxygen content will have no environmental impact because gasoline subject to this section is no longer made. The applicable provision relating to oxygen content is not proposed to be amended by this rulemaking.

D. Recommendations

The staff recommends that the Board adopt the following proposed 2011 amendments to the California reformulated gasoline regulations:

1. Amendments to the *California Procedures for Evaluating Alternative Specifications for Phase 3 Reformulated Gasoline Using the California Predictive Model* to amend transcription errors with coefficients.

2. Amendment that requires that gasoline with a RVP of 7.2 psi or less (or, correspondingly, an RVP value equal to or less than 5.99 psi for a final blend of CARBOB) be certified as an RVP-controlled gasoline.

3. Repeal of the outdated section relating to oxygen content, section 2258.

4. Amendment to section 2266, the notification requirements relating to test-certified alternative gasoline. This will improve enforceability of the regulations by allowing ARB inspectors an opportunity to sample and test the gasoline before it is transferred or commingled.

5. Amendment to section 2266.5(f)(1) to clarify that only those items listed may be blended with CARBOB after it has been supplied from the production or import facility.

6. Amendment to modify the definition of racing vehicle to more closely align with U.S. EPA's definition.

7. Other miscellaneous changes to increase enforceability, flexibility, and consistency of the regulations.

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Chapter I. Introduction

This report presents the Initial Statement of Reasons in support of proposed amendments to the Phase 3 California Reformulated Gasoline (CaRFG3) regulations. Over the years, the Air Resources Board (ARB or Board) developed and amended these regulations in three major phases. The most recent amendments, which became effective on August 29, 2008, mitigated emissions associated with permeation from on-road vehicles, lowered the sulfur cap of CaRFG, and updated the Predictive Model. Senate Bill 989 (1999), establishing Health and Safety Code section 43013.1, requires the Board to preserve the air quality benefits of the existing reformulated gasoline program as it existed in 1999.

<u>The Predictive Model.</u>

One purpose of the proposed amendments is to correct transcription errors in the *California Procedures for Evaluating Alternative Specifications for Phase 3 Reformulated Gasoline Using the California Predictive Model* (Procedures Guide or Predictive Model). The Procedures Guide contains the equations and the coefficients of the Predictive Model and is technically considered the Predictive Model. The terms “Procedures Guide” and “Predictive Model” will be used interchangeably throughout this document. The Predictive Model is a set of equations that relate changes in fuel properties to changes in emissions. The Predictive Model allows producers to certify alternative formulations of CaRFG3 by comparing the emission predictions for a candidate set of property limits to the predictions for the flat or averaging limits. There are nine coefficients that are proposed to be amended in the Procedures Guide. The coefficients have a very slight effect on the potency-weighted toxics emission portion of the Predictive Model, which affects the certification of alternative formulation of fuels.

As part of the 2007 CaRFG3 amendments, staff updated the Predictive Model with new emissions studies, emissions associated with permeation, and reactivity factors. Permeation refers to the diffusive process whereby fuel molecules migrate through the materials of a vehicle’s fuel system. Eventually, the fuel molecules are emitted into the air where they contribute to evaporative emissions from the vehicle. Reactivity factors are factors that attribute the relative contributions of various hydrocarbons and CO to ozone formation. When updating the Predictive Model, staff typically builds the model into a spreadsheet so that emission outputs of the model can be seen visually while changes are being made to the equations and coefficients. The Predictive Model in its spreadsheet form is finalized first. Then the equations and coefficients are transcribed from the spreadsheet to the Procedures Guide. Prior to the implementation on December 31, 2009, of the Predictive Model amended by the 2007 CaRFG3 amendments, staff discovered nine coefficient discrepancies between the Predictive Model spreadsheet and the Procedures Guide.

Upon discovery of the discrepancy of the coefficients between the Predictive Model spreadsheet and the Procedures Guide, ARB's Stationary Source Division and Enforcement Division issued advisories regarding the issue. Stationary Source Division's advisory, which was sent out through ARB's "Fuels" e-mail list serve, identified the incorrect coefficients and provided corrected values for the incorrect coefficients and indicated that ARB would enter into a rulemaking to correct the coefficients. Enforcement Division's advisory indicated that ARB would accept Predictive Model formulations that score a "pass" using either the coefficients in the Procedures Guide or the coefficients in the Predictive Model or CARBOB Model spreadsheets found on ARB's website. The advisory was issued in November 2009, prior to the December 31, 2009, start date for use of the new Predictive Model. The full advisory can be found at http://www.arb.ca.gov/enf/advs/advs409.pdf

Below is a brief description of each change that staff is proposing:

Amend the incorrect Predictive Model coefficients in the Procedures Guide. Staff proposes to amend the nine incorrect coefficient sin the Procedures Guide.

Require that gasoline with a Reid vapor pressure (RVP) of 7.2 psi or less be certified as an RVP-controlled gasoline. Staff is proposing to allow refiners to make RVP-controlled gasoline all year round for gasolines that have an RVP of 7.2 psi or less (5.99 or less for CARBOB), and to require that that gasoline be certified as RVP-controlled gasoline.

Repeal of outdated provisions. For gasoline sold or supplied between November 1, 1992, and February 29, 1996, California Code of Regulations, title 13, section 2258 specifies the oxygen content of gasoline during the wintertime. Section 2262.5[1] specifies the oxygen content of gasoline sold or supplied during the wintertime beginning on March 1, 1996. As section 2258 is no longer applicable, staff proposes to repeal this outdated section.

Notification regarding sales and supplies of a test-certified alternative gasoline formulation. Staff proposes to amend section 2266 to comport with the intent that any producer or importer intending to sell, offer, or supply a final blend of test-certified alternative gasoline formulation shall notify the Executive Officer sufficiently in advance to allow ARB inspectors an opportunity to sample and test the gasoline. Notification by the producers or importers after the gasoline has been transferred or commingled defeats these purposes.

Restrictions on blending CARBOB with other materials. Staff proposes to amend section 2266.5(f)(1) to comport with the intent that no person may combine any CARBOB that has been supplied from the facility at which it was produced or imported with anything other than what is listed.

[1] Unless otherwise indicated, all sections refer to the California Code of Regulations, title 13.

Amend definition of Racing Vehicle. Staff is proposing to amend the definition of racing vehicle to clear up ambiguity in the definition and more closely align with the U.S. Environmental Protection Agency's (U.S. EPA) definition.

Other miscellaneous changes. The staff is also proposing additional amendments to the CaRFG3 regulations to increase the flexibility, enforceability, and consistency of the regulations.

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Chapter II. Background

A. California Reformulated Gasoline Program

California Health and Safety Code section 43018 requires ARB to achieve the maximum feasible reductions from motor vehicles and motor vehicle fuels. In carrying out this requirement, ARB is to adopt standards and regulations that produce the most cost-effective combination of control measures on all classes of motor vehicles and motor vehicles fuels, including the specification of vehicular fuel composition. In response, the Board has adopted numerous regulations, including the California reformulated gasoline program.

The CaRFG program is a vital part of ARB's strategy to address motor vehicles and fuels as a system by combining cleaner fuels and motor vehicle controls to achieve the maximum emission reductions at the lowest cost. CaRFG also substantially reduced emissions from existing vehicles. The Board initially adopted the CaRFG program in two phases. Phase 1 of the program required changes to gasoline that could be made in a short time frame and only required small investments by producers and importers. (Note: "Producers" from this point forward in the Staff Report will refer to both producers and importers, unless otherwise specified.) Phase 2 was significantly more complex and achieved more emissions reductions. Phase 3 implemented the Governor's and Legislature's direction to remove methyl tertiary butyl ether (MTBE) from California gasoline.

In June 2007, the Board approved amendments to the CaRFG3 regulations. The 2007 CaRFG3 amendments required mitigation of emissions associated with permeation from on-road vehicles through the Predictive Model, lowered the sulfur cap of CaRFG from 30 parts per million by weight (ppmw) to 20 ppmw beginning December 31, 2011, and updated the Predictive Model with new data. The 2007 CaRFG3 amendments went into effect on August 29, 2008; use of the amended Predictive Model was required beginning December 31, 2009.

The CaRFG3 limits now in effect are shown in Table 1.

Table 1: CaRFG Limits and Caps

Property	Flat Limits	Averaging Limits	Cap Limits(1)
Reid vapor pressure, psi, max	7.00 or 6.90 (2)	---	6.40 - 7.20(3)
Benzene, vol%, max	0.8	0.70	1.10
Sulfur, ppmw, max	20	15	30
Aromatic HC, vol%, max	25	22	35.0
Olefins, vol%, max	6.0	4.0	10.0
Oxygen, wt%	1.8 to 2.2	---	1.8 – 3.5(4) 0 – 3.5
T50 (temp. at 50% distilled) ^oF, max	213	203	220
T90 (temp. at 90% distilled) ^oF, max	305	295	330

(1) The "cap limits" apply to all gasoline at any place in the marketing system and are not adjustable.

(2) 6.90 psi applies when a producer is using the evaporative emissions element of CaRFG3 Predictive Model and gasoline may not exceed a cap of 7.20 psi; otherwise, the 7.00 psi limit applies.

(3) The 7.20 psi RVP cap limit only applies during the RVP regulatory control period. The minimum 6.40 psi RVP limit applies all year round.

(4) The 1.8 weight percent minimum applies only during the winter and only in certain areas.

B. The California Predictive Model

Numerous studies have shown that the properties of gasoline affect motor vehicle emissions. Based on thousands of individual tests, equations have been developed that relate changes in fuel properties to changes in emissions. The Predictive Model takes advantage of these relationships to provide producers flexibility. The producers use the Predictive Model to identify alternative limits that achieve equal or better emission reductions compared to the use of the flat or averaging limits. The Predictive Model provides flexibility for the producers, while ensuring California's emissions reduction goals are met. This flexibility is highly valued by the producers and the vast majority of CaRFG is produced using the Predictive Model.

The Predictive Model allows producers to certify alternative formulations of CaRFG3 by comparing the emission predictions for a candidate set of property limits to the predictions for the flat or averaging limits. If each prediction for the candidate limit is no greater than 1.004 times the corresponding basic-limit prediction, the alternative set of limits is allowed. In effect, the model allows a producer to use one or more limits greater than flat or averaging limits in exchange for compensating reductions in other limits. Thus, the model provides valuable flexibility to individual refiners by allowing refiners to most efficiently meet the CaRFG3 requirements, taking into consideration the configuration of the refinery.

To facilitate the use of the Predictive Model, ARB staff provides a procedures guide, *California Procedures for Evaluation Alternative Specifications of Phase 3 Reformulated Gasoline Using the California Predictive Model*, a document that is incorporated by reference in the regulations. The Procedures Guide provides step-by-step instructions, including ARB staff notification requirements. For clarification, the Procedures Guide is the Predictive Model. Also, a computer spreadsheet is provided so that users can insert the specifications for the candidate fuel, and the spreadsheet will calculate if the candidate fuel passes or fails.

As part of the 2007 CaRFG3 amendments, staff updated the Predictive Model with new emissions studies, emissions associated with permeation, and reactivity factors. When updating the Predictive Model, staff typically builds the model into a spreadsheet so that emission outputs of the model can be seen visually while changes are being made to the equations and coefficients. The Predictive Model in its spreadsheet form is finalized first. The equations and coefficients are transcribed from the spreadsheet to the Procedures Guide.

C. Ethanol Use in California Gasoline

In general, oxygenates such as MTBE and ethanol are used in gasoline to reduce the exhaust emissions of hydrocarbons and carbon monoxide and improve the octane rating. However, as the result of the presence of MTBE in groundwater, on March 25, 1999, the Governor issued Executive Order D-5-99. The Executive Order directed the phase-out of MTBE in California's gasoline. The phase-out of MTBE left ethanol as the only oxygenate allowed to be used in California gasoline. In addition, the Legislature passed Senate Bill 989. Among other provisions, the bill directed the ARB to ensure that regulations adopted pursuant to the Executive Order maintain or improve upon emissions and air quality benefits achieved by CaRFG2 as of January 1, 1999 (Health and Safety Code section 43013.1).

Currently, CaRFG3 contains 10 percent ethanol by volume. Prior to 2010, most of California's gasoline contained 5.7 percent ethanol by volume. The recent increase of ethanol in gasoline can be traced to the 2007 CaRFG3 amendments, the Low Carbon Fuel Standard, and the Federal Renewable Fuels Standard. The Low Carbon Fuel Standard requires the reduction of carbon intensity in transportation fuels, mostly through the increased use of low-carbon biofuels. The Federal Renewable Fuels standard requires increasing amounts of biofuels, such as ethanol, to be used in transportation fuels.

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Chapter III. Proposed Amendments to the CaRFG3 Regulations

This chapter presents the staff's proposal to amend the CaRFG3 regulations. In summary, the staff is proposing the following amendments:

- Amend the *California Procedures for Evaluation Alternative Specifications of Phase 3 Reformulated Gasoline Using the California Predictive Model* to correct transcription errors;
- Require that gasoline with a Reid vapor pressure (RVP) of 7.2 psi or less be certified as an RVP-controlled gasoline;
- Repeal section 2258, an outdated provision relating to the oxygen content of gasoline sold or supplied during the wintertime between November 1, 1992 and February 29, 1996;
- Amend the notification requirements for test-certified alternative gasoline formulations;
- Amend the restrictions on blending CARBOB with other materials;
- Amend the definition of racing vehicle; and
- Other miscellaneous changes.

These proposed amendments are presented in strikeout-and-underline form in Appendix A.

A. Revise the Procedures Guide

When updating the Predictive Model, staff typically builds the model into a spreadsheet so that emission outputs of the model can be seen visually while changes are being made to the equations and coefficients. The Predictive Model in its spreadsheet form is finalized first. The equations and coefficients are then transcribed from the spreadsheet to the Procedures document. In working with producers to incorporate the Predictive Model into their computer systems, staff discovered that the emission outputs from the Predictive Model spreadsheet were not matching the emission outputs from the refiner's Predictive Models that were built from the Procedures Guide. The discrepancies between the Predictive Model spreadsheet and the Procedures Guide were traced to nine coefficients. A list of the nine Predictive Model coefficient changes that are being proposed are shown below:

1. The NOX Emissions for Tech 3 coefficient for RVP contribution is stated in the Procedures Guide as 0.424915. A typographical error occurred that left a zero out of the tenths place. Staff is proposing to change the coefficient to 0.0424915.

2. The PWT Benzene Emissions for Tech 3 coefficient for benzene contribution stated in the Procedures Guide as -0.12025037. This is a

typographical error that omitted the negative sign in front of the value. Staff is proposing to change the coefficient to 0.12025037.

3. PWT Benzene Emissions for Tech 4 coefficient for RVP contribution stated in the Procedures Guide is 0.07392876. From the Predictive Model spreadsheet, one must multiply the Tech 4 benzene model coefficient (0.03114189) by the Tech 4 standardized RVP value (-1.535703) to get the correct PWT Benzene Emission for Tech 4 coefficient (-0.04782469). The drafting error occurred during the transcription process when the original PWT Benzene Emission for Tech 4 coefficient (0.048140014) in the Procedures Guide was multiplied by the updated Tech 4 standardized RVP value (-1.535703) from the Predictive Model spreadsheet. The product of these two numbers is the incorrect PWT Benzene Emissions for Tech 4 coefficient for RVP contribution that currently exists in the Procedures Guide without the minus sign (0.07392876). Staff is proposing to change the PWT Benzene Emissions for Tech 4 coefficient for RVP contribution to -0.04782469.

4. PWT Benzene Emissions for Tech 5 coefficient for RVP contribution stated in the Procedures Guide is 0.06514198. From the Predictive Model spreadsheet, one must multiply the Tech 5 benzene model coefficient (0.03114189) by the Tech 4 standardized RVP value (-1.353177) to get the correct PWT Benzene Emission for Tech 5 coefficient (-0.04214049). The drafting error occurred during the transcription process when the original PWT Benzene Emission for Tech 5 coefficient (0.048140014) in the Procedures Guide was multiplied by the updated Tech 5 standardized RVP value (-1.353177) from the Predictive Model spreadsheet. The product of these two numbers is the incorrect PWT Benzene Emissions for Tech 5 coefficient for RVP contribution that currently exists in the Procedures Guide without the minus sign (0.06514198). Staff is proposing to change the PWT Benzene Emissions for Tech 5 coefficient for RVP contribution to -0.04214049.

5. The PWT Formaldehyde Emissions for Tech 5 coefficient for T90 contribution stated in the Procedures Guide as 0.000000. The value was inadvertently changed in the revisions to the Procedures Guide in the ensuing 15-day and second set of 15-day items change versions of the Procedures Guide. The correct value was in the original Initial Statement of Reasons (ISOR) version of the Procedures Guide in Appendix A. Staff is proposing to change the coefficient to 0.06037698.

6. The Tech 5 benzene mean coefficient in the Procedures Guide is stated as 1.014259. The correct value occurs in the Procedures Guide in the Mass Effect Emission for Tech 5 equation but is incorrect in Table 12. Staff is proposing to change the coefficient in Table 12 to 0.969248 to

match the correct coefficient as listed in the Mass Effect Emission for Tech 5 equation.

7. The Tech 5 benzene standard deviation in the Procedures Guide is stated as 0.537392. The correct value occurs in the Procedures Guide in the Mass Effect Emission for Tech 5 equation but is incorrect in Table 12. Staff is proposing to change the coefficient in Table 12 to 0.504325 to match the correct coefficient as listed in the Mass Effect Emission for Tech 5 equation.

8. PWT Acetaldehyde Emissions for Tech 5 coefficient for "oxygen as ethanol" contribution stated in the Procedures Guide is 0.046699012 but in the spreadsheet it is 0.46699012. This is a typographical error that inadvertently added an additional zero in the tens place of the coefficient.

9. Tech 4 RVP standard deviation in the Procedures Guide is stated as (0.8891114) but in the spreadsheet it is 0.889114. An extra one was inadvertently added in the ten-thousandths place of the coefficient.

1. Require that gasoline with a Reid vapor pressure (RVP) of 7.2 psi or less be certified as an RVP-controlled gasoline

ARB's gasoline requirements cap the Reid vapor pressure (RVP) of gasoline at 7.2 psi during the summer RVP control season, to reduce smog formation. Wintertime gasoline does not have an RVP cap. In California, the gasoline sold at the pumps from November through February is almost entirely all winter gasoline. March/April and October/early November are transition (switchover) periods, exact transition deadlines vary by air district. Refiners, and the pipelines that carry CARBOB, start the transition to summer (RVP-controlled) gasoline early, to ensure that wintertime (non-RVP-controlled) gasoline is cleared out of the distribution system in time.

The current regulation allows for a 15-day transition period, where refiners can start to make summer (RVP-controlled) gasoline early. The common carrier pipeline operator is looking for a longer transition period, to ensure their distribution system switches over in time. Rather than designating a specific date, staff is proposing that summer gasoline could be made at any time of the year, but that it would need to meet all the summer gasoline requirements. This would give refiners and pipeline operators flexibility on setting transition dates that work with their schedule, and ensure that any summer (RVP at 7.2 psi or less) gasoline would meet the RVP-controlled specifications. As part of this change, a refiner making a summer gasoline (RVP <=7.2 psi) early would have to use the THC model of the Predictive Model. A current, unnecessary requirement in the regulation prevents refiners from using the evaporative part of the Predictive Model in the winter – forcing them to make winter gasoline, a special transition gasoline, and a summer gasoline. The proposed changes would eliminate the need to make a special transition gasoline, something which most refiners support.

2. Outdated section relating to oxygen content.

The proposed amendment also repeals section 2258 in its entirety. Section 2258 is an outdated provision since it relates to the oxygen content of gasoline during the wintertime for gasoline sold or supplied between November 1, 1992, and February 29, 1996. Staff does not expect that gasoline sold or supplied during this time period is still available. Therefore, repeal of this outdated provision will help to clean up the regulations. The currently effective provision relating to the oxygen content of gasoline during the wintertime for gasoline sold or supplied beginning March 1, 1996, is section 2262.5. This section remains unchanged by the proposed amendments. Therefore, repeal of the outdated section 2258 is not expected to have any effect on the cost or production of CaRFG3, change the estimated benefit of the 2007 CaRFG3 amendments, or alter emissions from CaRFG3.

3. Notification relating to test-certified alternative gasoline.

In order to afford ARB inspectors an opportunity to sample and test California gasoline to ensure compliance with the regulations, staff also proposes amendments to the CaRFG3 regulations to ensure that any producer or importer intending to sell, offer, or supply a final blend of test-certified alternative gasoline formulation notifies the Executive Officer sufficiently in advance. The current regulations require notification at least 12 hours before start of physical transfer of the final blend from the production or import facility. Previously, it was thought that the final blend would be available for sampling at some point during this 12-hour period. However, staff has learned that producers and importers have been starting and completing the physical transfer during this period. As a result, the final blend was not available for sampling and confirmation of compliance. The proposed amendments correct this situation by specifying that the producer or importer must provide notification to the Executive Officer before the start of physical transfer of the gasoline from the production or import facility, and in no case less than 12 hours before the producer or importer either completes physical transfer or commingles the final blend. This amendment will ensure that the final blend will be available for sampling by ARB during the 12 hour period.

4. Combining CARBOB with other materials.

In addition, staff is proposing amendments to clarify that no person may combine any CARBOB that has been supplied from the facility at which it was produced or imported with anything other than what is specifically listed in the regulation. This will help stakeholders in understanding that combining CARBOB, after it has been supplied from the production or import facility, with anything not specifically listed is prohibited. An exhaustive list of materials that may not be combined with

CARBOB is not practical, but includes materials such as hydrocarbons, diesel fuel, jet fuel, aviation gasoline, biodiesel, renewable diesel, marine fuels, and transmix.

5. Amend definition of Racing Vehicle

Staff is proposing to amend the definition of racing vehicle to clear up the ambiguity in the definition and more closely align with U.S. EPA's definition. The current definition defines racing vehicle as a competition vehicle not used on public highways. The proposed definition of racing is shown in the language below.

"Racing vehicle" means a vehicle that:

(A) Is exclusively operated in conjunction with sanctioned racing events;

(B) Exhibits racing features and modifications such that it is incapable of safe and practical street or highway use;

(C) Is not licensed by the State of California Department of Motor Vehicles for operation on public streets or highways; and

(D) Is never operated on public streets or highways.

6. Miscellaneous amendments.

Staff is also proposing additional amendments to the CaRFG3 regulations to increase the flexibility, enforceability, and consistency of the regulations. The proposed regulatory amendments are in Appendix A.

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Chapter IV. Economic and Fiscal Impacts of the Proposed Amendments

This chapter presents a summary of potential effects of the proposed amendments on the production of CaRFG3 and an analysis of the costs to produce CaRFG3 gasoline in compliance with the proposed amendments. In addition, the chapter outlines potential economic impacts on businesses and consumers.

Health and Safety Code section 43013.1(b)(1) requires that CaRFG3 preserve the emission benefits of CaRFG2. The proposed amendments will correct coefficients in the Predictive Model to increase the accuracy of emissions estimations from the Predictive Model in fuel formula certifications. The proposed amendments associated with the use of CaRFG3 in on-road motor vehicles will preserve the emission benefits of CaRFG2.

Staff compared the emissions output using the current coefficients in the Procedures Guide versus the proposed coefficients. For both non-ethanol fuels and for ethanol fuels, the directional change in potency-weighted toxics (PWT) emissions was higher for the Predictive Model using the current coefficients and lower for the Predictive Model using the proposed coefficients. Staff used Statistical Analysis Software to run over 51 million combinations of fuel properties and found that the directional difference was consistent amongst all combinations; the current coefficients always had a slightly higher PWT emission output versus the proposed coefficients. The differences between current coefficients and the proposed coefficients for PWT emissions were 0.12 percent for non-ethanol fuels and 0.11 percent for ethanol fuels. The coefficients only affected the PWT portions of the Predictive Model. The hydrocarbon and oxides of nitrogen portions of the model were unaffected.

A. Effects of the Proposed Amendments on the Production of CaRFG3

1. Change in PWT Coefficients

The current coefficients predicting slightly higher PWT emissions means that the Predictive Model is slightly stricter under the current coefficients because refiners would need to make a slightly cleaner formulation to pass. The proposed coefficients would ease the PWT emission standard as compared to the current coefficients in the Predictive Model, but still preserve the emission benefits of CaRFG2. The lone incorrect NOx coefficient has no impact on the Predictive Model, but is still being corrected. All of the fuel formulations submitted by producers who chose to use the 2007 amended Predictive Model before December 31, 2009, passed the Predictive Model using the current coefficients, as well as the proposed coefficients. Because the difference in the Predictive Model between the current coefficients and the corrected coefficients is slight, and because all formulations submitted to date would pass under either formulation, ARB staff does not expect the proposed coefficients to have any impact on fuel formulations or the production of CaRFG3.

2. RVP-Controlled Gasoline All Year Round

Allowing RVP-controlled gasoline to be made all year round with the trigger being an RVP of 7.2 psi or less (or, correspondingly, an RVP value equal to or less than 5.99 psi for a final blend of CARBOB) removes the 15-day transition period from the non-RVP-controlled gasoline season to the RVP-controlled gasoline season. This amendment gives refiners the flexibility to choose when they would like to begin making RVP-controlled gasoline in preparation for the RVP control season. It is preferable by the common carrier pipeline operator that refiners start providing RVP-controlled gasoline more than 15 days in advance of the transition period to ensure that the downstream tanks are purged of non-RVP-controlled gasoline in time for the RVP control season. This amendment will require refiners to use the evaporative portion of the Predictive Model for gasolines with an RVP of 7.2 psi or less that are produced during the non-RVP regulatory period. This will take away the ability for refiners to make a gasoline with an RVP of 7.2 psi or less during the non-RVP-regulatory period without having to use the evaporative portion of the Predictive Model. Virtually all gasoline made during the non-RVP-regulatory season has an RVP greater than 7.2 psi and would be unaffected by this change. Therefore, ARB staff believes that there will be no impact to the production or cost of CaRFG3 as a result of the amendments.

3. Repeal of section 2258

Repealing the outdated section relating to oxygen content will have no impact on the production of CaRFG3, because gasoline subject to this section is no longer made. The applicable provision relating to oxygen content is not proposed to be amended by this rulemaking.

4. Notification requirements relating to test-certified alternative gasoline

Amending the notification requirements for test-certified alternative gasoline formulations will have no impact on the production of CaRFG3. This amendment changes the notification requirements such that ARB enforcement will have sufficient time to inspect the final blend of gasoline before the producer or importer completes physical transfer of the final blend

5. Blending CARBOB with other materials

Amending the restrictions on blending CARBOB with other liquids will have no impact on the production of CaRFG3. This amendment is meant to clarify the restrictions on liquids that may be blended with CARBOB.

6. Amending the definition of racing vehicle

Amending the definition of racing vehicle will have no impact on the production of CaRFG3. This amendment is meant to clarify ambiguity in the definition and more closely align with U.S. EPA's definition.

7. Other miscellaneous changes

Additional miscellaneous changes are proposed to increase enforceability, flexibility, and consistency, but have no impact on the production of CaRFG3.

B. Costs to Produce CaRFG3 Gasoline Fuel

No additional costs to produce CaRFG3 gasoline are expected as a result of the amendments because fuel formulations and production will remain unchanged. These proposed coefficients will allow slightly higher PWT emissions and therefore will not be more restrictive in the fuel formulations that qualify for CaRFG3. In addition, the Predictive Model Spreadsheet reflects the correct coefficient so that many producers are already using the proposed coefficient values to assess new fuel formulations. RVP-controlled gasoline production is also unlikely to change but, may provide producers with a smoother transition between RVP seasons. Repealing section 2258, applicable to the oxygen content in gasoline produced between 1992 and 1996, will not affect current costs to produce CaRFG3, since this section no longer applies to CaRFG3 produced today. Clarifying the blending restrictions of CARBOB with other materials will not affect cost to produce CaRFG3, because this clarification is a restatement of current industry practice and expectations. The other changes, i.e., changing the notification requirements relating to test-certified alternative gasoline, amending the definition of racing vehicle, and the other miscellaneous changes, will not affect the cost to produce CaRFG3, since these changes do not affect the fuel formulation or production.

C. Impact on Government Revenue

No impact on government revenue is expected as a result of the amendments because gasoline fuel sales and costs will remain unchanged.

D. Small Refiners

No additional costs to produce CaRFG3 gasoline fuel are expected as a result of the amendments for small refiners because no changes in fuel formulations or production are expected.

E. Small Business Economic Effect

Government Code sections 11342 et. seq. require the ARB to consider any adverse effects on small businesses that would have to comply with a proposed regulation. In defining small business, Government Code section 11342 explicitly excludes refiners from the definition of "small business." Also, the definition includes only businesses that are independently owned and, if in retail trade, gross less than $2,000,000 per year. Thus, our analysis of the economic effects on small business is limited to the costs to gasoline retailers and jobbers, retailers, and gasoline fuel end-users. A jobber is an individual or business that purchases wholesale gasoline and delivers and sells it to another party, usually a retailer or other end-user.

1. Jobbers and Retailers

No economic impact expected to affected jobbers and retailers as a result of the amendments because they do not certify fuel formulations for sale. Furthermore, these amendments would not change production costs or volumes, so fuel prices and supplies should remain unchanged.

2. Gasoline Fuel End-Users

No economic impact expected to affected jobbers and retailers as a result of the amendments because fuel prices and supplies should remain unchanged.

F. Fiscal Impacts

1. Impact on Government Revenue

No impact on government revenue is expected as a result of the amendments because gasoline fuel sales and costs will remain unchanged.

2. Impact on Government Expenditures

No impact on government entities as fuel end-users is expected as a result of the amendments because gasoline fuel sales and costs will remain unchanged.

There will be no additional person-years needed to enforce the amendments because the amendments do not add additional enforcement requirements above what is already currently being enforced.

Chapter V. Environmental Impacts of the Proposed Amendments

This chapter summarizes the expected environmental impacts of the proposed amendments. Health and Safety Code section 43013.1 requires that CaRFG3 preserve the emission benefits of CaRFG2. These benefits include emission reductions for all pollutants, including ozone precursors, identified in the State Implementation Plan, and emission reductions in potency-weighted air toxics compounds. The staff does not anticipate any significant adverse environmental impacts associated with the proposed amendments.

A. California Environmental Quality Act (CEQA)

CEQA and ARB policy require an analysis to determine the potential adverse environmental impacts of the proposed amendments. ARB's program involving the adoption of regulations has been approved by the Secretary of Resources (see Public Resources Code, section 21080.5). Therefore, the CEQA environmental analysis requirements are included in the ARB's Initial Statement of Reasons in lieu of preparing an environmental impact report or negative declaration. In addition, ARB will respond in writing to all significant environmental issues raised by the public during the public review period or the public Board hearing. These responses are to be contained in the Final Statement of Reasons for the proposed amendments.

Public Resources Code section 21159 requires that the environmental impact analysis conducted by the ARB include the following:

- An analysis of the reasonably foreseeable environmental impacts of the methods of compliance;
- An analysis of reasonably foreseeable mitigation measures; and
- An analysis of reasonably foreseeable alternative means of compliance with the standard.

Our analysis of the reasonably foreseeable environmental impacts of the methods of compliance and the analysis of reasonably foreseeable mitigation measures, if appropriate, are presented in the following sections. In general, ARB staff has not identified any significant environmental impacts associated with the proposed amendments; therefore, there has been no need to identify mitigation measures.

An assessment of potential alternatives to the proposed amendments is presented in Chapter VI. ARB staff has concluded there is no alternative considered by the agency that would be more effective in carrying out the purpose for which the regulation is proposed or would be as effective as and less burdensome to affected private persons than the proposed regulation.

B. Multimedia Evaluation

Health and Safety Code section 43830.8, enacted in 1999 (Stats. 1999, ch. 813; S.B. 529, Bowen) generally prohibits ARB from adopting a regulation establishing a specification for motor vehicle fuel unless the regulation is subject to a multimedia evaluation by the California Environmental Policy Council (CEPC). A multimedia evaluation is the identification and evaluation of any significant adverse impact on public health or the environment, including air, water, or soil, that may result from the production, use, or disposal of the motor vehicle fuel that may be used to meet the Board's motor vehicle fuel specifications. The statute provides that the Board may adopt a regulation that establishes a specification for motor vehicle fuel without the proposed regulation being subject to a multimedia evaluation if the CEPC, following an initial evaluation of the proposed regulation, conclusively determines that the regulation will not have any significant adverse impact on public health or the environment.

The proposed amendments do not change specifications of CaRFG3 gasoline and will not require a gasoline ingredient to be added or removed beyond what is already used to produce gasoline for sale in California. While these amendments do correct certain coefficients in the Predictive Model, they do not ultimately change specifications of CaRFG3 gasoline. Again, the Predictive Model is a set of mathematical equations used to predict whether a gasoline formulation will meet the CaRFG3 specifications. The CaRFG3 specifications are not proposed to be changed by this rulemaking. Therefore, staff believes that the proposed amendments to the CaRFG3 regulations are not subject to the requirement for a multimedia evaluation.

C. Air Quality

This section presents the air quality impacts of the proposed amendments.

1. Impact on On-road Sources

The proposed amendments are specifically designed to correct coefficients in the Predictive Model that estimate emissions for fuel certification purposes. Staff compared the emissions output using the current coefficients in the Procedures Guide versus the proposed coefficients. For both non-ethanol fuels and for ethanol fuels, the directional change in PWT emissions was higher for the Predictive Model using the current coefficients and lower for the Predictive Model using the proposed coefficients. Staff used Statistical Analysis Software to run over 51 million combinations of fuel properties and found that the directional difference was consistent amongst all combinations; the current coefficients always had a slightly higher PWT emission output versus the proposed coefficients. The minimum differences between current coefficients and the proposed coefficients for PWT emissions were 0.12 for non-ethanol fuels and 0.11 for ethanol fuels. The coefficients only affected the PWT portions of the

Predictive Model. The hydrocarbon and oxides of nitrogen portions of the model were unaffected.

The current coefficients predicting slightly higher PWT emissions means that the Predictive Model is slightly stricter under the current coefficients. Although stricter, the current coefficients exist as a result of drafting errors in transcribing the coefficients from the Predictive Model spreadsheet to the Procedures Guide and are not technically correct. The proposed coefficients are technically correct and would ease the PWT emission standard as compared to the current coefficients in the Predictive Model, but still preserve the emission benefits of CaRFG2. All of the fuel formulations submitted by producers who chose to use the 2007 amended Predictive Model before December 31, 2009, passed the Predictive Model under the current coefficients, as well as the proposed coefficients. The difference in the Predictive Model between the current coefficients and the corrected coefficients are slight, are limited to the toxics portion of the predictive model, and because all formulations submitted to date would have passed with either set of coefficients, ARB staff does not expect the proposed coefficients to have any impact on fuel formulations and therefore does not expect there would be any impact on air quality associated with the proposed changes.

Requiring that fuels with an RVP value equal to or less than 7.20 psi (or, correspondingly, an RVP value equal to or less than 5.99 psi for a final blend of CARBOB), be required to be certified as an RVP-controlled gasoline may result in emissions benefits should a producer or importer choose to make a lower RVP fuel during the non-RVP-controlled season. This amendment will preserve the emissions of CaRFG2.

Repealing the outdated section relating to oxygen content will not impact air quality, because this section is no longer applicable to gasoline currently produced or imported. The current section relating to oxygen content is not proposed for changes by this rulemaking.

Changing the notification requirements relating to test-certified alternative gasoline will not impact air quality, because these requirements are administrative in nature and do not affect the quality or specifications of the gasoline.

Restricting the materials that may be blended with CARBOB after it has been supplied from the production or import facility will not impact air quality, because this amendment merely restates the current industry practice and expectation.

Changing the definition of racing vehicle to more closely align with U.S. EPA’s definition will not impact air quality, because the proposed definition merely restates the current racing industry practice and expectation.

The other miscellaneous changes will not impact air quality, because these changes are merely administrative in nature and do not affect the quality or specifications of the gasoline.

a. Impact on the State Implementation Plan

The ARB's 2007 State Implementation Plan (SIP) proposal is a comprehensive strategy designed to attain federal air quality standards as quickly as possible through a combination of technologically feasible, cost-effective, and far reaching measures. The total magnitude of the reductions to be achieved through new actions is primarily driven by the scope of the air quality problems in the San Joaquin Valley and South Coast Air Basin. This proposed measure would not likely have a significant impact on the SIP, because the only changes that affect the quality of the gasoline are minor in nature.

D. Greenhouse Gas Emissions

The proposed changes to the CaRFG3 regulations are not expected to have a significant effect on greenhouse gas emissions, because the only changes that affect the quality of the gasoline are minor in nature.

E. Water Quality

The proposed amendments do not change flat or average limits of CaRFG3 gasoline. While they do change the coefficients in the Predictive Model, these changes are minor and are not expected to result in the addition of any new material to CaRFG3. The proposed requirement that gasoline with a RVP of 7.2 psi or less (or, correspondingly, an RVP value equal or less than 5.99 psi for a final blend of CARBOB) be certified as an RVP-controlled gasoline allows that an already approved, and more stricter, fuel formulation be used throughout the year, rather than just during the summer. Therefore, no major changes in fuel formulation are expected. The resulting fuel formulations from the proposed amendments are not expected to have a significant negative effect on the quality of both ground and surface water. The findings of the environmental fate and transport analysis and a health risk evaluation of ethanol performed in 1999 supports this analysis. In 1999, the Board approved the environmental assessment of CaRFG3 with ethanol. This assessment included ethanol levels up to 10 percent by volume. In 2000, the California Environmental Policy Council approved the multimedia environmental assessment of ethanol in gasoline for ethanol levels up to 10 percent by volume.

F. Community Health and Environmental Justice

Environmental justice is a core consideration in ARB's efforts to provide clean air for all California communities (CARB 2001, i.e. Policies and Actions for Environmental Justice, PTSD, 2001). The proposed changes to the CARFG3 regulations are not expected to have a significant effect on community health.

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Chapter VI. Alternatives to the Proposed Amendments

This chapter presents an analysis of alternatives to the proposed amendments. The only alternative to the proposed amendments would be to leave the incorrect coefficients unchanged. Staff determined that leaving the incorrect coefficients in the Predictive Model would undermine the technical credibility of the Predictive Model, add confusion, and fail to preserve the emission benefits of CaRFG2, as required by Health and Safety Code section 43013.1.

An alternative to requiring that fuels with an RVP value equal to or less than 7.20 psi (or, correspondingly, an RVP value equal to or less than 5.99 psi for a final blend of CARBOB), be required to be certified as an RVP-controlled gasoline would be to leave the regulation as it currently exists. Leaving the regulation as it currently exists would take away the refiners flexibility to make RVP-controlled gasoline more than 15 days before the start of the RVP control period. It would also allow refiners to continue to make a gasoline with an RVP of 7.2 psi or less that does not use the evaporative portion of the Predictive Model during the non-RVP-regulatory period. Staff determined allowing refiners to make an RVP-controlled gasoline all year round may provide an emission benefit above what the current regulations are achieving and give refiners the flexibility to meet common carrier pipeline specifications outside of the 15-day transition period for the RVP regulatory control period.

Leaving the outdated section relating to oxygen content, section 2258, intact would result in unnecessary confusion and complexity in the regulations.

The current regulations require notification at least 12 hours before start of physical transfer of the final blend of test-certified alternative gasoline from the production or import facility. Staff has learned that producers and importers have been starting and completing the physical transfer during this period. As a result, the final blend was not available for sampling and confirmation of compliance. The proposed amendments correct this situation by specifying that the producer or importer must provide notification to the Executive Officer before the start of physical transfer of the gasoline from the production or import facility, and in no case less than 12 hours before the producer or importer either completes physical transfer or commingles the final blend. This amendment will ensure that the final blend will be available for sampling by ARB during the 12 hour period. Leaving the notification provision unchanged will impede ARB's ability to sample and verify compliance of the fuel.

An alternative to changing section 2266.5(f)(1), relating to what may be blended with CARBOB after it has been supplied from the production or import facility, is to leave it unchanged. However, leaving it unchanged adds to confusion as to what may be added.

An alternative to changing the definition of “racing vehicle” is to leave it unchanged. However, leaving it unchanged results in a discrepancy between ARB’s definition and U.S. EPA’s definition, and therefore, confusion.

An alternative to the other miscellaneous changes is to leave them unchanged. However, this would result in a decrease in enforceability, flexibility, and consistency of the regulations.

No alternative considered by the agency would be more effective in carrying out the purpose for which the regulation is proposed or would be as effective as and less burdensome to affected stakeholders than the proposed regulation.

Chapter VII. References

1. State of California, Air Resources Board, Staff Report: Initial Statement of Reasons: *Proposed 2007 Amendments to the California Reformulated Gasoline Regulations*, Release Date: October 22, 1999.

2. State of California, Air Resources Board, *California Procedures for Evaluating Alternative Specifications for Phase 3 Reformulated Gasoline Using the California Predictive Model,* Last Amended: August 7, 2008

3. http://www.arb.ca.gov/fuels/gasoline/premodel/premodel.htm

4. http://www.arb.ca.gov/enf/advs/advs409.pdf

5. 40 Code of Federal Regulations 80.78(12)(ii)

6. Statistical Analysis System analysis of fuel property changes

APPENDIX A

PROPOSED CARFG3 REGULATIONS, INCLUDING PREDICTIVE MODEL PROCEDURES GUIDE

Contents:

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A-1) PROPOSED CARFG3 REGULATIONS

PROPOSED REGULATION ORDER

PROPOSED 2011 AMENDMENTS TO THE CALIFORNIA PHASE 3 REFORMULATED GASOLINE REGULATIONS

Note: The proposed amendments are shown in <u>underline</u> to indicate additions and ~~strikeout~~ to Indicate deletions**,** compared to the preexisting regulatory language. The symbol "* * * * *" means that intervening text not being amended is not shown. Subsection headings are shown in ***bold italics*** and are to be italicized in Barclays California Code of Regulations.

Repeal title 13, California Code of Regulations (CCR) section 2258, and amend sections 2260, 2261, 2264, 2265 (and the incorporated "California Procedures for Evaluating Alternative Specifications for Phase 3 Reformulated Gasoline Using the California Predictive Model" as last amended August 7, 2008), 2265.1, 2266, 2266.5, and 2271 to read as follows:

California Code of Regulations, Title 13, Division 3
Chapter 5. Standards for Motor Vehicle Fuels
Article 1. Standards for Gasoline

Subarticle 1. Gasoline Standards That Became Applicable Before March 1, 1996

~~§ 2258. Oxygen Content of Gasoline in the Wintertime.~~

~~(a) *Regulatory Standard.*~~

~~(1) Starting November 1, 1992, within each of the air basins during the regulatory control period set forth in section (a)(2), no person shall sell, offer for sale, supply, offer for supply, or transport California gasoline unless the gasoline has an oxygen content of not less than 1.8 percent by weight and not more than 2.2 percent by weight.~~

~~(2) Regulatory Control Periods.~~

~~(A) October 1 through February 29~~
~~South Coast Air Basin and Ventura County~~

~~(B) October 1 through January 31~~
~~Sacramento Valley Air Basin~~
~~San Joaquin Valley Air Basin~~
~~San Francisco Bay Area Air Basin~~
~~Lake Tahoe Air Basin~~
~~Great Basin Valley Air Basin~~
~~Mountain Counties Air Basin~~
~~North Coast Air Basin~~
~~Lake County Air Basin~~
~~Northeast Plateau Air Basin~~
~~North Central Coast Air Basin~~
~~San Luis Obispo County~~

~~(C) November 1 through February 29~~
~~San Diego Air Basin~~
~~Southeast Desert Air Basin~~
~~Santa Barbara County~~

~~(3) Section (a)(1) shall not apply to transactions involving gasoline not meeting the minimum oxygen content standard where the person selling, supplying, or offering the gasoline demonstrates by affirmative defense that: [i] the gasoline has not yet been supplied from the final distribution facility, and [ii] the documents accompanying such gasoline clearly state that it does not comply with the minimum oxygen content standard in section (a)(1), and either [iii] the person has taken reasonably prudent precautions to assure that he or she will bring the gasoline within the standards in section (a)(1) before it is supplied from the final distribution facility, or [iv] at or before the time of the transaction the person has obtained a written statement from the purchaser, recipient, or offeree of the gasoline stating that he or she will take reasonably prudent precautions to assure that the gasoline is brought within the standards of section (a)(1) before it is supplied from the final distribution facility.~~

~~(4) Section (a)(1) shall not apply to a transaction occurring in an air basin during the regulatory control period where the person selling, supplying, or offering the gasoline demonstrates as an affirmative defense that, prior to the transaction, he or she has taken reasonably prudent precautions to assure that the gasoline will be delivered to a retail service station or bulk purchaser-consumer's fueling facility when the station or facility is not subject to a basic regulatory control period.~~

~~(5) Section (a)(1) shall not apply to a transaction occurring in an air basin during the regulatory control period where the transaction involves the transfer of gasoline from a stationary storage tank to a motor vehicle fuel tank and the person selling, supplying, or offering the gasoline demonstrates as an affirmative defense that the last delivery of gasoline to the stationary storage tank occurred more than fourteen days before the start of the regulatory control period.~~

~~(6)(A) The regulatory standards in section (a)(1) shall not apply to a transaction occurring in the air basin during a transition period, where the transaction involves the transfer of gasoline from a stationary storage tank to a motor vehicle fuel tank and the person selling, supplying, or offering the gasoline demonstrates as an affirmative defense that he or she has made, prior to the transaction, specific arrangements with a gasoline distributor for the delivery of an oxygenated or nonoxygenated gasoline blend containing oxygenates in quantities that will result in gasoline in the stationary storage tanks at the facility having an oxygen content of from 1.8 percent to 2.2 percent by weight by the end of the transition period.~~

~~(B) The regulatory standards in section (a)(1) shall not apply to a transaction occurring in an air basin during a transition period, where the transaction involves the sale, offer for sale, supply, offer for supply, or transport of gasoline to a retail gasoline outlet or bulk purchaser-consumer's facility and the person selling, supplying, or offering the gasoline demonstrates as an affirmative defense that the gasoline is being distributed pursuant to a prior arrangement to deliver oxygenated or nonoxygenated gasoline to bring the retail gasoline outlet or bulk purchaser-consumer's facility into compliance with the regulatory standards in section (a)(1) by the end of the transition period.~~

~~(7) Section (a)(1) shall not apply to a transaction involving the sale, offer for sale, supply, or offer for supply of gasoline to a stationary storage tank at a retail gasoline outlet, or the transfer of gasoline from a stationary storage tank at a retail gasoline outlet to a motor vehicle fuel tank, if the person selling, offering, or supplying the gasoline demonstrates by affirmative defense all of the following:~~

~~(A) The retail gasoline outlet is within Modoc, Lassen, Sierra, Nevada, Placer, El Dorado, Alpine, Mono, Inyo, or San Bernardino counties, and is not within the Lake Tahoe or Sacramento Valley Air Basins.~~

~~(B) The final distribution facility from which the gasoline is being or has been delivered is outside California.~~

~~(C) The gasoline is being or has been delivered to the stationary storage tank by a tank truck having a total capacity not exceeding 4500 gallons.~~

~~(D) The stationary storage tank at the retail gasoline outlet has a total capacity not exceeding 2500 gallons, and~~

~~(E) The retail gasoline outlet has a monthly throughput not exceeding 10,000 gallons.~~

~~(8) For the purposes of section (a)(1), each sale of California gasoline at retail, and each dispensing of California gasoline into a motor vehicle fuel tank, shall also~~

be deemed a sale or supply by any person who previously sold or supplied such gasoline in violation of section (a)(1).

(b) Definitions.

For the purposes of this section:

(1) "Bulk purchaser-consumer" means a person who purchases or otherwise obtains gasoline in bulk and then dispenses it into the fuel tanks of motor vehicles owned or operated by the person.

(2) "California gasoline" means gasoline sold or intended for sale as a motor vehicle fuel in California.

(3) "Distributor" means any person engaged in the business of transporting and delivering gasoline to a retail gasoline outlet or bulk purchaser-consumer's facility.

(4) "Final distribution facility" means the stationary gasoline transfer point from which gasoline is transferred into the cargo tank truck, pipeline, or other delivery vessel from which the gasoline will be delivered to the facility at which the gasoline will be dispensed into motor vehicles; except that a cargo tank truck is the final distribution facility where the cargo tank truck is used to transport gasoline and carries written documentation demonstrating that oxygenates, in quantities that will bring the gasoline into compliance with section 2258(a)(1), will be or have been blended directly into the cargo tank truck prior to delivery of the gasoline from the cargo tank truck to the facility at which the gasoline will be dispensed into motor vehicles.

(5) "Gasoline means any fuel which is commonly or commercially known or sold as gasoline.

(6) "Motor vehicle" has the same meaning as defined in section 415 of the Vehicle Code.

(7) "Northern California" means the area of California not contained within the South Central Coast, South Coast, Southeast Desert and San Diego Air Basins.

(8) "Southern California" means the area of California contained within the South Central Coast, South Coast, Southeast Desert and San Diego Air Basins.

(9) "Supply" means to provide or transfer a product to a physically separate facility, vehicle, or transportation system.

(10) "Transition period" means:

a. the first 15 days of any October regulatory control period.

b. November 1 to November 15, 1992, and

c. November 1 through November 15 of 1993, 1994, or 1995 in the San Diego Air Basin, the Southeast Desert Air Basin, and Santa Barbara County.

(c) Sampling Procedures and Test Methods.

Compliance with the oxygen content standards in this regulation shall be determined by use of an applicable sampling methodology set forth in Title 13, California Code of Regulations, section 2296, and use of American Society for Testing and Materials Test Method ASTM D 4815-94, which is incorporated herein by reference. Another test method may be used following a determination by the executive officer that the other method produces results equivalent to the results obtained with ASTM D 4815-94.

(d) Inability to Produce Conforming Gasoline in Extraordinary Circumstances.

In appropriate extreme and unusual circumstances (e.g., natural disaster or Act of God) which are clearly outside the control of the refiner, importer, or oxygenate blender and which could not have been avoided by the exercise of prudence, diligence, and due care, the executive officer may permit a refiner, importer, or oxygenate blender, for a brief period, to distribute gasoline which does not meet the requirements in section (a)(1) if:

(1) It is in the public interest to do so (e.g., distribution of the nonconforming gasoline is necessary to meet projected shortfalls which cannot otherwise be compensated for);

(2) The refiner, importer, or oxygenate blender exercised prudent planning and was not able to avoid the violation and has taken all reasonable steps to minimize the extent of the nonconformity;

(3) The refiner, importer, or oxygenate blender can show how the requirements for oxygenated gasoline will be expeditiously achieved;

(4) The refiner, importer, or oxygenate blender agrees to make up air quality detriment associated with the nonconforming gasoline, where practical; and

(5) The refiner, importer, or oxygenate blender pays to the Air Pollution Control Fund an amount equal to the economic benefit of the nonconformity minus the amount expended, pursuant to section (d)(4), in making up the air quality detriment.

(e) Effect of Supply Waiver Under Federal Clean Air Act.

(1) If the Administrator of the U.S. Environmental Protection Agency issues, pursuant to 42 U.S.C. section 7545(m)(3)(C), a waiver of the requirements of 42 U.S.C. section 7545(m)(2) applicable to a geographic area or areas of California, the requirements of section (a)(1) shall not apply in any air basin containing an area covered by the waiver, during the effective period of the waiver.

(2) If the Administrator of the U.S. Environmental Protection Agency issues, pursuant to 42 U.S.C. section 7545(m)(3)(C), a waiver of the requirements of 42 U.S.C. section 7545(m)(2) applicable to a geographic area or areas within Southern California, section (a)(1) shall not apply, during the effective period of the waiver, in any air basin in Southern California not containing any area required under 42 U.S.C. section 7545(m) to have a wintertime oxygenates program.

(3) If the Administrator of the U.S. Environmental Protection Agency issues, pursuant to 42 U.S.C. section 7545(m)(3)(C), a waiver of the requirements of 42 U.S.C. section 7545(m)(2) applicable to a geographic area or areas within Northern California, section (a)(1) shall not apply, during the effective period of the waiver, in any air basin in Northern California not containing any area required under 42 U.S.C. section 7545(m) to have a wintertime oxygenates program.

(f) Sunset. This section shall not apply to gasoline sold or supplied after February 29, 1996.

NOTE: Authority cited: Sections 39600, 39601, 43013, 43013.1, 43018, and 43101, Health and Safety Code; and *Western Oil and Gas Ass'n*. v. *Orange County Air Pollution Control District*, 14 Cal.3d 411, 121 Cal.Rptr. 249 (1975). Reference: Sections 39000, 39001, 39002, 39003, 39010, 39500, 39515, 39516, 41511, 43000, 43013, 43013.1, 43016, 43018, and 43101, Health and Safety Code; and *Western Oil and Gas Ass'n.* v. *Orange County Air Pollution Control District*, 14 Cal.3d 411, 121 Cal.Rptr. 249 (1975)

Subarticle 2. Standards for Gasoline Sold Beginning March 1, 1996

§ 2260. Definitions.

(a) For the purposes of this subarticle, the following definitions apply:

* * * * *

(6.5) "California reformulated gasoline blendstock for oxygenate blending, or 'CARBOB,'" means a petroleum-derived liquid which is intended to be, or is represented as, a product that will constitute ~~Califoria~~ California gasoline upon the addition of a specified type and percentage (or range of percentages) of oxygenate to the product after the product has been supplied from the production or import facility at which it was produced or imported.

* * * * *

(7.7) “Drag reducing agent” means a long chain polymer chemical that is used in crude oil, refined products or non-potable water pipelines injected by the pipeline operator in small amounts (parts per million) and is used to reduce the frictional pressure drop along the pipeline's length.

* * * * *

(8.5) "Emissions associated with permeation" means the incremental increase in emissions because of permeation which is calculated as the difference between the emissions from the producer's or importer's final blend formulation and the flat limits without ethanol. The Phase 3 reformulated gasoline Predictive Model, as described in the applicable version of the "California Procedures for Evaluating Alternative Specifications for Phase 3 Reformulated Gasoline Using the California Predictive Model~~,~~" as ~~corrected November 18, 2004 and last amended August 7, 2008, which is~~ incorporated ~~herein~~ by reference in section 2265(a)(2)(A), shall be used to calculate emissions associated with permeation.

Emissions are calculated as follows:

Ozone Forming Potential (tons per day) = 18.4 (tons per day) * (PCE(OFP)/ 2.39) * 2.80 * percent share of California gasoline sales covered by the AERP, and

NOx (tons per day) = 427.8 (tons per day) * PCE(NOx) * percent share of California gasoline sales covered by the AERP, where

PCE(OFP) and PCE(NOx) = Percent change in emissions, as predicted by the CaRFG3 Predictive Model for Ozone Forming Potential (OFP) and Oxides of Nitrogen (NOx), respectively, as described in the applicable version of the

"California Procedures for Evaluating Alternative Specifications for Phase 3 Reformulated Gasoline Using the California Predictive Model~~,~~" as ~~corrected November 18, 2004 and~~ ~~last amended August 7, 2008 which is~~ incorporated ~~herein~~ by reference in section 2265(a)(2)(A).

* * * * *

(19.7) "Percent change in emissions values, as they pertain to the PM emissions offsetting compliance option" means values calculated, each for oxides of nitrogen, total ozone forming potential, and potency-weighted toxics, from the Phase 3 Predictive Model using the designated emissions offsetting limits for the candidate fuel and the flat limits in section 2262 for the reference fuel, as described in the "California Procedures for Evaluating Alternative Specifications for Phase 3 Reformulated Gasoline Using the California Predictive Model," ~~as corrected November 18, 2004 and last amended August 7, 2008~~ the applicable version as described in section 2265(a)(2), which is incorporated ~~herein~~ by reference in section 2265(a)(2)(A).

* * * * *

(29.5) "Racing vehicle" means a ~~competition vehicle not used on public highways.~~ vehicle that:

(A) Is exclusively operated in conjunction with sanctioned racing events;

(B) Exhibits racing features and modifications such that it is incapable of safe and practical street or highway use;

(C) Is not licensed by the State of California Department of Motor Vehicles for operation on public streets or highways; and

(D) Is never operated on public streets or highways.

* * * * *

NOTE: Authority cited: Sections 39600, 39601, 43013, 43013.1, 43018 and 43101, Health and Safety Code; and *Western Oil and Gas Ass'n*. v. *Orange County Air Pollution Control District*, 14 Cal.3d 411, 121 Cal.Rptr. 249 (1975). Reference: Sections 39000, 39001, 39002, 39003, 39010, 39048, 39500, 39515, 39516, 41511, 43000, 43013, 43013.1, 43016, 43018 and 43101, Health and Safety Code; and *Western Oil and Gas Ass'n.* v. *Orange County Air Pollution Control District*, 14 Cal.3d 411, 121 Cal.Rptr. 249 (1975).

§ 2261. Applicability of Standards; Additional Standards.

* * * * *

(b) *Applicability of the CaRFG Phase 3 Standards.*

* * * * *

(4) *Early compliance with the CaRFG Phase 3 Amendments (Emissions Associated with Permeation) Before December 31, 2009.*

(A) Any producer or importer that produces gasoline electing to supply from its production or import facility, before December 31, 2009, any final blends of gasoline subject to any of the applicable versions of the "California Procedures for Evaluating Alternative Specifications for Phase 3 Reformulated Gasoline Using the California Predictive Model," ~~as corrected November 18, 2004 and last amended August 7, 2008~~ which are incorporated by reference in section 2265(a)(2), shall notify the Executive Officer of its wish to do so. The notification shall include all of the information listed in section 2261(b)(4)(E).

* * * * *

(C) Any producer or importer electing to supply from its production or import facility, before December 31, 2009, any final blends of gasoline subject to any of the applicable versions of the "California Procedures for Evaluating Alternative Specifications for Phase 3 Reformulated Gasoline Using the California Predictive Model," ~~as corrected November 18, 2004 and last amended August 7, 2008~~ which are incorporated by reference in section 2265(a)(2), or to the "Procedures for Using the California Model for California Reformulated Gasoline Blendstocks for Oxygenate Blending (CARBOB)," as adopted April 25, 2001, last amended August 7, 2008, may elect to use either one of the two compliance options ~~(exhaust + evaporative emissions model elements or the exhaust emissions model element only)~~ (total hydrocarbon model or the exhaust hydrocarbon model) as defined in the "California Procedures for Evaluating Alternative Specifications for Phase 3 Reformulated Gasoline Using the California Predictive Model" to certify alternative blends of gasoline. With certain limited exceptions, which are described in the "California Procedures for Evaluating Alternative Specifications for Phase 3 Reformulated Gasoline Using the California Predictive Model," beginning December 31, 2009, a candidate fuel that is designated as "non-RVP-controlled gasoline" must use the exhaust hydrocarbon model in determining the emissions equivalency of the candidate fuel specifications. A candidate fuel that is designated as "RVP-controlled gasoline" must use the total hydrocarbon model in determining the emissions equivalency of the candidate fuel specifications. ~~Beginning December 31, 2009, only the first compliance option (exhaust + evaporative emissions model elements) shall be used during the RVP regulatory control periods in section 2262.4(b)(2) and only the second compliance option (exhaust emissions model element only) shall be used outside of the RVP regulatory control period.~~

* * * * *

(E) Notification.

1. The approximate date by which it intends to begin supplying from its production or import facility gasoline complying with any of the applicable versions of the "California Procedures for Evaluating Alternative Specifications for Phase 3 Reformulated Gasoline Using the California Predictive Model," ~~as corrected November 18, 2004 and last amended August 7, 2008~~ which are incorporated by reference in section 2265(a)(2), or the "Procedures for Using the California Model for California Reformulated Gasoline Blendstocks for Oxygenate Blending (CARBOB)," as adopted April 25, 2001, last amended August 7, 2008, referred to as the amended Procedures Guides, if permitted to do so;

* * * * *

NOTE: Authority cited: Sections 39600, 39601, 43013, 43013.1, 43018 and 43101, Health and Safety Code; and *Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District*, 14 Cal.3d 411, 121 Cal. Rptr. 249 (1975). Reference: Sections 39000, 39001, 39002, 39003, 39010, 39500, 39515, 39516, 41511, 43000, 43013, 43013.1, 43016, 43018, 43101 and 43830.8, Health and Safety Code; and *Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District*, 14 Cal.3d 411, 121 Cal. Rptr. 249 (1975).

§ 2264. Designated Alternative Limits.

* * * * *

(d) ***Designated alternative limits for PM alternative gasoline formulations.***

The producer or importer of a final blend of California gasoline that is subject to the PM averaging compliance option for one or more properties may assign a designated alternative limit to the final blend by satisfying the notification requirements of section 2264(a). The producer or importer of such a final blend shall be subject to all of the provisions of this section 2264, except that, with respect to that final blend, the PM averaging limit (if any) for ~~for~~ each property subject to the PM averaging compliance option shall replace any reference in this section 2264 to the averaging limit specified in section 2262.

NOTE: Authority cited: Sections 39600, 39601, 43013, 43013.1, 43018 and 43101, Health and Safety Code; and *Western Oil and Gas Ass'n*. v. *Orange County Air Pollution Control District*, 14 Cal.3d 411, 121 Cal.Rptr. 249 (1975). Reference: Sections 39000, 39001, 39002, 39003, 39010, 39500, 39515, 39516, 41511, 43000, 43013, 43013.1, 43016, 43018 and 43101, Health and Safety Code; and *Western Oil and Gas Ass'n.* v. *Orange County Air Pollution Control District*, 14 Cal.3d 411, 121 Cal.Rptr. 249 (1975).

§ 2265. Gasoline Subject to PM Alternative Specifications Based on the California Predictive Model.

(a) ***Election to sell or supply a final blend as a PM alternative gasoline formulation.***

* * * * *

~~(2) The producer or importer shall evaluate the candidate PM alternative specifications for gasoline subject to the CaRFG Phase 2 standards in accordance with the Air Resources Board's "California Procedures for Evaluating Alternative Specifications for Phase 2 Reformulated Gasoline Using the California Predictive Model," as adopted April 20, 1995 and last amended December 11, 1998, which is incorporated herein by reference. The producer or importer shall evaluate the candidate PM alternative specifications for gasoline subject to the CaRFG Phase 3 standards in accordance with the Air Resources Board's "California Procedures for Evaluating Alternative Specifications for Phase 3 Reformulated Gasoline Using the California Predictive Model," as corrected November 18, 2004, which is incorporated herein by reference. Starting December 31, 2009, the producer or importer shall evaluate the candidate PM alternative specifications for gasoline subject to the CaRFG Phase 3 standards in accordance with the Air Resources Board's "California Procedures for Evaluating Alternative Specifications for Phase 3 Reformulated Gasoline Using the California Predictive Model," as corrected November 18, 2004 and last amended August 7, 2008, which is incorporated herein by reference. The three documents incorporated by reference in this section 2265(a)(2) are collectively referred to as the "Predictive Model Procedures." If the PM alternative specifications meet the criteria for approval in the applicable Predictive Model Procedures, the producer shall notify the executive officer of: (A) The identity and location of the final blend; (B) the PM alternative specifications that will apply to the final blend, including for each specification whether it applies as a PM flat limit or a PM averaging limit; and (C) the numerical values for percent change in emissions for oxides of nitrogen, total ozone forming potential, and potency-weighted toxic air contaminants as determined in accordance with the applicable Predictive Model Procedures. The notification shall be received by the executive officer before the start of physical transfer of the gasoline from the production or import facility, and in no case less than 12 hours before the producer or importer either completes physical transfer or commingles the final blend.~~

(2)(A) ***Evaluation of the Candidate PM Alternative Specifications.***

1. The producer or importer shall evaluate the candidate PM alternative specifications in accordance with the applicable “Predictive Model Procedures” documents incorporated by reference below.

2. ***Gasoline Subject to the CaRFG Phase 2 Standards***. The producer or importer shall evaluate the candidate PM alternative specifications for gasoline subject to the CaRFG Phase 2 standards in accordance with the Air Resources

Board's "California Procedures for Evaluating Alternative Specifications for Phase 2 Reformulated Gasoline Using the California Predictive Model," as adopted April 20, 1995, and last amended December 11, 1998, which is incorporated herein by reference.

3. ***Gasoline Subject to the CaRFG Phase 3 Standards and Supplied Before April 9, 2005.*** For a final blend subject to the CaRFG Phase 3 standards and starting to be sold or supplied from the production or import facility before April 9, 2005, the producer or importer shall evaluate the candidate PM alternative specifications in accordance with the Air Resources Board's "California Procedures for Evaluating Alternative Specifications for Phase 3 Reformulated Gasoline Using the California Predictive Model," as adopted April 25, 2001, which is incorporated herein by reference.

4. ***Gasoline Supplied From April 9, 2005 through December 30, 2009.*** For a final blend starting to be sold or supplied from the production or import facility from April 9, 2005, through December 30, 2009, the producer or importer shall evaluate the candidate PM alternative specifications in accordance with the Air Resources Board's "California Procedures for Evaluating Alternative Specifications for Phase 3 Reformulated Gasoline Using the California Predictive Model," as amended November 18, 2004, which is incorporated herein by reference.

5. ***Gasoline Supplied From December 31, 2009 through [Insert day before operative date of amendments].*** For a final blend starting to be sold or supplied from the production or import facility from December 31, 2009 through [Insert day before operative date of amendments], the producer or importer shall evaluate the candidate PM alternative specifications for gasoline subject to the CaRFG Phase 3 standards in accordance with the Air Resources Board's "California Procedures for Evaluating Alternative Specifications for Phase 3 Reformulated Gasoline Using the California Predictive Model," as last amended August 7, 2008, which is incorporated herein by reference.

6. ***Gasoline Supplied Starting [insert operative date of amendments].*** For a final blend starting to be sold or supplied from the production or import facility on or after [insert operative date of amendments], the producer or importer shall evaluate the candidate PM alternative specifications for gasoline subject to the CaRFG Phase 3 standards in accordance with the Air Resources Board's "California Procedures for Evaluating Alternative Specifications for Phase 3 Reformulated Gasoline Using the California Predictive Model," last amended [insert date of amendment], which is incorporated herein by reference.

(B) ***Notification to the Executive Officer.*** If the PM alternative specifications being evaluated meet the criteria for approval in the applicable Predictive Model Procedures, the producer or importer shall notify the Executive Officer of:

1. The identity and location of the final blend;
2. the PM alternative specifications that will apply to the final blend, including for each specification whether it applies as a PM flat limit or a PM averaging limit;
3. the numerical values for percent change in emissions for oxides of nitrogen, total ozone forming potential, and potency-weighted toxic air contaminants as determined in accordance with the applicable Predictive Model Procedures;
4. the grade of gasoline of the final blend;
5. the location of the final blend with sufficient specificity to locate and sample the gasoline. This shall include, but is not limited to, the name of the facility, address, and identification of the storage tank.

The notification shall be received by the Executive Officer before the start of physical transfer of the gasoline from the production or import facility, and in no case less than 12 hours before the producer or importer either completes physical transfer or commingles the final blend.

* * * * *

NOTE: Authority cited: Sections 39600, 39601, 43013, 43013.1, 43018 and 43101, Health and Safety Code; and *Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District*, 14 Cal.3d 411, 121 Cal. Rptr. 249 (1975). Reference: Sections 39000, 39001, 39002, 39003, 39010, 39500, 39515, 39516, 41511, 43000, 43013, 43013.1, 43016, 43018 and 43101, Health and Safety Code; and *Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District*, 14 Cal.3d 411, 121 Cal. Rptr. 249 (1975).

§ 2265.1. Offsetting Emissions Associated with Higher Sulfur Levels.

(a) Assignment of designated emissions offsetting limits and percent change in emissions values for batches of gasoline for which the emissions associated with higher sulfur levels are being offset.

* * * * *

(3) Notification of final blends associated with a final blend credit.

(A) For each final blend associated with a final blend credit, the producer or the importer that produces gasoline shall notify the executive officer in writing for receipt by the executive officer before the start of physical transfer of the gasoline from the production facility or the import facility, and in no case less than 12 hours before the producer or the importer that produces gasoline either completes physical transfer or commingles the final blend, with the following information:

~~(1)~~ 1. The company name, address, phone number, and contact information,

~~(2)~~ 2. The production facility or the import facility name, batch name, number, or other identification, the blend identity, grade of California gasoline, the location (with sufficient specificity to allow ARB inspectors to locate and sample the gasoline; this shall include, but is not limited to, the name of the facility, address, and identification of the tank), and other information that uniquely identifies the California gasoline associated with a final blend credit,

~~(3)~~ 3. The estimated volume (in barrels),

~~(4)~~ 4. The designated emissions offsetting limits for RVP, sulfur content, benzene content, aromatics content, olefins content, T50, T90, and oxygen content for the final blend,

~~(5)~~ 5. The percent change in emissions values, as they pertain to the PM emissions offsetting compliance option, for oxides of nitrogen, total ozone forming potential, and potency-weighted toxics for the final blend,

~~(6)~~ 6. A statement, signed by a legal representative for the producer or the importer that produces gasoline that all information submitted with the notification is true and correct, and

~~(7)~~ 7. Within 24 hours after the completion of the physical transfer, the date and time of the completion of physical transfer from the production facility or the import facility.

* * * * *

NOTE: Authority cited: Sections 39600, 39601, 43013, 43013.1, 43018 and 43101, Health and Safety Code; and *Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District*, 14 Cal.3d 411, 121 Cal.Rptr. 249 (1975). Reference: Sections 39000, 39001, 39002, 39003, 39010, 39500, 39515, 39516, 41511, 43000, 43013, 43013.1, 43016, 43018 and 43101, Health and Safety Code; and *Western Oil and Gas Ass'n.v. Orange County Air Pollution Control District*, 14 Cal.3d 411, 121 Cal.Rptr. 249 (1975).

§ 2266. Certified Gasoline Formulations Resulting in Equivalent Emission Reductions Based on Motor Vehicle Emissions Testing.

* * * * *

(c) ***Notification regarding sales and supplies of a test-certified alternative gasoline formulation.*** A producer or importer intending to sell or supply a final blend of California gasoline from its production facility or import facility as a test-certified alternative gasoline formulation shall notify the ~~e~~Executive ~~o~~Officer in accordance with this section (c). The notification shall identify the final blend and the identification name of the test-certified alternative gasoline formulation. The notification shall be received by the ~~e~~Executive ~~o~~Officer ~~at least 12 hours before start of physical transfer of the final blend from the production or import facility.~~ before the start of physical transfer of the gasoline from the production or import facility, and in no case less than 12 hours before the producer or importer either completes physical transfer or commingles the final blend. A producer or importer intending to have a series of its final blends be a specific test-certified alternative gasoline formulation may enter into a protocol with the executive officer for reporting such blends as long as the executive officer reasonably determines the reporting under the protocol would provide at least as much notice to the executive officer as notification pursuant to the express terms of this section (c).

NOTE: Authority cited: Sections 39600, 39601, 43013, 43013.1, 43018 and 43101, Health and Safety Code; and *Western Oil and Gas Ass'n*. v. *Orange County Air Pollution Control District*, 14 Cal.3d 411, 121 Cal.Rptr. 249 (1975). Reference: Sections 39000, 39001, 39002, 39003, 39010, 39500, 39515, 39516, 41511, 43000, 43013, 43013.1, 43016, 43018 and 43101, Health and Safety Code; and *Western Oil and Gas Ass'n.* v. *Orange County Air Pollution Control District*, 14 Cal.3d 411, 121 Cal.Rptr. 249 (1975).

§ 2266.5. Requirements Pertaining to California Reformulated Gasoline Blendstock for Oxygen Blending (CARBOB) and Downstream Blending.

* * * * *

(e) *Restrictions on transferring CARBOB.*

(1) *Required agreement by transferee*. No person may transfer ownership or custody of CARBOB to any other person unless the transferee has agreed in writing with the transferor that either:

* * * * *

(B) The transferee will take all reasonably prudent steps necessary to assure that the CARBOB is transferred to a registered oxygen blender who adds the type and amount (or within the range of amounts) of oxygenate designated in accordance with section (b) to the CARBOB before the CARBOB is ~~transfered~~ transferred from a final distribution facility.

(2) *Prohibited sales of CARBOB from a final distribution facility*~~-~~. No person may sell, offer, or supply CARBOB from a final ~~distribition~~ distribution facility where the

type and amount or range of amounts of oxygenate designated in accordance with section (b) has not been added to the CARBOB.

(f) ***Restrictions on blending CARBOB with other ~~products~~ materials.***

(1) *Basic prohibition*. No person may combine any CARBOB that has been supplied from the facility at which it was produced or imported with any ~~other CARBOB, gasoline, blendstock or oxygenate,~~ material except:

* * * * *

(F) Deposit Control Additives that meet the limits specified in sections 2253.4 and 2254, and that are certified pursuant to 2257

(G) Additives that a pipeline operator that would add for operational purposes, such as, drag reducing agent.

* * * * *

NOTE: Authority cited: Sections 39600, 39601, 43013, 43013.1, 43018 and 43101, Health and Safety Code; and *Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District*, 14 Cal.3d 411, 121 Cal. Rptr. 249 (1975). Reference: Sections 39000, 39001, 39002, 39003, 39010, 39500, 39515, 39516, 41511, 43000, 43013, 43013.1, 43016, 43018, 43021 and 43101, Health and Safety Code; and *Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District*, 14 Cal.3d 411, 121 Cal. Rptr. 249 (1975).

§ 2271. Variances.

* * * * *

(g) *Duration of variances.*

* * * * *

(2) *Variances related to a physical catastrophe*. Notwithstanding the provisions of section (g)(1), a refiner may be granted a variance with a duration of more than 120 days, or a variance extension of more than 90 days, if the applicant demonstrates that the additional time is necessary due to a physical catastrophe, and the requirements of sections (d) and (e) are met. In order to receive a variance or variance extension, the applicant must submit an application as specified in section (a) and a hearing must be held as specified in sections (b) and (c). As used in this section, "physical catastrophe" means a sudden ~~unforseen~~ unforeseen emergency beyond the reasonable control of the refiner,

causing the severe reduction or total loss of one or more critical refinery units that materially impact the refiner's ability to produce complying gasoline. "Physical catastrophe" does not include events which are not physical in nature such as design errors or omissions, financial or economic burdens, or any reduction in production that is not the direct result of qualifying physical damage.

* * * * *

NOTE: Authority cited: Sections 39600, 39601, 43013, 43013.1, 43013.2, 43018 and 43101, Health and Safety Code; and *Western Oil and Gas Ass'n*. v. *Orange County Air Pollution Control District*, 14 Cal.3d 411, 121 Cal.Rptr. 249 (1975). Reference: Sections 39000, 39001, 39002, 39003, 39010, 39500, 39515, 39516, 40000, 41511, 43000, 43013, 43013.1, 43013.2, 43016, 43018 and 43101, Health and Safety Code; and *Western Oil and Gas Ass'n.* v. *Orange County Air Pollution Control District*, 14 Cal.3d 411, 121 Cal.Rptr. 249 (1975).

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A-2) PROCEDURES FOR USING THE PREDICTIVE MODEL

State of California
California Environmental Protection Agency
AIR RESOURCES BOARD

California Procedures for Evaluating Alternative Specifications for Phase 3 Reformulated Gasoline Using the California Predictive Model

Adopted: June 16, 2000
Amended: April 25, 2001
Amended: November 18, 2004
~~Last~~ Amended: August 7, 2008
Last Amended: [Insert date of amendment]

Note: The preexisting text is set forth below in normal type. The amendments are shown in *underline italic* to indicate additions and ~~strikeout~~ to indicate deletions.

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Table of Contents

Table of Contents (continued)

List of Tables

I. INTRODUCTION

A. Purpose and Applicability

1. The predictive model prescribed in this document may be used to evaluate gasoline specifications as alternatives to the Phase 3 California Reformulated Gasoline (RFG) flat and averaging limits in the gasoline specifications set forth in Title 13, California Code of Regulations (13 CCR), section 2262.

   This procedure:

   - prescribes the range of specifications that may be utilized to select a set of candidate Phase 3 RFG alternative gasoline specifications for evaluation,
   - defines the Phase 3 RFG reference specifications,
   - prescribes the calculations to be used to predict the emissions from the candidate fuel specifications and the reference Phase 3 RFG specifications,
   - prescribes the calculations to be used to compare the emissions resulting from the candidate fuel specifications to the reference Phase 3 RFG specifications,
   - establishes the requirements for the demonstration and approval of the candidate fuel specifications as an alternative Phase 3 RFG formulation, ~~and~~
   - establishes the notification requirements*, and*
   - *identifies when the exhaust hydrocarbon equations models and the evaporative hydrocarbon emissions equations must be used.*

2. Gasoline properties for which alternative gasoline specifications may be set by this procedure include all eight Phase 3 RFG properties.

3. The Phase 3 RFG specifications, established in 13 CCR, section 2262, are shown in Table 1.

4. The pollutant emissions addressed by these procedures and the units of model predictions are shown in Table 2.

Table 1
Properties and Specifications for Phase 3 Reformulated Gasoline

Fuel Property	Units	Flat Limit	Averaging Limit	Cap Limit
Reid vapor pressure (RVP)	psi, max.	6.90[1]/7.00	none	7.20
Sulfur (SUL)	ppmw, max.	20	15	60/30[3]/20[3]
Benzene (BENZ)	vol.%, max.	0.80/1.00[2]	0.70	1.10
Aromatic HC (AROM)	vol.%, max.	25.0/35.0[2]	22.0	35.0
Olefin (OLEF)	vol.%, max.	6.0	4.0	10.0
Oxygen (OXY)	wt. %	1.8 (min) 2.2 (max)	none	1.8(min)[4] 3.5(max)[5]
Temperature at 50 % distilled (T50)	deg. F, max.	213/220[2]	203	220
Temperature at 90% distilled (T90)	deg. F, max.	305/312[2]	295	330

1 The flat limit for RVP is 7.00 psi. The flat limit for RVP is 6.90 when the fuel being certified is blended without ethanol. The Reid vapor pressure (RVP) standards apply only during the warmer weather months identified in section 2262.4.

2 The higher value is the small refiner CaRFG flat limit for qualifying small refiners only, as specified in section 2272.

3 The CaRFG Phase 3 sulfur content cap limits of 60, 30, and 20 parts per million are phased in starting December 31, 2003, December 31, 2005, and December 31, 2011, respectively, in accordance with section 2261(b)(1)(A).

4 Applicable only during specified winter months in the areas identified in 13 CCR, section 2262.5(a).

5 If the gasoline contains more than 3.5 percent by weight oxygen but not more than 10 volume percent ethanol, the maximum oxygen content cap is 3.7 percent by weight.

Table 2
Predictive Model Pollutants and Their Units of Measurement

Pollutant Predictions	**Units**
Oxides of Nitrogen (NOx)	gm/mile
Exhaust Hydrocarbons (*Ex*HC)	gm/mile
Evaporative Hydrocarbons ~~(HC)~~	Percent Change (Candidate Fuel Relative to Reference Fuel)
Exhaust Potency-Weighted Toxics (PWT)	mg/mile
Evaporative Benzene	mg/mile
~~Exhaust~~ *Carbon Monoxide (*CO*)* ~~(Adjustment Factor for Oxygen)~~	gm/mile

B. Synopsis of Procedure

The predictive model is used to predict the emissions for gasoline meeting the Phase 3 RFG specifications (reference fuel specifications) and the emissions for a candidate gasoline meeting alternative specifications (candidate fuel specifications). The predicted emissions are functions of the regulated fuel properties shown in Table 1. The candidate gasoline is ~~accepted as equivalent~~ ~~*to*~~ *deemed acceptable as* Phase 3 RFG if its predicted emissions for each pollutant is less than or equal (within round-off) to the predicted emissions for a fuel meeting the Phase 3 RFG specifications.

1. What is the Predictive Model?

The predictive model consists of a number of sub-models. The sub-models are equations which relate gasoline properties to the exhaust emissions and evaporative emissions changes which result when the gasoline is used to fuel a motor vehicle. The emissions predictions are expressed in the units shown in Table 2.

Twenty-one separate exhaust sub-models have been developed for seven pollutants (NOx, *hydrocarbon (*HC*)*, CO, benzene, 1,3-butadiene, formaldehyde, and acetaldehyde). Three exhaust sub-models have been developed for each of the seven pollutants: one sub-model for each of three vehicle emissions control technology "Tech" classes (Tech 3, Tech 4, and Tech 5).

In addition, six sub-models have been developed for evaporative emissions. Three sub-models have been developed for evaporative hydrocarbon emissions and three sub-models have been developed for evaporative benzene emissions. For both evaporative hydrocarbon emissions and evaporative benzene emissions, one sub-model has been developed for each of the following evaporative emission processes: 1) Diurnal/Resting

Losses, 2) Hot Soak Emissions, and 3) Running Losses. ~~Finally, an adjustment factor has been developed to predict the effect of changing fuel properties on exhaust CO emissions.~~

2. Combination of Sub-Model Predictions for Exhaust Emissions Across Tech Classes *(referred to as the Exhaust Hydrocarbon Model (ExHC Model) in this procedures document)*

In the ExHC Model, ~~T~~*t*he exhaust emissions of the reference fuel specifications and the candidate fuel specifications for each Tech class of vehicles are predicted by the sub-models of the predictive model. The differences between the predicted exhaust emissions for the reference fuel specifications and the candidate fuel specifications are combined to yield Tech class-weighted predicted emissions differences. These predicted differences represent the predicted differences in exhaust emissions between the reference fuel specifications and the candidate fuel specifications for the entire California vehicle fleet. For NOx and ~~exhaust~~ *Ex*HC emissions, the differences in predictions for each Tech class are combined using Tech class weighting factors which represent the fraction of the total emissions originating from each Tech class.

For the exhaust toxics emissions, the predicted emissions for Tech classes are weighted both by fractions and by potencies. The potency weights represent the relative carcinogenicity of the toxic pollutants. For each toxic pollutant, the predicted exhaust emissions for each Tech class is weighted by the HC exhaust Tech group weighting factor which represents the fraction of the total vehicle miles traveled by each Tech class. Then, the Tech class-weighted emissions prediction for each toxic pollutant is multiplied by the relative potency for that pollutant. The Tech class-weighted, potency-weighted predictions for each toxic pollutant are then summed to yield the predicted total potency-weighted exhaust toxics emissions. Finally, an emissions prediction for evaporative benzene emissions is added to the prediction for total potency-weighted exhaust toxics emissions to yield a prediction for total potency-weighted toxics emissions. This calculation is performed for both the reference fuel specifications and the candidate fuel specifications.

3. Combination of Evaporative HC Emissions Predictions*,* ~~with~~ Exhaust H*ydrocarbon*~~C~~ Emissions Predictions*, and CO Emissions Predictions* *(referred to as the Total Hydrocarbon Model (THC Model) in this procedures document)*

~~Two compliance options are available to applicants. The first compliance option~~ *The THC Model* includes predictions for differences in *exhaust and* evaporative HC emissions and CO emissions between the candidate fuel specifications and the Phase 3 RFG reference fuel in the evaluation of the ~~HC emissions~~ equivalency of the candidate fuel. ~~The second option does not, and the HC emissions equivalency of the candidate fuel specifications is based only on the predictions of the exhaust HC emissions models, as is the case in the Phase 2 RFG regulations.~~ In the *THC Model* ~~first compliance option~~, the Tech class-weighted difference in the predicted ~~exhaust~~ *Ex*HC emissions between the reference fuel specifications and the candidate fuel specifications is combined with the predicted difference in evaporative HC emissions *and CO emissions* between the two fuels when evaluating the ~~HC emissions~~ equivalency of the candidate fuel specifications. This combination estimates the difference in total HC emissions (exhaust plus evaporative) *and*

CO emissions between the reference fuel specifications and the candidate fuel specifications. ~~In the second compliance option, the predicted evaporative HC emissions changes are not included and the HC emissions equivalency of the candidate fuel specifications is based only on the Tech class-weighted difference in the predicted exhaust HC emissions. This was the only compliance option available in the Phase 2 RFG regulations. The second option is being offered for applicants who are not interested in using the evaporative HC emissions model in the evaluation of the HC emissions equivalency of the alternative fuel specifications.~~

~~Under first compliance option~~ *In the THC Model*, when combining the Tech class-weighted difference in the predicted ~~exhaust~~ *ExHC* emissions with the predicted difference in evaporative HC emissions, the greater ozone-forming potential of the exhaust emissions is recognized by the inclusion of a "reactivity adjustment" factor for the evaporative HC emissions. Also, the ozone-forming potential of CO emissions is recognized in ~~this compliance option~~ *the THC Model* by the inclusion of emissions in the sum of exhaust and evaporative HC emissions. Thus, ~~under this compliance option~~ *in the THC Model*, the combination of the model predictions for ~~exhaust~~ *ExHC* emissions, evaporative HC emissions changes, and CO emissions yields a number which represents a prediction for the change in ozone-forming potential (OFP) between the reference fuel specifications and the candidate fuel specifications. The flat and cap RVP limits for ~~this compliance option~~ *the THC Model* are 7.00 psi, and 7.20 psi, respectively for fuels containing ethanol, and flat and cap RVP limits of 6.90 and 7.20 psi, respectively for fuels not containing ethanol.

~~Under the second compliance option, only the Tech class-weighted difference in the predicted exhaust HC emissions is used in comparing the HC emissions of the reference fuel specifications to the HC emissions of the candidate fuel specifications. Under this option, evaporative HC emissions of the candidate fuel are limited by the imposition of a flat (and cap) RVP limit of 7.0. The CO adjustment factor also is not used under the second compliance option.~~

~~Either the first or second compliance options can be used during the RVP control season until December 31, 2009. Beginning December 31, 2009, only the first compliance option can be used during the RVP control season. Only the second compliance option can be used outside of the RVP control season.~~

4. Determination of Emissions Equivalency

The candidate fuel specifications are deemed equivalent to the reference fuel specifications if, for each pollutant (NOx, total OFP or ~~exhaust~~ *Ex*HC, and potency-weighted toxics (PWT)), the predicted percent change in emissions between the candidate fuel specifications and the reference Phase 3 RFG specifications is equal to or less than 0.04%. If the applicant ~~has elected to use the evaporative HC emissions model~~ *is using or is required to use the THC Model* in the evaluation of the emissions equivalency, the 0.04% criteria must be met for NOx, OFP, and PWT. If the applicant ~~has elected not to use the evaporative HC emissions model~~ *is using or is required to use the ExHC Model*, the 0.04% criteria must be met for NOx, ~~exhaust~~ *Ex*HC, and PWT. If, for any of the three pollutants in the criteria, the predicted percent change in emissions between the candidate fuel specifications and the reference Phase 3 RFG specifications is equal to or greater than 0.05%, the candidate specifications are deemed unacceptable and may not be a substitute for Phase 3 RFG. [Note: All final values of the percent change in emissions shall be reported to the nearest hundredth using conventional rounding.]

C. Definitions

1. **Alternative gasoline formulation** means a final blend of gasoline that is subject to a set of alternative specifications deemed acceptable pursuant to the *California Procedures for Evaluating Alternative Specifications for Phase 3 Reformulated Gasoline Using the California Predictive Model*.

2. **Alternative fuel specifications** means the specifications for the following gasoline properties, as determined in accordance with ~~13 CCR~~California Code of Regulations, title 13, section 2263:
   - ♦ maximum Reid vapor pressure, expressed in the nearest hundredth of a pound per square inch;
   - ♦ maximum sulfur content, expressed in the nearest parts per million by weight;
   - ♦ maximum benzene content, expressed in the nearest hundredth of a percent by volume;
   - ♦ maximum olefin content, expressed in the nearest tenth of a percent by volume;
   - ♦ minimum and maximum oxygen content, expressed in the nearest tenth of a percent by weight;
   - ♦ maximum T50, expressed in the nearest degree Fahrenheit;
   - ♦ maximum T90, expressed in the nearest degree Fahrenheit; and
   - ♦ maximum aromatic hydrocarbon content, expressed in the nearest tenth of a percent by volume.

3. **Applicant** means the party seeking approval of alternative gasoline specifications and responsible for the demonstration described herein.

4. **Aromatic hydrocarbon content (Aromatic HC, AROM)** means the amount of aromatic hydrocarbons in the fuel expressed to the nearest tenth of a percent by volume in accordance with 13 CCR, section 2263.

5. **ASTM** means the American Society of Testing and Materials.

6. **Averaging Limit** means a limit for a fuel property that must be achieved in accordance with 13 CCR, section 2264.

7. **Benzene content (BENZ or Benz)** means the amount of benzene contained in the fuel expressed to the nearest hundredth of a percent by volume in accordance with 13 CCR, section 2263.

8. **Candidate fuel or candidate fuel specifications** means the fuel or set of specifications which are being evaluated for its emission performance using these procedures.

9. **Cap limit** means a limit that applies to all California gasoline throughout the gasoline distribution system, in accordance with 13 CCR, sections 2262.3 (a), 2262.4 (a), and 2262.5 (a) and (b).

9.5. ***Carbon Monoxide (CO) Emissions Equations*** *means the equations that relate gasoline properties to carbon monoxide emissions which result when the gasoline is used to fuel a motor vehicle.*

10. **EMFAC2007** means the EMFAC2007 motor vehicle emission inventory and emissions calculation system maintained by the ARB.

11. **Ethanol content** means the amount of ethanol in the fuel expressed to the nearest tenth of a percent by volume.

11.5. ***Evaporative hydrocarbon emissions equations (Evaporative HC emissions equations)*** *means the equations that relate gasoline properties to evaporative hydrocarbon emissions which result when the gasoline is used to fuel a motor vehicle.*

12. **Executive Officer** means the executive officer of the Air Resources Board, or his or her designee.

12.5 ***Exhaust hydrocarbon emissions Equations (ExHC emissions equations)*** *means the equations that relate gasoline properties to exhaust hydrocarbon emissions which result when the gasoline is used to fuel a motor vehicle.*

13. **Exhaust~~-only~~ ~~option~~** ***Hydrocarbon Model (ExHC Model)*** means the ~~compliance option available to applicants~~ *model* which uses only the exhaust ~~HC~~*hydrocarbon* emissions models in the evaluation of the HC emissions equivalency of the candidate fuel specifications.

14. *[Reserved]* ~~**Evap option** means the compliance option available to applicants which uses evaporative HC emissions models and the CO adjustment factor in the evaluation of the HC emissions equivalency of the candidate fuel specifications.~~

15. **Flat limit** means a single limit for a fuel property that applies to all California

gasoline sold or supplied from a California production facility or import facility.

16. **Intercept** means the average vehicle effect for a particular Tech class and a particular pollutant. The intercept represents the average emissions across vehicles in the Tech class, for a fuel with properties equal to the average values of all fuels in the data base for that Tech class.

17. **MTBE content (MTBE)** means the amount of methyl tertiary-butyl ether in the fuel expressed in the nearest tenth of a percent by volume.

*17.5 **Non-RVP-controlled gasoline** means gasoline sold or supplied from a production or import facility outside the applicable RVP control periods set forth in California Code of Regulations, title 13, section 2262.4 or gasoline subject to 2262.4(c)(1) or (2).*

18. **Olefin content (OLEF)** means the amount of olefins in the fuel expressed in the nearest tenth of a percent by volume in accordance with 13 CCR, section 2263.

19. **Oxygen content (OXY)** means the amount of oxygen contained in the fuel expressed in the nearest tenth of a percent by weight in accordance with 13 CCR, section 2263.

20. **Phase 3 reformulated gasoline (Phase 3 RFG)** means gasoline meeting the flat or averaging limits of the Phase 3 RFG regulations.

21. **Potency-weighted exhaust toxics (PWT)** means the mass exhaust emissions of benzene, 1,3-butadiene, formaldehyde, and acetaldehyde multiplied by the relative potency with respect to 1,3-butadiene.

22. **Predictive model** means a set of equations that relate the properties of a particular gasoline formulation to the predicted exhaust and evaporative emissions that result when that gasoline is combusted in a motor vehicle engine.

23. **Reference fuel or reference fuel specifications** means a gasoline meeting the flat or average specifications for Phase 3 RFG.

24. **Reid vapor pressure (RVP)** means the vapor pressure of the fuel expressed in the nearest hundredth of a pound per square inch in accordance with 13 CCR, section 2263.

*24.5 **RVP-controlled gasoline** means gasoline sold or supplied from a production or import facility during the applicable RVP control period set forth in California Code of Regulations, title 13, section 2262.4 or gasoline subject to paragraph III.B.4 below.*

25. **Sulfur content (SUL)** means the amount of sulfur contained in the fuel expressed in the nearest part per million in accordance with 13 CCR, section 2263.

26. **Technology class (Tech 3, Tech 4, and Tech 5)** means a classification of vehicles by model year based on the type of technology used to control gasoline exhaust emissions.

*26.5 **Total Hydrocarbon Model (THC Model)** means the model which uses the exhaust hydrocarbon emissions equations, evaporative hydrocarbon emissions equations, and the carbon monoxide emissions equations in the evaluation of the emissions equivalency of the candidate fuel specifications.*

27. **50% distillation temperature (T50)** means the temperature at which 50% of the fuel evaporates expressed in the nearest degree Fahrenheit in accordance with *California Code of Regulations, title 13*, section 2263.

28. **90% distillation temperature (T90)** means the temperature at which 90% of the fuel evaporates expressed in the nearest degree Fahrenheit in accordance with *California Code of Regulations, title 13*, section 2263.

29. **Total potency-weighted toxics (PWT)** means the sum of the mass exhaust emissions of benzene, 1,3-butadiene, formaldehyde, and acetaldehyde, and the evaporative benzene emissions, multiplied by the relative potency with respect to 1,3-butadiene.

30. **Toxic air contaminants** means exhaust emissions of benzene, 1,3-butadiene, formaldehyde, and acetaldehyde, and evaporative benzene emissions.

II. VEHICLE TECHNOLOGY CLASS AND WEIGHTING FACTORS

A. Vehicle Technology Groups

For the purpose of these procedures, exhaust sub-models have been developed for three categories of light-duty vehicles (passenger cars and light-duty trucks) using the vehicle model year as an indicator of the type of emission controls used. Table 3 shows the three vehicle categories.

Table 3
Vehicle Categories

Technology Class	Model Year	Emission Controls
Tech 3	1981-1985	older closed-loop three-way catalyst
Tech 4	1986-1995	closed-loop three-way catalyst
Tech 5	1996-2015	three-way catalyst, adaptive learning, LEVs

B. Emission-Weighting Factors

Emission-weighting factors are used~~,~~ for NOx, ~~exhaust~~ *Ex*HC, and CO emissions~~,~~ to weight the model predictions for each technology class. These weightings represent, for each of the three pollutants, the fractional contribution of exhaust emissions from on-road gasoline-fueled vehicles in a particular Tech class to the total emissions from these vehicles from all three Tech classes in the year 2015. The year 2015 was selected because it approximately represents the midpoint year over which the Phase 3 reformulated gasoline regulations will be most effective. The factors were calculated using the information in EMFAC2007. The emission-weighting factors (EWF) are shown in Table 4 and are used in the combination of the sub-models for NOx, ~~exhaust~~ *Ex*HC, and CO emissions.

Table 4
Emission-Weighting Factors

Pollutant	Tech 3	Tech 4	Tech 5
NOx	0.052	0.325	0.622
HC	0.075	0.380	0.546
CO	0.063	0.288	0.649

C. Toxics Weighting Factors

Since toxics emissions are also ~~exhaust~~ *Ex*HC, the hydrocarbon weighting factors are used to weight the model predictions for each technology class. The values were calculated for the year 2015 using the ARB's EMFAC2007 motor vehicle emissions inventory. The toxics weighting factors (TWFs) are shown in Table 5 and are used in the combination of the exhaust toxics emissions sub-models.

Table 5
Toxics Weighting Factors (TWFs)

Pollutant	Tech 3	Tech 4	Tech 5
Benzene	0.075	0.380	0.546
1,3-Butadiene	0.075	0.380	0.546
Formaldehyde	0.075	0.380	0.546
Acetaldehyde	0.075	0.380	0.546

III. GENERAL EQUATIONS FOR CALCULATING PERCENT CHANGES IN EMISSIONS

A. Summary and Explanation

♦ ~~The applicant will first select one of two compliance options. The first compliance option, referred to as the exhaust and evap model option, uses the exhaust HC emissions models, the evaporative HC emissions changes models, and the CO adjustment in determining the HC emissions equivalency of the candidate fuel specifications based on ozone forming potential. The second option, referred to as the exhaust-only option, is set to sunset December 31, 2009 and uses only the exhaust HC emissions model in the determination of the HC emissions equivalency of the candidate fuel specifications. (See III.B)~~

~~The exhaust and evap model option may only be used for final blends of California gasoline or CARBOB where some part of the final blend is physically transferred from its production or import facility during the Reid vapor pressure control period for the production or import facility set forth in section 2262.4, title 13, California Code of Regulations, or within 15 days before the start of such period.~~

With certain limited exceptions, which are described in paragraph B below, beginning December 31, 2009, a candidate fuel that is designated as "non-RVP-controlled gasoline" must use the ExHC model in determining the emissions equivalency of the candidate fuel specifications. A candidate fuel that is designated as "RVP-controlled gasoline" must use the THC model in determining the emissions equivalency of the candidate fuel specifications.

♦ The applicant will select a candidate specification for each property, and will identify whether the specification represents a flat limit or an averaging limit. The Phase 3 RFG reference specification is identified for each property using the flat/average limit compliance option selected for the corresponding candidate specification. (See III.B.)

♦ The selected candidate specifications and the comparable Phase 3 RFG reference specifications are inserted into the predictive model equations to determine the predicted candidate and reference emissions by Tech class. (See III.C.)

♦ Because oxygen is specified in the form of a range, emissions predictions are, in a majority of the cases, made for two oxygen levels, the upper level of the specified range for the candidate fuel specifications and the lower level. The emissions of the candidate fuel are compared to the emissions of the reference fuel at both of these oxygen levels. When the range between the upper and lower oxygen levels is less than or equal to 0.4 percent then the prediction is only made for two oxygen levels. If the range is greater than 0.4 percent, then the prediction is based on the individual upper and lower levels.

- For NOx and ~~exhaust~~ *Ex*HC, the ratio of the predicted emissions for the candidate fuel specifications to the predicted emissions for the reference fuel specifications is emissions weighted according to the relative contribution of each technology class. These emissions-weighted ratios are summed, reduced by 1, and multiplied by 100 to represent the Tech class-weighted percent change in emissions. The resulting values represent the predicted percent change in NOx or ~~exhaust~~ *Ex*HC emissions between the candidate fuel specifications and reference fuel specifications. (See III.D.)

- If ~~the exhaust and evap model option has been selected~~ *the THC Model is used or is required to be used*, the predicted percent change in evaporative HC emissions between the candidate fuel specifications and the reference fuel specifications is computed using the equations given in Section VII*I*.A. The predicted change is computed for each evaporative emissions process. (See VII*I*.A)

- If ~~the exhaust and evap model option has been selected~~ *the THC Model is used or is required to be used*, the CO emissions a*re* calculated in accordance with the equations given in Section VI.A. (See VI.A)

- If ~~the exhaust and evap model option has been selected~~ *the THC Model is used or is required to be used*, the predicted percent changes in ~~exhaust~~ *Ex*HC emissions, evaporative HC emissions, and the CO emissions are combined in accordance with the equation given in Section X to yield the predicted percent change in ozone-forming potential (OFP) between the reference fuel specifications and the candidate fuel specifications. (See X)

- For exhaust toxics emissions, the predicted emissions for the candidate fuel specifications and the reference fuel specifications (for each pollutant and each Tech class) are weighted using the toxics weighting factors and potency-weighted, in accordance with the equations given in VII.B. (See VII.B)

- The evaporative benzene emissions predictions for the reference fuel specifications and the candidate fuel specifications are calculated in accordance with the equations given in Section IX.A. Note that emissions predictions for evaporative benzene emissions are made even if the applicant is not using ~~the compliance option which provides for the use of the evaporative HC emissions models~~ *the THC Model*. (See IX.A)

- For both the reference fuel specifications and the candidate fuel specifications, the potency-weighted exhaust toxics emissions predictions are combined with the potency-weighted evaporative benzene emissions predictions, in accordance with the equations given in Sections XI.A and XI.B. This yields the total potency-weighted toxics emissions prediction for the reference fuel specifications and for the candidate fuel specifications. (See XI.A and XI.B)

- ♦ The percent change in the predicted total potency-weighted toxics emissions between the reference fuel specifications and the candidate fuel specifications is calculated in accordance with the equation given in Section XI.C. (See XI.C)

B. Selection by Applicant of Candidate and Reference Specifications

~~Before December 31, 2009, the applicant shall first select one of two compliance options. The first compliance option uses the exhaust HC emissions models, the evaporative HC emissions models, and the CO emissions model in determining the HC emissions equivalency of the candidate fuel specifications. The second option uses only the exhaust HC emissions model in the determination of the HC emissions equivalency of the candidate fuel specifications. After December 31, 2009, the second compliance option sunsets and the first compliance option that uses the exhaust HC emissions models, the evaporative HC emissions models, and the CO emissions model in determining the HC emissions equivalency of the candidate fuel specifications becomes the only compliance option during the RVP control season.~~

1. RVP-Controlled Period

Beginning December 31, 2009, for gasoline that is sold or supplied from a production or import facility during the applicable RVP control period set forth in California Code of Regulations, title 13, section 2262.4 for that facility, the applicant must designate the gasoline as "RVP-controlled gasoline" and use the THC Model in determining the HC emissions equivalency of the candidate fuel specifications.

2. RVP-Controlled Period with assurances that the gasoline will be delivered during the Non-RVP-Controlled Period

Notwithstanding paragraph 1, above, the applicant must designate gasoline, which is subject to California Code of Regulations, title 13, section 2262.4(c)(1) or (2) as "non-RVP-controlled gasoline." The applicant must use the ExHC model in determining the HC emissions equivalency of these candidate fuel specifications for this "non-RVP-controlled gasoline." Gasoline produced in California and sold or supplied to the South Coast Air Basin, Ventura County, or the San Diego Air Basin must also meet the requirements in Section 2262.4(c)(4).

3. Non-RVP-Controlled Period

For gasoline that is sold or supplied from a production or import facility during the time period other than the applicable RVP control period for that facility, the applicant must designate the gasoline as "non-RVP-controlled gasoline" and use the ExHC Model in determining the HC emissions equivalency of the candidate fuel specifications.

4. Low RVP gasoline during the Non-RVP-Controlled Period

Notwithstanding paragraph 3, above,, if an applicant submits candidate fuel specifications for a final blend of gasoline that includes an RVP value equal to or less than 7.20 psi (or, correspondingly, an RVP value equal to or less than 5.99 psi for a final blend of CARBOB) and that is sold or supplied from a production or import facility during the time period other than the applicable RVP control period for that facility, the applicant must designate this gasoline as “RVP-controlled gasoline” and use the THC model in determining the HC emissions equivalency of these candidate fuel specifications . Gasoline produced in California and sold or supplied to the South Coast Air Basin, Ventura County, or the San Diego Air Basin must also meet the requirements in Section 2262.4(c)(4)

~~If~~ *When* the applicant ~~selects the first compliance option~~ *uses, or is required to use, the THC Model*, the applicable Phase 3 RVP limits are a flat limit of 7.00 psi and a cap limit of 7.20 psi. ~~That is if the applicant elects to use the evaporative HC emissions predictive model, all evaporative HC emissions changes predicted by the model for the candidate fuel will be based on the use of 7.00 psi as the RVP of the Phase 3 reference fuel.~~ ~~If~~ *When* the applicant ~~selects the second compliance option~~ *uses the ExHC Model*, the applicable Phase 3 RVP limit is a flat (and cap) limit of 7.00 psi. If the applicant selects to certify an alternative formulation produced without ethanol, then the applicable flat limit for either compliance option is 6.90 psi RVP.

Next, the applicant shall, for each fuel property, select a candidate specification and indicate whether this specification represents a flat limit or an averaging limit. The appropriate corresponding Phase 3 RFG reference specifications (flat or average) are then identified. Table 7 provides an optional worksheet to assist the applicant in selecting the candidate and reference specifications. These steps are summarized below.

1. Identify the value of the candidate specification for each fuel property and insert the values into Table 7. The candidate specifications may have any value for RVP, sulfur, benzene, aromatic hydrocarbons, olefins, T50, and T90 as long as each specification is less than or equal to the cap limits shown in Table 1. Note that, if the applicant is not using ~~the compliance option which provides for the use of the evaporative HC emissions models~~ *the THC Model*, no value is entered for RVP into the “Candidate Fuel Specifications” column of Table 7 (In this case the RVP is 7.00). The candidate specification may have any value for oxygen as long as the specification is within the range of the cap limits shown in Table 1.

2. When the range between the upper and lower oxygen levels is less than or equal to 0.4 percent, then the prediction is only made for the average of the

two oxygen levels. If the range is greater than 0.4 percent, then the prediction is based on the individual upper and lower levels. If the range between the upper and lower oxygen levels is greater than 0.4 percent, then the oxygen contents of the reference fuel specifications can be found from Table 6. Since oxygen is specified in the form of a range, there are usually two candidate fuel specifications for oxygen, the upper end of the range (maximum) and the lower end of the range (minimum).

3. The hot soak benzene emissions model contains a MTBE content term. The relevant oxygen content value is the oxygen content as MTBE, not the total oxygen content as in the case of the exhaust emissions predictions. The result is that, if the candidate fuel does not contain MTBE, the oxygen content as MTBE for the reference fuel is 2.0 percent, and the oxygen content as MTBE for the candidate fuel is zero percent. The reason it is assumed that the reference fuel contains MTBE is that MTBE was the oxygenate used while the Phase 2 regulations were in effect, and this assumption helps ensure that potency-weighted toxics emissions from Phase 3 gasoline will not be greater than those from Phase 2 gasoline.

4. For each property other than oxygen and RVP, indicate whether the candidate specification will represent a flat limit or an averaging limit.

5. For each candidate specification identified in 1., identify the appropriate corresponding Phase 3 RFG reference specifications (flat or average). Circle the appropriate flat or average limit for the reference fuel in Table 7. The circled values are the reference specifications which will be used in the predictive model.

   When the range between the upper and lower oxygen levels is less than or equal to 0.4 percent, then the oxygen level of the reference fuel is 2.0 wt%. If the range is greater than 0.4 percent, then Table 6 gives the oxygen contents of the reference fuel specifications. Because oxygen is specified in the form of a range, there are two reference fuel oxygen specifications. In most cases they are the same, but in two cases they are not. These two cases are: 1) If the minimum oxygen content of the candidate fuel specifications is within 1.8 to 2.2 percent (inclusive) and the maximum oxygen content of the candidate is greater than 2.2 percent, and 2) If the minimum oxygen content of the candidate fuel specifications is less than 1.8 percent and the maximum oxygen content of the candidate is between 1.8 and 2.2 percent (inclusive). In case 1), the oxygen contents of the reference fuel specifications are 1.8 and 2.0 percent. In case 2), the oxygen contents of the reference fuel specifications are 2.0 and 2.2 percent. (See Table 6)

Table 6
Candidate and Reference Specifications for Oxygen

Oxygen Content for Candidate Fuel Specified by Applicant		Number of Reference vs. Candidate Comparisons Required	Values to be Used in Comparison in Equations	
Minimum	**maximum**		**Candidate**	**Reference**
> 1.8, < 2.2	> 2.2	2	minimum	1.8
			maximum	2.0
< 1.8	> 1.8, < 2.2	2	minimum	2.0
			maximum	2.2
< 1.8	> 2.2	2	minimum	2.0
			maximum	2.0
< 1.8	< 1.8	2	minimum	2.0
			maximum	2.0
> 2.2, < 2.5	> 2.2	2	maximum	2.0
			minimum	2.0
> 2.5	> 2.9	2	minimum	2.0
			maximum	2.0

Table 7
Optional Worksheet for Candidate and Reference Fuel Specifications

~~Does the applicant which to use the evaporative HC emissions model and the CO adjustment factor in the evaluation of the equivalency of the candidate fuel specifications?~~ *Is this an RVP-controlled gasoline?* YES ___ NO ___

If the above question is answered yes, *the applicant must use the Total Hydrocarbon Model and* the reference fuel flat RVP limit is 7.00 psi and the RVP cap is 7.20 psi, unless the gasoline does not contain ethanol in which case the reference fuel flat RVP limit is 6.90 psi and the RVP cap is 7.20 psi.

If the above question is answered no, *the applicant must use the Exhaust Hydrocarbon Model and* 7.00 psi is the flat RVP limit and the candidate fuel RVP specification.

Fuel Property	**Candidate Fuel[1]: Specifications**	**Compliance Option: Flat or Average**	**Reference Fuel: Phase 3 RFG Specifications** (Circle Option Chosen)	
			Flat	**Average**
RVP		Flat	7.00[5] / 6.90[5]	None
Sulfur			20	15
Benzene			0.80/1.00[6]	0.70
Aromatic			25.0/35.0[6]	22.0
Olefin			6.0	4.0
Oxygen[2] (Total)	(min) (max)	Flat-Range	(min) (max)	None
Oxygen[3] (as MTBE)	(min) (max)	Not Applicable	Not Applicable	None
Oxygen[4] (as EtOH)	(min) (max)	Not Applicable	Not Applicable	None
T50			213/220[6]	203
T90			305/312[6]	295

Note: Footnotes are on the next page

Footnotes for Table 7

[1] The fuel property value must be within or equal to the cap limit.

[2] When the range between the upper and lower oxygen levels is less than or equal to 0.4 percent, then the prediction for the candidate fuel is only made for the average of the two oxygen levels, and the reference fuel oxygen value is 2.0. If the range is greater than 0.4 percent, then the prediction for the candidate fuel is based on the individual upper and lower levels, and the reference fuel oxygen value is obtained from Table 6.

[3] The oxygen content (as MTBE) is reported because the hot soak evaporative benzene emissions model includes an MTBE content term (See VIII.A.2).

[4] The oxygen content (as EtOH) is reported because the exhaust formaldehyde and the exhaust acetaldehyde models include EtOH content terms for the predictions for the candidate fuel specifications (See VI.A.1.c & d., VI.A.2.c & d., VI.A.3.c & d.). The EtOH content term is not included in the exhaust formaldehyde and acetaldehyde predictions for the reference fuel specifications because it is assumed that, for the reference fuel specifications, MTBE is the oxygenate used to meet the oxygen requirement.

[5] If the applicant elects to certify an alternative formulation without the use of ethanol, then the appropriate flat limit will be 6.90 psi; otherwise, the flat limit for RVP is 7.00 psi.

[6] The higher value is the small refiner CaRFG flat limit for qualifying small refiners only, as specified in section 2272.

C. General Equations for Calculating Exhaust Emissions by Pollutant and by Technology Class

The selected candidate specifications and set reference specifications are inserted into the predictive model equations to determine the predicted pollutant emissions generated from each fuel formulation by Tech Class. The following is the general form of the equations used to calculate exhaust emissions of the candidate and reference fuel specifications for each pollutant and for each technology class.

$ln\ y_{Tech}$ = intercept + Σ [(fuel effects coefficient) x (standardized fuel property)]

or

y_{Tech} = Exp {intercept + Σ [(fuel effects coefficient) x (standardized fuel property)]}

where

ln is the natural logarithm.

Exp is the exponential.

$\mathbf{y_{Tech}}$ is the exhaust emission prediction in grams per mile (for NOx, HC, and CO), and milligrams per mile (for benzene, 1,3-butadiene, formaldehyde, and acetaldehyde) for a particular technology class. (Note: $\mathbf{y_{Tech\text{-}REF}}$ is the emissions prediction for the reference fuel specifications and $\mathbf{y_{Tech\text{-}CAND}}$ is the emissions prediction for the candidate fuel specifications.)

intercept represents the average vehicle effect for a particular Tech class and a particular pollutant. The intercepts are provided in Table 13, Coefficients for NOx, ~~Exhaust~~ *Ex*HC, and CO Equations, and Table 14, Coefficients for Toxics Equations.

fuel effects coefficient represents the average fuel effects across all vehicles in the database for a particular Tech class and a particular pollutant. The fuel effect coefficients are provided in Table 13, Coefficients for NOx, ~~Exhaust~~ *Ex*HC, and CO Equations, and Table 14, Coefficients for Exhaust Toxics Equations.

standardized fuel property is defined as:

standardized fuel property =

$$\frac{[(\text{actual fuel property}) - (\text{mean fuel value})]}{\text{standard deviation of the value for the fuel property}}$$

actual fuel property represents the candidate or reference fuel property selected by the applicant in Table 7, Worksheet for Candidate and Reference Specifications.

Note that the actual fuel property may represent the minimum value of selected candidate fuel properties and is established by the linearization equations defined in sections IV. A. 2 & 3 and V. A. 2 & 3.

mean fuel value represents the average fuel values from all data that are used in developing the California Predictive Model. The mean and standard deviation are provided in Table 12, Standardization of Fuel Properties-Mean and Standard Deviation.

standard deviation of the value for the fuel property is the standard deviation from all data that are used in developing the California Predictive Model.

The equations include a term for the RVP effect, however, this term has been made a constant. This was done by computing the standardized RVP value at an actual RVP value of 7.0, and then multiplying this standardized RVP value by the RVP effect coefficient, thereby yielding an additional constant in the equations. Thus, the RVP term is shown as an additional constant (in addition to the intercept) in the exhaust emissions equations. This effectively removes from the exhaust models RVP as fuel property which effects exhaust emissions.

D. General Equations for Calculating Percent Change of Exhaust Emissions Between Candidate and Reference Specifications

To calculate the percent change of NOx, ~~exhaust~~ *Ex*HC, and CO emissions, the ratio of the predicted emissions for the candidate specifications to the predicted emissions from reference specifications is multiplied by the technology class emission-weighting factors for NOx, HC, and CO. These weighted ratios are summed. The sum is reduced by 1 and multiplied by 100 to give the percent change in NOx, HC, and CO emissions.

The following is the general form of the equations used to calculate percent change in exhaust emissions between the candidate fuel specifications and the reference fuel specifications for each pollutant.

% Change in NOx, ~~Exhaust~~ *Ex*HC, and CO Emissions:

%CE = percent change in emissions =

$$\{[(y_{Tech\ 3\text{-}CAND} / y_{Tech\ 3\text{-}REF}) \times EWF_{3q}] +$$
$$[(y_{Tech\ 4\text{-}CAND} / y_{Tech\ 4\text{-}REF}) \times EWF_{4q}] +$$
$$[(y_{Tech\ 5\text{-}CAND} / y_{Tech\ 5\text{-}REF}) \times EWF_{5q}]\} - 1\} \times 100$$

where

$\mathbf{y_{Tech\ 3}}$, $\mathbf{y_{Tech\ 4}}$, and $\mathbf{y_{Tech\ 5}}$ are the pollutant emissions in grams per mile of a particular pollutant and particular Tech class,

$\mathbf{y_{Tech\text{-}CAND}}$ is the emissions for the candidate specifications, and
$\mathbf{y_{Tech\text{-}REF}}$ is the emissions for the reference specifications.

$\mathbf{EWF_{3q}}$, $\mathbf{EWF_{4q}}$, and $\mathbf{EWF_{5q}}$ are the technology class 3, technology class 4, and technology class 5 weighting factors for the particular pollutant q. The Vehicle Technology Class Weighting Factors are provided in Table 4.

E. General Equations for Calculating Percent Change of Exhaust Emissions Between Candidate and Reference Specifications

The total Tech class-weighted, potency-weighted exhaust toxics emissions are calculated as shown below.

$E_{PWT\text{-}CAND}$ = Exhaust PWT emissions for candidate specifications =

$$\sum\{[((y_{Tech\ 3q\text{-}CAND}) \times (TWF_3)) + ((y_{Tech\ 4q\text{-}CAND}) \times (TWF_4)) +$$
$$((y_{Tech\ 5q\text{-}CAND}) \times (TWF_5))] \times (PWF_q)\}$$

$E_{PWT\text{-}REF}$ = Exhaust PWT emissions for reference specifications =

$$\sum\{[((y_{Tech\ 3q\text{-}REF}) \times (TWF_3)) + ((y_{Tech\ 4q\text{-}REF}) \times (TWF_4)) +$$
$$((y_{Tech\ 5q\text{-}REF}) \times (TWF_5))] \times (PWF_q)\}$$

where

The summations are performed across the q number of toxics pollutants, that is: **($y_{Tech\ 3q}$)**, **($y_{Tech\ 4q}$)**, **($y_{Tech\ 5q}$)** are the predicted emissions in milligrams per mile for each toxic air contaminant for Tech classes 3, 4, and 5.

$y_{Tech\text{-}CAND}$ is the emissions for the candidate fuel specifications, and
$y_{Tech\text{-}REF}$ is the emissions for the reference fuel specifications

TWF_3, **TWF_4, TWF_5** are the toxics weighting factors for Tech classes 3, 4 and 5, respectively. These values are shown in Table 5.

PWF_q is the potency-weighting factor for each toxic air contaminant q provided in Table 8.

These equations are shown again in more detail in Section VII.B.1 for the candidate fuel specifications and Section VII.B.2 for the reference fuel specifications.

Table 8
Toxic Air Contaminant Potency-Weighting Factors

Pollutant	Potency-Weighting Factor
Benzene	0.170
1,3-Butadiene	1.000
Formaldehyde	0.035
Acetaldehyde	0.016

IV. OXIDES OF NITROGEN (NOx) EXHAUST EMISSIONS CALCULATIONS

A. NOx Emissions by Technology Class

The property values from the Table 7 worksheet are used to calculate NOx emissions for the candidate and reference specifications.

1. NOx Emissions for Tech 3

The NOx emissions for the candidate ($y_{\text{Tech 3-CAND}}$) and reference ($y_{\text{Tech 3-REF}}$) specifications for Tech 3 are calculated as follows:

NOx emissions Tech 3 = $y_{\text{Tech 3}}$ =

Description	Equation	
	Exp	
intercept	{-0.159800	+
RVP	(0.*0*424915)	+
Sulfur	$(0.028040)\ \frac{(\text{SULFUR} - 139.691080)}{126.741459}$	+
Aromatic HC	$(0.047060)\ \frac{(\text{AROM} - 30.212969)}{8.682044}$	+
Olefin	$(0.021110)\ \frac{(\text{OLEF} - 7.359624)}{5.383804}$	+
Oxygen	$(0.014910)\ \frac{(\text{OXY} - 0.892363)}{1.235405}$	+
T50	$(-0.007360)\ \frac{(\text{T50} - 212.245188)}{15.880385}$	+
T90	$(0.000654)\ \frac{(\text{T90} - 312.121596)}{23.264684}$	}

where

SULFUR, AROM, OLEF, OXYGEN, T50, and T90 are the value limits for the candidate and reference specifications identified in the Table 7 worksheet.

2. NOx Emissions for Tech 4

The NOx emissions for the candidate ($y_{\text{Tech 4-CAND}}$) and reference ($y_{\text{Tech 4-REF}}$) specifications for Tech 4 are calculated as follows:

NOx emissions Tech 4 = $y_{\text{Tech 4}}$ =

Description	Equation	
	Exp	
intercept	$\{-0.634694$	+
RVP	(-0.007046)	+
Sulfur	$(0.051043)\ \dfrac{(SULFUR - 154.120828)}{136.790450}$	+
Aromatic HC	$(0.011366)\ \dfrac{(AROM - 27.317137)}{6.880833}$	+
Olefin	$(0.017193)\ \dfrac{(OLEF - 6.549450)}{4.715345}$	+
Oxygen	$(0.028711)\ \dfrac{(OXY - 1.536017)}{1.248887}$	+
T50	$(-0.002431)\ \dfrac{(T50 - 205.261051)}{17.324472}$	+
T90	$(0.002087)\ \dfrac{(T90 - 310.931422)}{20.847425}$	+
T50T50	$(0.006268)\ \dfrac{(T50 - 205.261051)}{17.324472}\ \dfrac{(T50 - 205.261051)}{17.324472}$	+
T90ARO	$(-0.002892)\ \dfrac{(T90 - 310.931422)}{20.847425}\ \dfrac{(AROM - 27.317137)}{6.880833}$	+
OXYOXY	$(0.010737)\ \dfrac{(OXY - 1.536017)}{1.248887}\ \dfrac{(OXY - 1.536017)}{1.248887}$	$\}$

where

For calculating the reference fuel NOx emissions, SULFUR, AROM, OLEF, OXY, T50, and T90 are equal to the corresponding values for the reference specifications in the Table 7 worksheet.

For calculating candidate fuel NOx emissions, SULFUR, AROM, OLEF, OXY, and T90 are equal to the corresponding values for the candidate specifications in the Table 7 worksheet. The value for T50 is determined as follows:

If the value for the candidate T50 specification in the Table 7 worksheet is greater than 213 then 213 is the value for T50.

If the value for the candidate T50 specification in the Table 7 worksheet is less than or equal to 213, the T50 specification in the Table 7 worksheet is the value for T50.

3. NOx Emissions for Tech 5

The NOx emissions for the candidate ($y_{\text{Tech 5-CAND}}$) and reference ($y_{\text{Tech 5-REF}}$) specifications for Tech 5 are calculated as follows:

NOx emissions Tech 5 = $y_{\text{Tech 5}}$ =

Description	Equation	
	Exp	
intercept	{-1.599255	+
RVP	(-0.000533)	+
Sulfur	$(0.947915)\left(\frac{\text{SULFUR} - 144.6289001}{140.912234}\right)$	+
Aromatic HC	$(0.013671)\left(\frac{\text{AROM} - 26.875944}{6.600312}\right)$	+
Olefin	$(0.017335)\left(\frac{\text{OLEF} - 6.251891}{4.431845}\right)$	+
Oxygen	$(0.016036)\left(\frac{\text{OXY} - 1.551772}{1.262823}\right)$	+
T50	$(0.012397)\left(\frac{\text{T50} - 206.020870}{16.582090}\right)$	+

T90	$(0.000762)\left(\frac{T90 - 310.570200}{22.967591}\right)$	+
T50T50	$(-0.022211)\left(\frac{T50 - 206.020870}{16.582090}\right)\left(\frac{T50 - 206.020870}{16.582090}\right)$	+
T50OXY	$(-0.015564)\left(\frac{T50 - 206.020870}{16.582090}\right)\left(\frac{OXY - 1.551772}{1.262823}\right)$	+
OXYOXY	$(0.015199)\left(\frac{OXY - 1.551772}{1.262823}\right)\left(\frac{OXY - 1.551772}{1.262823}\right)$	}

where

For calculating the reference fuel NOx emissions, SULFUR, AROM, OLEF, OXY, T50, and T90 are equal to the corresponding values for the reference specifications in the Table 7 worksheet.

For calculating candidate fuel NOx emissions, SULFUR, AROM, OLEF, and T90 are equal to the corresponding values for the candidate specifications in the Table 7 worksheet. The value for OXY and T50 are determined as follows:

If the value of the candidate fuel Oxygen specification in the Table 7 worksheet is less than the $OXYGEN_{(LIN)}$ value, then the $OXYGEN_{(LIN)}$ value is the value for OXY, where $OXYGEN_{(LIN)}$ is calculated as follows:

$$OXYGEN_{(LIN)} = -7.148 + (0.039 \times T50)$$

If the value for the candidate Oxygen specification in the Table 7 worksheet is greater than or equal to the $OXYGEN_{(LIN)}$ value, then the Oxygen specification in the Table 7 worksheet is the value for OXY.

If the value of the candidate fuel T50 specification in the Table 7 worksheet is less than the $T50_{(LIN)}$ value, then the $T50_{(LIN)}$ value is the value for T50, where $T50_{(LIN)}$ is calculated as follows:

$$T50_{(LIN)} = 217.8 - (4.6 \times OXY)$$

If the value for the candidate T50 specification in the Table 7 worksheet is greater than or equal to the $T50_{(LIN)}$ value, then the T50 specification in the Table 7 worksheet is the value for T50.

B. Percent Change in NOx Emissions

The percent change in NOx emissions between the candidate specifications and the reference specifications is calculated as follows:

$$\%CE_{NOx}=\{\{[(y_{Tech\ 3\text{-}CAND} / y_{Tech\ 3\text{-}REF}) \times EWF_{3\text{-}NOx}] + [(y_{Tech\ 4\text{-}CAND} / y_{Tech\ 4\text{-}REF}) \times EWF_{4\text{-}NOx}] + [(y_{Tech\ 5\text{-}CAND} / y_{Tech\ 5\text{-}REF}) \times EWF_{5\text{-}NOx})]\} - 1\} \times 100$$

where

$\mathbf{y_{Tech\ 3\text{-}CAND}}$, $\mathbf{y_{Tech\ 4\text{-}CAND}}$, and $\mathbf{y_{Tech\ 5\text{-}CAND}}$ are the NOx emissions for the candidate specifications in grams per mile for Tech 3, Tech 4, and Tech 5 respectively.

$\mathbf{y_{Tech\ 3\text{-}REF}}$, $\mathbf{y_{Tech\ 4\text{-}REF}}$, and $\mathbf{y_{Tech\ 5\text{-}REF}}$ are the NOx emissions for the reference specifications in grams per mile for Tech 3, Tech 4, and Tech 5 respectively.

The NOx emissions for Tech 3 are calculated in accordance with the equations in section IV. A. 1.

The NOx emissions for Tech 4 are calculated in accordance with the equations in section IV. A. 2.

The NOx emissions for Tech 5 are calculated in accordance with the equations in section IV. A. 3.

$\mathbf{EWF_{3\text{-}NOx}}$, $\mathbf{EWF_{\text{-}4\text{-}NOx}}$, and $\mathbf{EWF_{\text{-}5\text{-}NOx}}$ are the emission-weighting factors for NOx as shown in Table 4.

V. EXHAUST HYDROCARBONS (HC) EMISSIONS CALCULATIONS

A. ~~Exhaust~~ *Ex*HC Emissions by Technology Class

The property values from the Table 7 worksheet are used to calculate HC emissions for the candidate and reference specifications.

1. ~~Exhaust~~ *Ex*HC Emissions for Tech 3

The HC emissions for the candidate ($y_{\text{Tech 3-CAND}}$) and reference ($y_{\text{Tech 3-REF}}$) specifications for Tech 3 are calculated as follows:

HC emissions Tech 3 = $y_{\text{Tech 3}}$ =

Description	Equation	
	Exp	
intercept	$\{-0.752270$	+
RVP	(0.000013)	+
Sulfur	$(0.038207)\left(\frac{\text{SULFUR} - 139.691080}{126.741459}\right)$	+
Aromatic HC	$(0.014103)\left(\frac{\text{AROM} - 30.212969}{8.682044}\right)$	+
Olefin	$(-0.016533)\left(\frac{\text{OLEF} - 7.359624}{5.383804}\right)$	+
Oxygen	$(-0.026365)\left(\frac{\text{OXY} - 0.892363}{1.235405}\right)$	+
T50	$(0.015847)\left(\frac{\text{T50} - 212.245188}{15.880385}\right)$	+
T90	$(0.011768)\left(\frac{\text{T90} - 312.121596}{23.264684}\right)$	+
T90ARO	$(0.016606)\left(\frac{\text{T90} - 312.121596}{23.264684}\right)\left(\frac{\text{AROM} - 30.212969}{8.682044}\right)$	+

T90OLE $(-0.007995)\left(\frac{T90 - 312.121596}{23.264684}\right)\left(\frac{OLEF - 7.359624}{5.383804}\right)$ }

where

SULFUR, AROM, OLEF, OXYGEN, T50, and T90 are the value limits for the candidate and reference specifications identified in the Table 7 worksheet.

2. ~~**Exhaust**~~ ***Ex*HC Emissions for Tech 4**

The HC emissions for the candidate ($y_{\text{Tech 4-CAND}}$) and reference ($y_{\text{Tech 4-REF}}$) specifications for Tech 4 are calculated as follows:

HC emissions Tech 4 = $y_{\text{Tech 4}}$ =

Description	Equation	
	Exp	
intercept	{-1.142182	+
RVP	(-0.019335)	+
Sulfur	$(0.079373)\left(\frac{SULFUR - 154.120828}{136.790450}\right)$	+
Aromatic HC	$(0.002047)\left(\frac{AROM - 27.317137}{6.880833}\right)$	+
Olefin	$(-0.010716)\left(\frac{OLEF - 6.549450}{4.715345}\right)$	+
Oxygen	$(-0.019880)\left(\frac{OXY - 1.536017}{1.248887}\right)$	+
T50	$(0.052939)\left(\frac{T50 - 205.261051}{17.324472}\right)$	+
T90	$(0.037684)\left(\frac{T90 - 310.931422}{20.847425}\right)$	+
T50ARO	$(0.019031)\left(\frac{T50 - 205.261051}{17.324472}\right)\left(\frac{AROM - 27.317137}{6.880833}\right)$	+

T50T50	$(0.017086)\left(\frac{T50 - 205.261051}{17.324472}\right)\left(\frac{T50 - 205.261051}{17.324472}\right)$	+
T50OXY	$(0.013724)\left(\frac{T50 - 205.261051}{17.324472}\right)\left(\frac{OXY - 1.536017}{1.248887}\right)$	+
T90T90	$(0.013914)\left(\frac{T90 - 310.931422}{20.847425}\right)\left(\frac{T90 - 310.931422}{20.847425}\right)$	+
AROARO	$(-0.010999)\left(\frac{AROM - 27.317137}{6.880833}\right)\left(\frac{AROM - 27.317137}{6.880833}\right)$	+
AROOXY	$(0.007221)\left(\frac{AROM - 27.317137}{6.880833}\right)\left(\frac{OXY - 1.536017}{1.248887}\right)$	}

where

For calculating the reference fuel HC emissions, SULFUR, AROM, OLEF, OXY, T50, and T90 are equal to the corresponding values for the reference specifications in the Table 7 worksheet.

For calculating the candidate fuel HC emissions, SULFUR, OLEF, and OXY are equal to the corresponding values for the candidate specifications in the Table 7 worksheet. The values for AROM, T50, and T90 are determined as follows:

If the value for the candidate Aromatics specification in the Table 7 worksheet is greater than $AROM_{(LIN)}$ then $AROM_{(LIN)}$ is the value for AROM where $AROM_{(LIN)}$ is calculated as follows:

$$AROM_{(LIN)} = -45.3466 + (1.8086 \times OXY) + (0.3436 \times T50)$$

If the value for the candidate T50 specification in the Table 7 worksheet is less than or equal to $AROM_{(LIN)}$, the Aromatics specification in the Table 7 worksheet is the value for AROM.

If the value for the candidate T50 specification in the Table 7 worksheet is less than $T50_{(LIN)}$ then $T50_{(LIN)}$ is the value for T50 where $T50_{(LIN)}$ is calculated as follows:

$$T50_{(LIN)} = 225.3 - (1.4 \times AROM) - (5.6 \times OXY)$$

If the value for the candidate T50 specification in the Table 7 worksheet is greater than or equal to $T50_{(LIN)}$, the T50 specification in the Table 7 worksheet is the value for T50.

If the value for the candidate fuel T90 specification in the Table 7 worksheet is less than the 283 value, then the 283 value is the value for T90.

If the value for the candidate T90 specification in the Table 7 worksheet is greater than or equal to the 283 value, then the T90 specification in the Table 7 worksheet is the value for T90.

3. ~~Exhaust~~ ***Ex***HC Emissions for Tech 5

The HC emissions for the candidate ($y_{\text{Tech 5-CAND}}$) and reference ($y_{\text{Tech 5-REF}}$) specifications for Tech 5 are calculated as follows:

HC emissions Tech 5 = $y_{\text{Tech 5}}$ =

Description	Equation	
	Exp	
intercept	{-2.671187	+
RVP	(-0.012824)	+
Sulfur	$(0.242238)\left(\frac{\text{SULFUR} - 144.628901}{140.912204}\right)$	+
Aromatic HC	$(0.003039)\left(\frac{\text{AROM} - 26.875944}{6.600312}\right)$	+
Olefin	$(-0.010908)\left(\frac{\text{OLEF} - 6.251891}{4.431845}\right)$	+
Oxygen	$(-0.007528)\left(\frac{\text{OXY} - 1.551772}{1.262823}\right)$	+
T50	$(0.056796)\left(\frac{\text{T50} - 206.020870}{16.582090}\right)$	+
T90	$(0.010803)\left(\frac{\text{T90} - 310.570200}{22.967591}\right)$	+
T50ARO	$(0.016761)\left(\frac{\text{T50} - 206.020870}{16.582090}\right)\left(\frac{\text{AROM} - 26.875944}{6.600312}\right)$	+

T50T50 $(0.019563) \left(\frac{T50 - 206.020870}{16.582090}\right) \left(\frac{T50 - 206.020870}{16.582090}\right)$ +

T50OXY $(0.014082) \left(\frac{T50 - 206.020870}{16.582090}\right) \left(\frac{OXY - 1.551772}{1.262823}\right)$ +

T90T90 $(0.015216) \left(\frac{T90 - 310.570200}{22.967591}\right) \left(\frac{T90 - 310.570200}{22.9675901}\right)$ +

T90OXY $(0.013372) \left(\frac{T90 - 310.570200}{22.967590}\right) \left(\frac{OXY - 1.551772}{1.262823}\right)$ +

AROARO $(-0.009740) \left(\frac{AROM - 26.875944}{6.600312}\right) \left(\frac{AROM - 26.875944}{6.600312}\right)$ +

AROOXY $(0.006902) \left(\frac{AROM - 26.875944}{6.600312}\right) \left(\frac{OXY - 1.551772}{1.262823}\right) \Big\}$

where

For calculating the reference fuel HC emissions, SULFUR, AROM, OLEF, OXY, T50, and T90 are equal to the corresponding values for the reference specifications in the Table 7 worksheet.

For calculating the candidate fuel HC emissions, SULFUR, OLEF, and OXY are equal to the corresponding values for the candidate specifications in the Table 7 worksheet. The values for AROM, T50, and T90 are determined as follows:

If the value for the candidate Aromatics specification in the Table 7 worksheet is greater than $AROM_{(LIN)}$ then $AROM_{(LIN)}$ is the value for AROM where $AROM_{(LIN)}$ is calculated as follows:

$$AROM_{(LIN)} = -45.5269 + (1.8518 \times OXY) + (0.3425 \times T50)$$

If the value for the candidate Aromatics specification in the Table 7 worksheet is less than or equal to $AROM_{(LIN)}$, the Aromatics specification in the Table 7 worksheet is the value for AROM.

If the value for the candidate T50 specification in the Table 7 worksheet is less than $T50_{(LIN)}$, then $T50_{(LIN)}$ is the value for T50, where $T50_{(LIN)}$ is calculated as follows:

$$T50_{(LIN)} = 218.2 - (1.1 \times AROM) - (4.7 \times OXY)$$

If the value for the candidate T50 specification in the Table 7 worksheet is greater than or equal to $T50_{(LIN)}$, the T50 specification in the Table 7 worksheet is the value for T50.

If the value for the candidate fuel T90 specification in the Table 7 worksheet is less than the $T90_{(LIN)}$ value, then the $T90_{(LIN)}$ value is the value for T90 where $T90_{(LIN)}$ is calculated as follows:

$$T90_{(LIN)} = 314.8 - (8.0 \times OXY)$$

If the value for the candidate T90 specification in the Table 7 worksheet is greater than or equal to the $T90_{(LIN)}$ value, then the T90 specification in the Table 7 worksheet is the value for T90.

B. Percent Change in ~~Exhaust~~ <u>*Ex*</u>HC Emissions

The percent change in ~~exhaust~~ <u>*Ex*</u>HC emissions between the candidate fuel specifications and the reference fuel specifications is calculated as follows:

$$\%CE_{ExHC} = \{\{[(y_{Tech\ 3\text{-}CAND} / y_{Tech\ 3\text{-}REF}) \times EWF_{3\text{-}HC}] + [(y_{Tech\ 4\text{-}CAND} / y_{Tech\ 4\text{-}REF}) \times EWF_{4\text{-}HC}] + [(y_{Tech\ 5\text{-}CAND} / y_{Tech\ 5\text{-}REF}) \times EWF_{5\text{-}HC}]\} - 1\} \times 100$$

where

$y_{Tech\ 3\text{-}CAND}$, $y_{Tech\ 4\text{-}CAND}$, and $y_{Tech\ 5\text{-}CAND}$ are the ~~exhaust~~ <u>*Ex*</u>HC emissions for the candidate specifications in grams per mile for Tech 3, Tech 4, and Tech 5 respectively.

$y_{Tech\ 3\text{-}REF}$, $y_{Tech\ 4\text{-}REF}$, and $y_{Tech\ 5\text{-}REF}$ are the ~~exhaust~~ <u>*Ex*</u>HC emissions for the reference specifications in grams per mile for Tech 3, Tech 4, and Tech 5 respectively.

The ~~exhaust~~ <u>*Ex*</u>HC emissions for Tech 3 are calculated according to the equations in section V. A. 1.

The ~~exhaust~~ <u>*Ex*</u>HC emissions for Tech 4 are calculated according to the equations in section V. A. 2.

The ~~exhaust~~ <u>*Ex*</u>HC emissions for Tech 5 are calculated according to the equations in section V. A. 3.

$EWF_{3\text{-}HC}$, $EWF_{4\text{-}HC}$, and $EWF_{5\text{-}HC}$ are the emission-weighting factors for HC as shown in Table 4.

VI. CARBON MONOXIDE (CO) EMISSIONS CALCULATIONS

A. CO Emissions by Technology Class

The property values from the Table 6 worksheet are used to calculate CO emissions for the candidate and reference specifications.

1. CO Emissions for Tech 3

The CO emissions for the candidate ($y_{\text{Tech 3-CAND}}$) and reference ($y_{\text{Tech 3-REF}}$) specifications for Tech 3 are calculated as follows:

CO emissions Tech 3 = $y_{\text{Tech 3}}$ =

Description	Equation	
	Exp	
intercept	{1.615613	+
RVP	(0.012087)	+
Sulfur	$(0.031849)\left(\frac{\text{SULFUR} - 139.691080}{126.741459}\right)$	+
Aromatic HC	$(0.085541)\left(\frac{\text{AROM} - 30.212969}{8.682044}\right)$	+
Olefin	$(0.002416)\left(\frac{\text{OLEF} - 7.359624}{5.383804}\right)$	+
Oxygen	$(-0.068986)\left(\frac{\text{OXY} - 0.892363}{1.235405}\right)$	+
T50	$(0.009897)\left(\frac{\text{T50} - 212.245188}{15.880385}\right)$	+
T90	$(-0.025449)\left(\frac{\text{T90} - 312.121596}{23.264684}\right)$	+
T50T90	$(0.017463)\left(\frac{\text{T50} - 212.245188}{15.880385}\right)\left(\frac{\text{T90} - 312.121596}{23.264684}\right)$	}

where

SULFUR, AROM, OLEF, OXYGEN, T50, and T90 are the value limits for the candidate and reference specifications identified in the Table 7 worksheet.

2. CO Emissions for Tech 4

The CO emissions for the candidate ($y_{\text{Tech 4-CAND}}$) and reference ($y_{\text{Tech 4-REF}}$) specifications for Tech 4 are calculated as follows:

CO emissions Tech 4 = $y_{\text{Tech 4}}$ =

Description	Equation	
	Exp	
intercept	{1.195246	+
RVP	(-0.025878)	+
Sulfur	$(0.073616)\left(\frac{SULFUR - 154.120828}{136.790450}\right)$	+
Aromatic HC	$(0.025960)\left(\frac{AROM - 27.317137}{6.880833}\right)$	+
Olefin	$(0.001263)\left(\frac{OLEF - 6.549450}{4.715345}\right)$	+
Oxygen	$(-0.052530)\left(\frac{OXY - 1.536017}{1.248887}\right)$	+
T50	$(0.022750)\left(\frac{T50 - 205.261051}{17.324472}\right)$	+
T90	$(-0.008820)\left(\frac{T90 - 310.931422}{20.847425}\right)$	+
OXYOXY	$(-0.016510)\left(\frac{OXY - 1.536017}{1.248887}\right)\left(\frac{OXY - 1.536017}{1.248887}\right)$	+
T50ARO	$(0.009884)\left(\frac{T50 - 205.261051}{17.324472}\right)\left(\frac{AROM - 27.317137}{6.880833}\right)$	+
T90OLE	$(-0.007360)\left(\frac{T90 - 310.931422}{20.847425}\right)\left(\frac{OLEF - 6.549450}{4.715345}\right)$	+

T90T90	$(0.007767)\left(\frac{T90 - 310.931422}{20.847425}\right)\left(\frac{T90 - 310.931422}{20.847450}\right)$	}

where

For calculating the reference fuel CO emissions, SULFUR, AROM, OLEF, OXY, T50, and T90 are equal to the corresponding values for the reference specifications in the Table 7 worksheet.

For calculating the candidate fuel CO emissions, SULFUR, AROM, OLEF, OXY, and T50 are equal to the corresponding values for the candidate specifications in the Table 7 worksheet. The value for T90 is determined as follows:

If the value for the candidate fuel T90 specification in the Table 7 worksheet is greater than the $T90_{(LIN)}$ value, then the $T90_{(LIN)}$ value is the value for T90 where $T90_{(LIN)}$ is calculated as follows:

$$T90_{(LIN)} = 308.3 + (2.5 \times OLEF)$$

If the value for the candidate T90 specification in the Table 7 worksheet is less than or equal to the $T90_{(LIN)}$ value, then the T90 specification in the Table 7 worksheet is the value for T90.

3. CO Emissions for Tech 5

The CO emissions for the candidate ($y_{\text{Tech 5-CAND}}$) and reference ($y_{\text{Tech 5-REF}}$) specifications for Tech 5 are calculated as follows:

CO emissions Tech 5 = $y_{\text{Tech 5}}$ =

Description	Equation	
	Exp	
intercept	{-0.240521	+
RVP	(-0.014137)	+
Sulfur	$(0.123649)\left(\frac{SULFUR - 144.628901}{140.91224}\right)$	+

Aromatic HC	$(0.025775) \left(\frac{AROM - 26.875944}{6.600312}\right)$	+
Olefin	$(0.005001) \left(\frac{OLEF - 6.251891}{4.431845}\right)$	+
Oxygen	$(-0.087967) \left(\frac{OXY - 1.551772}{1.262823}\right)$	+
T50	$(0.018195) \left(\frac{T50 - 206.020870}{16.582090}\right)$	+
T90	$(-0.128296) \left(\frac{T90 - 310.570200}{22.967591}\right)$	+
OXYOXY	$(0.026309) \left(\frac{OXY - 1.551772}{1.262823}\right) \left(\frac{OXY - 1.551772}{1.262823}\right)$	+
T50ARO	$(0.009797) \left(\frac{T50 - 206.020870}{16.582090}\right) \left(\frac{AROM - 26.875944}{6.600312}\right)$	+
T50OXY	$(0.021763) \left(\frac{T50 - 206.020870}{16.582090}\right) \left(\frac{OXY - 1.551772}{1.262823}\right) \}$	

where

For calculating the reference fuel CO emissions, SULFUR, AROM, OLEF, OXY, T50, and T90 are equal to the corresponding values for the reference specifications in the Table 7 worksheet.

For calculating the candidate fuel CO emissions, SULFUR, AROM, OLEF, T50, and T90 are equal to the corresponding values for the candidate specifications in the Table 7 worksheet. The value for OXY is determined as follows:

If the value for the candidate fuel Oxygen specification in the Table 7 worksheet is greater than the $OXY_{(LIN)}$ value, then the $OXY_{(LIN)}$ value is the value for OXY where $OXY_{(LIN)}$ is calculated as follows:

$$OXY_{(LIN)} = 10.152 - (0.0315 \times T50)$$

If the value for the candidate Oxygen specification in the Table 7 worksheet is less than or equal to the $OXY_{(LIN)}$ value, then the Oxygen specification in the Table 7 worksheet is the value for OXY.

B. Percent Change in CO Emissions

The percent change in CO emissions between the candidate fuel specifications and the reference fuel specifications is calculated as follows:

$$\%CE_{CO} = \{\{[(y_{Tech\ 3\text{-}CAND} / y_{Tech\ 3\text{-}REF}) \times EWF_{3\text{-}CO}] + [(y_{Tech\ 4\text{-}CAND} / y_{Tech\ 4\text{-}REF}) \times EWF_{4\text{-}CO}] + [(y_{Tech\ 5\text{-}CAND} / y_{Tech\ 5\text{-}REF}) \times EWF_{5\text{-}CO}]\} - 1\} \times 100$$

where

$\mathbf{y_{Tech\ 3\text{-}CAND}}$, $\mathbf{y_{Tech\ 4\text{-}CAND}}$, and $\mathbf{y_{Tech\ 5\text{-}CAND}}$ are the CO emissions for the candidate specifications in grams per mile for Tech 3, Tech 4, and Tech 5 respectively.

$\mathbf{y_{Tech\ 3\text{-}REF}}$, $\mathbf{y_{Tech\ 4\text{-}REF}}$, and $\mathbf{y_{Tech\ 5\text{-}REF}}$ are the CO emissions for the reference specifications in grams per mile for Tech 3, Tech 4, and Tech 5 respectively.

The CO emissions for Tech 3 are calculated according to the equations in section VI. A. 1.

The CO emissions for Tech 4 are calculated according to the equations in section VI. A. 2.

The CO emissions for Tech 5 are calculated according to the equations in section VI. A. 3.

$\mathbf{EWF_{3\text{-}CO}}$, $\mathbf{EWF_{4\text{-}CO}}$, and $\mathbf{EWF_{5\text{-}CO}}$ are the emission-weighting factors for CO as shown in Table 4.

VII. POTENCY-WEIGHTED TOXICS (PWT) EXHAUST EMISSIONS CALCULATIONS

A. Mass Emissions of Toxics by Technology Class

The property values from the Table 7 worksheet are used to calculate mass toxic emissions for the candidate and reference specifications.

1. Mass Emissions for Tech 3

The mass emissions for each toxic for Tech 3 are calculated as follows:

a. Benzene mass emissions Tech 3 = $y_{\text{Tech 3}}$ =

Description	Equation	
	Exp	
intercept	{2.95676525	+
Sulfur	$(0.0683768) \left(\frac{SULFUR - 139.691080}{126.741459}\right)$	+
Aromatic HC	$(0.15191575) \left(\frac{AROM - 30.212969}{8.682044}\right)$	+
Oxygen	$(-0.03295985) \left(\frac{OXY - 0.892363}{1.235405}\right)$	+
BENZ	~~(-0.12025037)~~ *(0.12025037)* $\left(\frac{BENZ - 1.36412}{0.513051}\right)$	}

b. 1,3-Butadiene mass emissions Tech 3 = $y_{Tech\ 3}$ =

Description	Equation
	Exp
intercept	{0.67173886 +
Olefin	$(0.18408319)\left(\frac{OLEF - 7.359624}{5.383804}\right)$ +
T50	$(0.11391774)\left(\frac{T50 - 212.245188}{15.880385}\right)$ }

c. Formaldehyde mass emissions Tech 3 = $y_{Tech\ 3}$ =

Description	Equation	
	Exp	
intercept	$\{2.16836424$	+
Aromatic HC	$(-0.07537099)\left(\frac{AROM - 30.212969}{8.682044}\right)$	+
Oxygen	$(0.12278577)\left(\frac{OXY - 0.892363}{1.235405}\right)$	+
Oxygen (as EtOH)[1]	$(-0.12295089)(Type)\left(\frac{OXY - 0.892363}{1.235405}\right)$	+
BENZ	$(-0.1423482)\left(\frac{BENZ - 1.36412}{0.513051}\right)$	$\}$

1 — The Oxygen (as EtOH) term is an indicator variable term which is included only in the model prediction for the candidate fuel specifications, and only if the oxygen originates from the use of ethanol. This term is not included in the calculation for the reference fuel specifications because it is assumed that the oxygen from the reference fuel originates from the use of MTBE. Mathematically, this means that the value of Type in the above equation is 1.0 for the prediction for the candidate fuel specifications if ethanol is used, 0 for the prediction for the candidate fuel specifications if ethanol is not used, and 0 for all predictions for reference fuel specifications.

d. Acetaldehyde mass emissions Tech 3 = $y_{Tech\ 3}$ =

Description	Equation	
	Exp	
intercept	$\{1.10122139$	+
Aromatic HC	$(-0.09219416)\left(\frac{AROM - 30.212969}{8.682044}\right)$	+
Oxygen	$(0.00122983)\left(\frac{OXY - 0.892363}{1.235405}\right)$	+
Oxygen (as EtOH)[1]	$(0.54678495)(Type)\left(\frac{OXY - 0.892363}{1.235405}\right)$	$\}$

where

SULFUR, AROM, OLEF, OXYGEN, T50, and T90 are the value limits for the candidate and reference specifications identified in the Table 7 worksheet.

1 — The Oxygen (as EtOH) term is an indicator variable term which is included only in the model prediction for the candidate fuel specifications, and only if the oxygen originates from the use of ethanol. This term is not included in the calculation for the reference fuel specifications because it is assumed that the oxygen from the reference fuel originates from the use of MTBE. Mathematically, this means that the value of Type in the above equation is 1.0 for the prediction for the candidate fuel specifications if ethanol is used, 0 for the prediction for the candidate fuel specifications if ethanol is not used, and 0 for all predictions for reference fuel specifications.

2. Mass Emissions for Tech 4

The mass emissions for each toxic for Tech 4 are calculated as follows:

a. Benzene mass emissions Tech 4 = $y_{\text{Tech 4}}$ =

Description	Equation	
	Exp	
intercept	{2.3824773	+
	Exp	
intercept	{2.3824773	+
RVP	~~(0.07392876)~~ *(-0.04782469)*	+
Sulfur	(0.09652526) $\left(\frac{SULFUR - 154.120828}{136.790450}\right)$	+
Aromatic HC	(0.15517085) $\left(\frac{AROM - 27.317137}{6.880833}\right)$	+
Olefin	(-0.02548759) $\left(\frac{OLEF - 6.549450}{4.715345}\right)$	+
T50	(0.04666208) $\left(\frac{T50 - 205.261051}{17.324472}\right)$	+
BENZ	(0.11689441) $\left(\frac{BENZ - 1.014259}{0.537392}\right)$	}

b. 1,3-Butadiene mass emissions Tech 4 = $y_{Tech\ 4}$ =

Description	Equation	
	Exp	
intercept	{0.43090426	+
Aromatic HC	$(-0.03604344)\left(\frac{AROM - 27.317137}{6.880833}\right)$	+
Olefin	$(0.10354089)\left(\frac{OLEF - 6.549450}{4.715345}\right)$	+
Oxygen	$(-0.02511374)\left(\frac{OXY - 1.536017}{1.248887}\right)$	+
T50	$(0.03707822)\left(\frac{T50 - 205.261051}{17.324472}\right)$	+
T90	$(0.09454201)\left(\frac{T90 - 310.931422}{20.847425}\right)$	+
BENZ	$(0.03644387)\left(\frac{BENZ - 1.01425}{0.537392}\right)$	}

c. Formaldehyde mass emissions Tech 4 = $y_{\text{Tech 4}}$ =

Description	Equation	
	Exp	
intercept	{1.05886661	+
Sulfur	$(-0.04135075)\ \frac{(SULFUR - 154.120828)}{136.790450}$	+
Aromatic HC	$(-0.05466283)\ \frac{(AROM - 27.317137)}{6.880833}$	+
Oxygen	$(0.06370091)\ \frac{(OXY - 1.536017)}{1.248887}$	+
Oxygen (as EtOH)[1]	$(-0.09819814)\ (Type)\ \frac{(OXY - 1.536017)}{1.248887}$	+
T90	$(0.06037698)\ \frac{(T90 - 310.981422)}{20.847425}$	}

1 — The Oxygen (as EtOH) term is an indicator variable term which is included only in the model prediction for the candidate fuel specifications, and only if the oxygen originates from the use of ethanol. This term is not included in the calculation for the reference fuel specifications because it is assumed that the oxygen from the reference fuel originates from the use of MTBE. Mathematically, this means that the value of Type in the above equation is 1.0 for the prediction for the candidate fuel specifications if ethanol is used, 0 for the prediction for the candidate fuel specifications if ethanol is not used, and 0 for all predictions for reference fuel specifications.

d. Acetaldehyde mass emissions Tech 4 = $y_{Tech\ 4}$ =

Description	Equation	
	Exp	
intercept	{0.16738341	+
Sulfur	$(0.02788263)\ \frac{(SULFUR - 154.120828)}{136.790450}$	+
Aromatic HC	$(-0.05552641)\ \frac{(AROM - 27.317137)}{6.880833}$	+
Oxygen	$(0.02382123)\ \frac{(OXY - 1.536017)}{1.248887}$	+
Oxygen (as EtOH)[1]	$(0.46699012)\ (Type)\ \frac{(OXY - 1.536017)}{1.248887}$	+
T50	$(0.04314573)\ \frac{(T50 - 205.261051)}{17.324472}$	+
T90	$(0.06252964)\ \frac{(T90 - 310.931422)}{20.847425}$	+
BENZ	$(0.06148653)\ \frac{(BENZ - 1.014259)}{0.537392}$	}

where

SULFUR, AROM, OLEF, OXYGEN, T50, and T90 are the values for the candidate and reference specifications in the Table 7 worksheet.

1 — The Oxygen (as EtOH) term is an indicator variable term which is included only in the model prediction for the candidate fuel specifications, and only if the oxygen originates from the use of ethanol. This term is not included in the calculation for the reference fuel specifications because it is assumed that the oxygen from the reference fuel originates from the use of MTBE. Mathematically, this means that the value of Type in the above equation is 1.0 for the prediction for the candidate fuel specifications if ethanol is used, 0 for the prediction for the candidate fuel specifications if ethanol is not used, and 0 for all predictions for reference fuel specifications.

3. Mass Emissions for Tech 5

The mass emissions for each toxic for Tech 5 are calculated as follows:

a. Benzene mass emissions Tech 5 = $y_{\text{Tech 5}}$ =

Description	Equation
	Exp
intercept	{2.3824773 +
RVP	~~(0.06514198)~~ *(-0.04214049)* +
Sulfur	$(0.09652526)\left(\frac{SULFUR - 144.628901}{140.91224}\right)$ +
Aromatic HC	$(0.15517085)\left(\frac{AROM - 26.875944}{6.600312}\right)$ +
Olefin	$(-0.02548759)\left(\frac{OLEF - 6.251891}{4.431845}\right)$ +
T50	$(0.04666208)\left(\frac{T50 - 206.020870}{16.582090}\right)$ +
BENZ	$(0.11689441)\left(\frac{BENZ - 0.969248}{0.504325}\right)$ }

b. 1,3-Butadiene mass emissions Tech 5 = $y_{Tech\ 5}$ =

Description	Equation
	Exp
intercept	{0.43090426 +
Aromatic HC	$(-0.03604344)\left(\frac{AROM - 26.875944}{6.600312}\right)$ +
Olefin	$(0.10354089)\left(\frac{OLEF - 6.251891}{4.431845}\right)$ +
Oxygen	$(-0.02511374)\left(\frac{OXY - 1.551772}{1.262823}\right)$ +
T50	$(0.03707822)\left(\frac{T50 - 206.020870}{16.582090}\right)$ +
T90	$(0.09454201)\left(\frac{T90 - 310.570200}{22.967591}\right)$ +
BENZ	$(0.03644387)\left(\frac{BENZ - 0.969248}{0.504325}\right)$ }

c. Formaldehyde mass emissions Tech 5 = $y_{\text{Tech 5}}$ =

Description	Equation	
	Exp	
intercept	{1.05886661	+
Sulfur	$(-0.04135075)\left(\frac{\text{SULFUR} - 144.628901}{140.91224}\right)$	+
Aromatic HC	$(-0.05466283)\left(\frac{\text{AROM} - 26.875940}{6.600312}\right)$	+
Oxygen	$(0.06370091)\left(\frac{\text{OXY} - 1.551772}{1.262823}\right)$	+
Oxygen (as EtOH)[1]	$(-0.09819814)(\text{Type})\left(\frac{\text{OXY} - 1.551772}{1.262823}\right)$	+
T90	~~(0.000000)~~ *(0.06037698)* $\left(\frac{\text{T90} - 310.570200}{22.967591}\right)$	}

1 — The Oxygen (as EtOH) term is an indicator variable term which is included only in the model prediction for the candidate fuel specifications, and only if the oxygen originates from the use of ethanol. This term is not included in the calculation for the reference fuel specifications because it is assumed that the oxygen from the reference fuel originates from the use of MTBE. Mathematically, this means that the value of Type in the above equation is 1.0 for the prediction for the candidate fuel specifications if ethanol is used, 0 for the prediction for the candidate fuel specifications if ethanol is not used, and 0 for all predictions for reference fuel specifications.

d. Acetaldehyde mass emissions Tech 5 = $y_{\text{Tech 5}}$ =

Description	Equation	
	Exp	
intercept	{0.16738341	+
Sulfur	$(0.02788263)\,\frac{(SULFUR - 144.628901)}{140.91224}$	+
Aromatic HC	$(-0.05552641)\,\frac{(AROM - 26.875944)}{6.600312}$	+
Oxygen	$(0.02382123)\,\frac{(OXY - 1.551772)}{1.262823}$	+
Oxygen (as EtOH)[1]	~~(0.046699012)~~ *(0.46699012)* $(Type)\,\frac{(OXY - 1.551772)}{1.262823}$	+
T50	$(0.04314573)\,\frac{(T50 - 206.020870)}{16.582090}$	+
T90	$(0.06252964)\,\frac{(T90 - 310.570200)}{22.967591}$	+
BENZ	$(0.06148653)\,\frac{(BENZ - 0.969248)}{0.504325}$	}

where

SULFUR, AROM, OLEF, OXYGEN, T50, and T90 are the values for the candidate and reference specifications in the Table 7 worksheet.

1 — The Oxygen (as EtOH) term is an indicator variable term which is included only in the model prediction for the candidate fuel specifications, and only if the oxygen originates from the use of ethanol. This term is not included in the calculation for the reference fuel specifications because it is assumed that the oxygen from the reference fuel originates from the use of MTBE. Mathematically, this means that the value of Type in the above equation is 1.0 for the prediction for the candidate fuel specifications if ethanol is used, 0 for the prediction for the candidate fuel specifications if ethanol is not used, and 0 for all predictions for reference fuel specifications.

B. Computation of Total Potency-Weighted Exhaust Toxics Emissions

1. Calculation of Potency-weighted Exhaust Toxics Emissions for Candidate Specifications

$EX_{PWT\text{-}CAND}$ =

$\{((y_{BZ\text{-}TECH3} \times TWF_3)+(y_{BZ\text{-}TECH4} \times TWF_4)+(y_{BZ\text{-}TECH5} \times TWF_5))x(PWF_{BZ})\}$ +

$\{((y_{BD\text{-}TECH3} \times TWF_3)+(y_{BD\text{-}TECH4} \times TWF_4)+(y_{BD\text{-}TECH5} \times TWF_5))x(PWF_{BD})\}$ +

$\{((y_{FOR\text{-}TECH3} \times TWF_3)+(y_{FOR\text{-}TECH4} \times TWF_4)+(y_{FOR\text{-}TECH5} \times TWF_5))x(PWF_{FOR})\}$ +

$\{((y_{ACE\text{-}TECH3} \times TWF_3)+(y_{ACE\text{-}TECH4} \times TWF_4)+(y_{ACE\text{-}TECH5} \times TWF_5))x(PWF_{ACE})\}$

where

$\mathbf{EX_{PWT\text{-}CAND}}$ is the PWT emissions for the candidate specifications.

$\mathbf{y_{BZ\text{-}TECH}}$ is the benzene emissions prediction for Tech 3, Tech 4, or Tech 5,
$\mathbf{y_{BD\text{-}TECH}}$ is the 1,3-butadiene emissions prediction for Tech 3, Tech 4, or Tech 5,
$\mathbf{y_{FOR\text{-}TECH}}$ is the formaldehyde emissions prediction for Tech 3, Tech 4, or Tech 5,
$\mathbf{y_{ACE\text{-}TECH}}$ is the acetaldehyde emissions prediction for Tech 3, Tech 4, or Tech 5.

$\mathbf{TWF_3}$, $\mathbf{TWF_4}$, and $\mathbf{TWF_5}$ are the toxics weighting factors for Tech class 3, Tech class 4, and Tech class 5 vehicles, respectively. These values are shown in Table 5.

$\mathbf{PWF_q}$ is the potency weighting factor for toxic pollutant q provided in Table 8.

2. Calculation of Potency-Weighted Emissions for Reference Specifications

$EX_{PWT\text{-}REF}$ =

$$\{((y_{BZ\text{-}TECH3} \text{ x } TWF_3)+(y_{BZ\text{-}TECH4} \text{ x } TWF_4)+(y_{BZ\text{-}TECH5} \text{ x } TWF_5))\text{x}(PWF_{BZ})\} +$$

$$\{((y_{BD\text{-}TECH3} \text{ x } TWF_3)+(y_{BD\text{-}TECH4} \text{ x } TWF_4)+(y_{BD\text{-}TECH5} \text{ x } TWF_5))\text{x}(PWF_{BD})\} +$$

$$\{((y_{FOR\text{-}TECH3} \text{ x } TWF_3)+(y_{FOR\text{-}TECH4} \text{ x } TWF_4)+(y_{FOR\text{-}TECH5} \text{ x } TWF_5))\text{x}(PWF_{FOR})\} +$$

$$\{((y_{ACE\text{-}TECH3} \text{ x } TWF_3)+(y_{ACE\text{-}TECH4} \text{ x } TWF_4)+(y_{ACE\text{-}TECH5} \text{ x } TWF_5))\text{x}(PWF_{ACE})\}$$

where

$EX_{PWT\text{-}REF}$ is the PWT emissions for the reference specifications.

$y_{BZ\text{-}TECH}$ is the benzene emissions prediction for Tech 3, Tech 4, or Tech 5,
$y_{BD\text{-}TECH}$ is the 1,3-butadiene emissions prediction for Tech 3, Tech 4, or Tech 5,
$y_{FOR\text{-}TECH}$ is the formaldehyde emissions prediction for Tech 3, Tech 4, or Tech 5,
$y_{ACE\text{-}TECH}$ is the acetaldehyde emissions prediction for Tech 3, Tech 4, or Tech 5.

TWF_3, **TWF_4**, and **TWF_5** are the toxics weighting factors for Tech class 3, Tech class 4, and Tech class 5 vehicles, respectively. These values are shown in Table 5.

PWF_q is the potency-weighting factor for toxic pollutant q provided in Table 8.

VIII. CALCULATIONS FOR CHANGES IN EVAPORATIVE HYDROCARBON (HC) EMISSIONS

A. Evaporative HC Emissions by Process

The evaporative HC *emissions* models predict the percent change in evaporative HC emissions as a function of RVP in psi, relative to a reference fuel's RVP. As stated in Table 1, the RVP of the reference fuel is 7.0 psi for an ethanol blended candidate fuel or 6.9 psi for a non-oxygenated candidate fuel. Thus, the models predict the percent change in evaporative HC emissions of the candidate fuel relative to a particular reference fuel. There are three evaporative HC *emissions* models for each type of candidate fuel, i.e., oxygenated (ethanol) and non-oxygenated candidate fuels. The three HC models are for each of the following three evaporative emissions processes: 1) Diurnal/Resting Loss Emissions, 2) Hot Soak Emissions, and 3) Running Loss Emissions.

1. Diurnal/Resting Loss Emissions

a. The predicted percent change in Diurnal/Resting Loss Emissions (% CE_{DIRES}) of an oxygenated candidate fuel is:

$$\% \mathbf{CE}_{DIRES} = \frac{100 \times [43.589427 + (3.730921 \times RVP)]}{[34.535116 + (3.730921 \times 7.0)]} - 100$$

where RVP is the RVP of the candidate fuel.

b. The predicted percent change in Diurnal/Resting Loss Emissions (% $\mathbf{CE}_{DIRES}$) of a non-oxygenated candidate fuel is:

$$\% \mathbf{CE}_{DIRES} = \frac{100 \times [34.535116 + (3.730921 \times RVP)]}{[34.535116 + (3.730921 \times 6.9)]} - 100$$

where RVP is the RVP of the candidate fuel.

2. Hot Soak Emissions

a. The predicted percent change in Hot Soak Emissions (% CE_{HS}) of an oxygenated candidate fuel is:

$$\% \mathbf{CE}_{HS} = \frac{100 \times [10.356585 + (4.369978 \times RVP)]}{[9.228675 + (4.369978 \times 7.0)]} - 100$$

where RVP is the RVP of the candidate fuel.

b. The predicted percent change in Hot Soak Emissions (% $\mathbf{CE}_{HS}$) of a non-oxygenated candidate fuel is:

$$\% \mathbf{CE}_{HS} = \frac{100 \times [9.228675 + (4.369978 \times RVP)]}{[9.228675 + (4.369978 \times 6.9)]} - 100$$

where RVP is the RVP of the candidate fuel.

3. Running Loss Emissions

a. The predicted percent change in Running Loss (% $\mathbf{CE}_{RL}$) of an oxygenated candidate fuel is:

$$\% \mathbf{CE}_{RL} = \frac{100 \times [42.517912 + (9.744935 \times RVP)]}{[40.567912 + (9.744935 \times 7.0)]} - 100$$

where RVP is the RVP of the candidate fuel.

b. The predicted percent change in Running Loss (% $\mathbf{CE}_{RL}$) of a non-oxygenated candidate fuel is:

$$\% \mathbf{CE}_{RL} = \frac{100 \times [40.567912 + (9.744935 \times RVP)]}{[40.567912 + (9.744935 \times 6.9)]} - 100$$

where RVP is the RVP of the candidate fuel.

IX. EVAPORATIVE BENZENE EMISSIONS CALCULATIONS

A. Evaporative Benzene Emissions by Process

The evaporative benzene models predict the evaporative benzene emissions (in units of milligrams per mile) as a function of RVP, gasoline benzene content, and gasoline MTBE content (for Hot Soak Benzene Emissions). There are three evaporative benzene models, one for each of the following three processes of evaporative benzene emissions: 1) Diurnal/Resting Loss Emissions, 2) Hot Soak Emissions, and 3) Running Loss Emissions.

1. Diurnal/Resting Loss Emissions

The predicted Diurnal/Resting Loss Benzene Emissions ($EVBenz_{DIRES}$) of an ethanol containing fuel is calculated as follows:

$$EVBenz_{DIRES} = \{592 \times [(3.730921 \times RVP + 43.589427) \times 907.18 / 939430)] \times [(0.0294917804 \times Benz) - (0.0017567009 \times Benz \times RVP)]\}$$

The predicted Diurnal/Resting Loss Benzene Emissions ($EVBenz_{DIRES}$) of a non-ethanol containing fuel is calculated as follows:

$$EVBenz_{DIRES} = \{592 \times [(3.730921 \times RVP + 34.535116) \times 907.18 / 939430)] \times [(0.0294917804 \times Benz) - (0.0017567009 \times Benz \times RVP)]\}$$

where

$EVBenz_{DIRES}$ is the predicted evaporative Diurnal/Resting Loss benzene emissions and is calculated for both the reference and candidate fuel specifications,

Benz is the benzene content of the gasoline, in percent by volume, and

RVP is the RVP of the gasoline, in psi.

2. Hot Soak Loss Emissions

The predicted Hot Soak Benzene emissions ($EVBenz_{HS}$) is calculated as follows:

$$EVBenz_{HS} = \{592 \times [(4.369978 \times RVP + 10.356585) \times 907.18 / 939430] \times [(0.0463141591 \times Benz) - (0.0027179513 \times Benz \times RVP) - (0.0008184128 \times Benz \times MTBE)]\}$$

The predicted Hot Soak Benzene emissions ($EVBenz_{HS}$) of a non-ethanol containing gasoline is calculated as follows:

$$EVBenz_{HS} = \{592 \times [(4.369978 \times RVP + 9.228675) \times 907.18 / 939430] \times [(0.0463141591 \times Benz) - (0.0027179513 \times Benz \times RVP) - (0.0008184128 \times Benz \times MTBE)]\}$$

where

$EVBenz_{HS}$	is the predicted evaporative Hot Soak benzene emissions and is calculated for both the reference and candidate fuel specifications,
Benz	is the benzene content of the gasoline, in percent by volume,
RVP	is the RVP of the gasoline, in psi, and
MTBE	is the MTBE content of the gasoline, in percent by volume.

3. Running Loss Emissions

The predicted Running Loss Benzene emissions ($EVBenz_{RL}$) of an ethanol containing gasoline is calculated as follows:

$$EVBenz_{RL} = \{592 \times [(9.744935 \times RVP + 42.517912) \times 907.18 / 939430] \times [(0.0648391842 \times Benz) - (0.005622979 \times Benz \times RVP)]\}$$

The predicted Running Loss Benzene emissions ($EVBenz_{RL}$) of a non-ethanol containing gasoline is calculated as follows:

$$EVBenz_{RL} = \{592 \times [(9.744935 \times RVP + 40.567912) \times 907.18 / 939430] \times [(0.0648391842 \times Benz) - (0.005622979 \times Benz \times RVP)]\}$$

where

$EVBenz_{RL}$ is the predicted evaporative Running Loss benzene emissions and is calculated for both the reference and candidate fuel specifications,

Benz is the benzene content of the gasoline, in percent by volume, and

RVP is the RVP of the gasoline, in psi.

X. COMBINATION OF EX~~HAUST~~ HC EMISSIONS PREDICTION*S*, EVAPORATIVE HC EMISSIONS PREDICTIONS, AND CO EMISSIONS PREDICTIONS

In combining the model predictions for ~~exhaust~~ *Ex*HC, evaporative HC, and CO emissions, the ozone-forming potential of each of the three processes is recognized. The predicted percent change in emissions for each process is multiplied by a factor which represents, for that process, the ozone-forming potential of the emissions. For purposes of this discussion, this ozone-forming potential value will be referred to as relative reactivity. The predicted percent change for each process is also multiplied by a factor which represents the relative contribution of the process to the total inventory of reactive ozone precursors (HC and CO) from gasoline vehicles. The products of the predicted changes in emissions, relative reactivities, and contribution factors are then added. This sum is then divided by the sum of the products of the individual reactivities and emissions contribution fractions for each process. This quotient represents the percent change in the ozone-forming potential of the candidate fuel specifications relative to the reference fuel specifications.

The predicted percent change in ~~exhaust~~ *Ex*HC emissions is the Tech class-weighted predicted change computed in accordance with the equation shown in Section V.B. For evaporative HC emissions, each of the individual evaporative processes (Diurnal/Resting, Hot Soak, and Running) has a different relative reactivity. Thus, for the evaporative emissions processes, the products of the predicted change in emissions and relative reactivity are computed separately. These three products are included individually in the overall sum. The predicted percent change in the three evaporative HC emissions processes are those computed in accordance with the equations given in Sections VIII.A.1, VIII.A.2, and VIII.A.3. The predicted percent change in CO emissions is the prediction computed in accordance with the equation given in section VI.B.

The combination of the ~~exhaust~~ *Ex*HC, the evaporative HC, and the CO emissions models predictions can be illustrated mathematically as follows: (Note that this calculation is performed only if the applicant selects the compliance option which provides for the use of the evaporative HC emissions models and the CO ~~adjustment factor~~*emissions models*.)

$$\%CE_{OFP} = [(\%CE_{E\cancel{X}\underline{x}HC} \times R_{E\cancel{X}\underline{x}HC} \times F_{E\cancel{X}\underline{x}HC}) + (\%CE_{DIRES} \times R_{DIRES} \times F_{DIRES}) + (\%CE_{HS} \times R_{HS} \times F_{HS}) + (\%CE_{RL} \times R_{RL} \times F_{RL}) + (\%CE_{CO} \times R_{CO} \times F_{CO})] \Big/ [(R_{E\cancel{X}\underline{x}HC} \times F_{E\cancel{X}\underline{x}HC}) + (R_{DIRES} \times F_{DIRES}) + (R_{HS} \times F_{HS}) + (R_{RL} \times F_{RL}) + (R_{CO} \times F_{CO})]$$

where

$\%CE_{OFP}$ is the net percent change in ozone-forming potential of the reference fuel specifications relative to the candidate fuel specifications,

$\%CE_{E\cancel{X}\underline{x}HC}$ is the predicted percent change in Tech-class weighted ~~exhaust~~ *Ex*HC as given by the equation in Section V.B,

$\%CE_{DIRES}$ is the predicted percent change in Diurnal/Resting Loss emissions as given by the equation in Section VIII.A.1,

$\%CE_{HS}$ is the predicted percent change in Hot Soak emissions as given by the equation in Section VIII.A.2,

$\%CE_{RL}$ is the predicted percent change in Running Loss emissions as given by the equation in Section VIII.A.3,

$\%CE_{CO}$ is the predicted percent change in CO emissions as given by the equation in Section VI.B, and

the R's are the relative reactivities as shown below in Table 9, and the F's are the fractions of emissions from gasoline vehicles for each process in the year 2015, as given by the ARB's EMFAC2007 motor vehicle emissions model and shown below in Table 10.

Table 9
Relative Reactivity Values

Process	R Value
~~exhaust~~ *Ex*HC	1.00
Diurnal/Resting HC	0.68
Hot Soak HC	0.78
Running Loss HC	0.68
CO	0.015

Table 10
Emissions Fractions

Process	F Value
~~exhaust~~ *Ex*HC	0.0454
Diurnal/Resting HC	0.0174
Hot Soak HC	0.0113
Running Loss HC	0.0310
CO	0.8949

XI. COMBINATION OF EXHAUST TOXICS EMISSIONS PREDICTIONS WITH EVAPORATIVE BENZENE EMISSIONS PREDICTIONS

The Diurnal/Resting Loss, Hot Soak, and Running Loss evaporative benzene predictions are each multiplied by the toxic air contaminant potency-weighting factor for benzene given in Table 8, and then summed to give the total potency-weighted evaporative benzene prediction. This prediction is then added to the total Tech class-weighted, potency-weighted exhaust toxics predictions computed in accordance with the equations given in Section V.B to give the total Tech class-weighted, potency-weighted toxics emissions predictions. The addition is performed for both the candidate fuel and the reference fuel. The combination is shown mathematically below:

A. Total Toxics for the Candidate Fuel Specifications:

Total Potency-Weighted Evaporative Benzene Prediction

$$\mathbf{EVBENZ_{TOT\text{-}CAND} = (EVBENZ_{DIRES\text{-}CAND} + EVBENZ_{HS\text{-}CAND} + EVBENZ_{RL\text{-}CAND}) \times PWF_{BENZ}}$$

Total Potency-Weighted Toxics Prediction

$$E_{PWT\text{-}CAND} = EX_{PWT\text{-}CAND} + EVBENZ_{TOT\text{-}CAND}$$

where

$EVBENZ_{TOT\text{-}CAND}$ is the total potency-weighted evaporative benzene emission prediction for the candidate fuel specifications,

$EVBENZ_{DIRES\text{-}CAND}$ is the diurnal/resting loss benzene emission prediction for the candidate fuel specifications, as given by the equation in Section IX.A.1,

$EVBENZ_{HS\text{-}CAND}$ is the hot soak benzene emission prediction for the candidate fuel specifications, as given by the equation in Section IX.A.2,

$EVBENZ_{RL\text{-}CAND}$ is the running loss benzene emission prediction for the candidate fuel specifications, as given by the equation in Section IX.A.3,

PWF_{BENZ} is the potency-weighting factor for benzene shown in Table 8,

$E_{PWT\text{-}CAND}$ is the total potency-weighted toxics prediction for the candidate fuel specifications, and

$EX_{PWT\text{-}CAND}$ is the total Tech class-weighted, potency-weighted exhaust toxics prediction for the candidate fuel specifications computed in accordance with the equation give in Section VII.B.1.

B. Total Toxics for the Reference Fuel Specifications

Total Potency-Weighted Evaporative Benzene Prediction

$$EVBENZ_{TOT\text{-}REF} = (EVBENZ_{DIRES\text{-}REF} + EVBENZ_{HS\text{-}REF} + EVBENZ_{RL\text{-}REF}) \times PWF_{BENZ}$$

Total Potency-Weighted Toxics Prediction

$$E_{PWT\text{-}REF} = EX_{PWT\text{-}REF} + EVBENZ_{TOT\text{-}REF}$$

where

$EVBENZ_{TOT\text{-}REF}$	is the total potency-weighted evaporative benzene emission prediction for the reference fuel specifications,
$EVBENZ_{DIRES\text{-}REF}$	is the diurnal/resting loss benzene emission prediction for the reference fuel specifications, as given by the equation in Section IX.A.1,
$EVBENZ_{HS\text{-}REF}$	is the hot soak benzene emission prediction for the reference fuel specifications, as given by the equation in Section IX.A.2,
$EVBENZ_{RL\text{-}REF}$	is the running loss benzene emission prediction for the reference fuel specifications, as given by the equation in Section IX.A.3,
PWF_{BENZ}	is the potency-weighting factor for benzene shown in Table 8
$E_{PWT\text{-}REF}$	is the total potency-weighted toxics prediction for the reference fuel specifications, and
$EX_{PWT\text{-}REF}$	is the total Tech class-weighted, potency-weighted exhaust toxics prediction for the reference fuel specifications computed in accordance with the equation give in Section VII.B.2.

C. Calculation of the Percent Change in Total Predicted Toxics Emissions

The percent change in the total predicted toxics emissions between the candidate fuel specifications and the reference fuel specification is calculated as follows:

$$\%CE_{PWT} = \left[\left(E_{PWT\text{-}CAND} - E_{PWT\text{-}REF}\right) / E_{PWT\text{-}REF}\right] \times 100$$

XII. DETERMINATION OF ACCEPTABILITY

If, for each pollutant (NOx, Ozone-forming Potential (OFP) or exhaust HC (ExHC), and Potency-Weighted Toxics (PWT)), the percent difference in emissions between the candidate fuel specifications and the reference Phase 3 RFG specifications is equal to or less than 0.04%, the candidate specifications are deemed acceptable as an alternative to Phase 3 RFG. If the applicant ~~selects the compliance option which provides for the use of the evaporative HC emissions models~~ <u>*uses, or is required to use, the THC Model*</u>, the candidate fuel specifications must pass for NOx, OFP, and PWT to be acceptable as an alternative Phase 3 RFG formulation. If the applicant ~~does not select the compliance option which provides for the use of the evaporative HC emissions models~~ <u>*uses, or is required to use the ExHC Model*</u>, the candidate fuel specifications must pass for NOx, E~~X~~<u>*x*</u>HC, and PWT to be acceptable as an alternative Phase 3 RFG formulation.

These criteria are mathematically shown below.

<u>Applicant</u> ~~Elects to Use the Evaporative HC Emissions Model Compliance Option During the RVP Control Season~~ <u>*uses, or is required to use, the THC Model for RVP-Controlled Gasoline*</u>

$\%CE_{NOx} \leq 0.04\%$, and
$\%CE_{OFP} \leq 0.04\%$, and
$\%CE_{PWT} \leq 0.04\%$.

<u>Applicant</u> ~~Elects not to Use the Evaporative HC Emissions Model Compliance Option During the RVP Control Season, or Outside of the RVP Control Season~~ <u>*uses, or is required to use, the ExHC Model for non-RVP-Controlled Gasoline*</u>

$\%CE_{NOx} \leq 0.04\%$, and
$\%CE_{E\cancel{X}\underline{x}HC} \leq 0.04\%$, and
$\%CE_{PWT} \leq 0.04\%$.

where

$\%CE_{NOx}$ is given by the equation in Section IV.B,
$\%CE_{OFP}$ is given by the equation in Section X,
$\%CE_{E\cancel{X}\underline{x}HC}$ is given by the equation in Section V.B, and
$\%CE_{PWT}$ is given by the equation in Section XI.C.

If the percent change in emission between the candidate specifications and the reference Phase 3 RFG specifications is equal to or greater than 0.05% for any pollutant (NOx, OFP, E~~X~~<u>*x*</u>HC, PWT) in the above equivalency criteria, then the candidate specifications are deemed unacceptable and may not be a substitute for Phase 3 RFG. [Note: All final values of the percent change in emissions shall be reported to the nearest hundredth using conventional rounding.]

If the candidate specifications are deemed acceptable, the property values and the compliance options of the candidate specifications become the property values and compliance options for the alternative gasoline formulation.

XIII. NOTIFICATION OF INTENT TO OFFER AN ALTERNATIVE GASOLINE FORMULATION

A producer or importer intending to sell or supply an alternative gasoline formulation of California gasoline from its production facility or import facility shall notify the executive officer in accordance with 13 CCR, section 2265(a).

Table 11, Alternative Specifications for Phase 3 RFG Using the California Predictive Model Notification, has been provided as an example of the minimum information required.

Table 11
Alternative Specifications for Phase 3 RFG
Using California Predictive Model Notification

Name of Producer/Importer:__________________Facility Location:
Name of Person Reporting:______________________Telephone No:
Date/Time of This Report:____________ I.D. of 1st Batch with this Specification:
Notification Date:______________Notification Time:_______________
Start Production Date:____________Start Production Time:______________
Batch Number:________________Tank Number:________________

- All California gasoline transferred from this facility will meet the specifications listed below until the next Alternative Specifications report to the ARB.
- Fuel properties that will be averaged will be reported as the “Designated Alternative Limit and Volume of Gasoline Report” separately to the ARB.

~~Compliance Option (check one): Evap. Option_______Exhaust-Only Option~~
Type of gasoline (check one):
____ *RVP-controlled gasoline; using the THC Model*
____ *non-RVP-controlled gasoline; using the ExHC Model*

Fuel Property	**Candidate Fuel Property Value**	**Compliance Option**:	**Reference Fuel: Phase 3 RFG Property Value**	
			Flat	**Average**
RVP		**Flat**	**6.90/7.00**	**None**
Sulfur			**20**	**15**
Benzene			**0.80**	**0.70**
Aromatic HC			**25.0**	**22.0**
Olefin			**6.0**	**4.0**
Oxygen[1]	**(min.)**	**Flat Range**	**(min.)**	**None**
	(max.)		**(max.)**	
T50			**213**	**203**
T90			**305**	**295**

1- See Table 6 in the Predictive Model Procedures for the specification of candidate and reference oxygen levels.

Pollutant[2]	**Percent Change in Emissions**[3]
Oxides of Nitrogen	
OFP or ~~Exhaust~~ *Ex*HC	
Potency-Weighted Toxics	

2- Where Applicable, a %CE must be reported for both the candidate fuel minimum and maximum oxygen specifications. See Table 6 for explanation of when both %CE’s must be reported.

3- Percent change calculated using equations presented in sections IV.B, V.B, VI.B, and X of the Phase 3 Predictive Model Procedures Document.

Table 12
Standardization of Fuel Properties - Mean and Standard Deviation

Fuel Property	Tech 3		Tech 4		Tech 5	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
RVP	8.670892	0.635066	8.365415	0.889~~1~~114	8.221700	0.902838
Sulfur	139.691080	126.741459	154.120828	136.790450	144.628901	140.912204
Aromatic HC	30.212969	8.682044	27.317137	6.880833	26.875944	6.600312
Olefin	7.359624	5.383804	6.549450	4.715345	6.251891	4.431845
Oxygen	0.892363	1.235405	1.536017	1.248887	1.551772	1.262623
T50	212.245188	15.880385	205.261051	17.324472	206.020870	16.582090
T90	312.121596	23.264684	310.931422	20.847425	310.570200	22.967591
Benzene	1.36412	0.513051	1.014259	0.537392	*(0.969248)* ~~1.014259~~	*(0.504325)* ~~0.537392~~

Table 13
Coefficients for NOx, ~~Exhaust~~ *Ex*HC, and CO Equations

Model Term	Tech 3			Tech 4			Tech 5		
	NOx	HC	CO	NOx	HC	CO	NOx	HC	CO
Intercept	-0.159800	-0.752270	1.615613	-0.634694	-1.142182	1.195246	-1.599255	-2.671187	-0.240521
RVP	0.0424915	0.000013	0.012087	-0.007046	-0.019335	-0.025878	-0.000533	-0.012824	-0.014137
Sulfur	0.028040	0.038207	0.031849	0.051043	0.079373	0.073616	0.947915	0.242238	0.123649
Aromatic HC	0.047060	0.014103	0.085541	0.011366	0.002047	0.025960	0.013671	0.003039	0.025775
Olefin	0.021110	-0.016533	0.002416	0.017193	-0.010716	0.001263	0.017335	-0.010908	0.005001
Oxygen	0.014910	-0.026365	-0.068986	0.028711	-0.019880	-0.052530	0.016036	-0.007528	-0.087967
T50	-0.007360	0.015847	0.009897	-0.002431	0.052939	0.022750	0.012397	0.056796	0.018195
T90	0.000654	0.011768	-0.025449	0.002087	0.037684	-0.008820	0.000762	0.010803	-0.128296
T90ARO		0.016606		-0.002892					
T90OLE		-0.007995				-0.007360			
T50T90			0.017463						
T50T50				0.006268	0.017086		-0.022211	0.019563	
OXYOXY				0.010737		-0.016510	0.015199		0.026309
T50ARO					0.019031	0.009884		0.016761	0.009797
T50OXY					0.013724		-0.015564	0.014082	0.021763
T90T90					0.013914	0.007767		0.015216	
AROARO					-0.010999			-0.009740	
AROOXY					0.007221			0.006902	
T90OXY								0.013372	

Table 14
Coefficients for Exhaust Toxics Equations

Model Term	**Tech 3**			
	Benzene	**Butadiene**	**Formaldehyde**	**Acetaldehyde**
Intercept	2.95676525	0.67173886	2.16836424	1.10122139
RVP (constant)				
Sulfur	0.0683768			
Aromatic HC	0.15191575		-0.07537099	-0.09219416
Olefin		0.18408319		
Oxygen	-0.03295985		0.12278577	0.00122983
Oxygen (as EtOH)			-0.12295089	0.54678495
T50		0.11391774		
T90				
Benzene	*(0.12025037)* ~~-0.12025037~~		-0.1423482	
Model Term	**Tech 4**			
	Benzene	**Butadiene**	**Formaldehyde**	**Acetaldehyde**
Intercept	2.3824773	0.43090426	1.05886661	0.16738341
RVP (constant)	*(-0.04782469)* ~~0.07392876~~			
Sulfur	0.09652526		-0.04135075	0.02788263
Aromatic HC	0.15517085	-0.03604344	-0.05466283	-0.05552641
Olefin	-0.02548759	0.10354089		
Oxygen		-0.02511374	0.06370091	0.02382123
Oxygen (as EtOH)			-0.09819814	0.46699012
T50	0.04666208	0.03707822		0.04314573
T90		0.09454201	0.06037698	0.06252964

Benzene	0.11689441	0.03644387		0.06148653

Model Term	**Tech 5**			
	Benzene	**Butadiene**	**Formaldehyde**	**Acetaldehyde**
Intercept	2.3824773	0.43090426	1.05886661	0.16738341
RVP (constant)	*(-0.04214049)* ~~0.06514198~~			
Sulfur	0.09652526		-0.04135075	0.02788263
Aromatic HC	0.15517085	-0.03604344	-0.05466283	-0.05552641
Olefin	-0.02548759	0.10354089		
Oxygen		-0.02511374	0.06370091	0.02382123
Oxygen (as EtOH)			-0.09819814	0.~~0~~46699012
T50	0.04666208	0.03707822		0.04314573
T90		0.09454201	*(0.06037698)* ~~0.000000~~	0.06252964
Benzene	0.11689441	0.03644387		0.06148653