Workshop Regarding Regulatory Fuels Activities

February 6, 2001

California Environmental Protection Agency

Air Resources Board

Agenda

- Introductions
- Diesel fuel Amendments
  - ARB staff presentation
  - Industry presentations
  - Other
- Other Diesel Issues - Lubricity, Additives, Lube Oils
  - ARB staff presentation
  - Industry presentations
  - Other
- CaRFG3
  - ARB staff presentation
  - Industry presentations
  - Other
- Future Activities

EPA Tier II Emissions Standards

- New diesel vehicle emission reductions:
  - 90% reduction in particulate matter (PM)
  - 95% reduction in NOx
  - To take effect for 2007 model year

Required Technology Identified to Meet EPA Emission Standards

- Most viable exhaust after treatment devices capable of meeting emissions standards for PM and NOx:
  - Catalyzed diesel particulate filters (CDPF)
  - NOx adsorbers
- Both systems require very low sulfur in the exhaust to remain effective

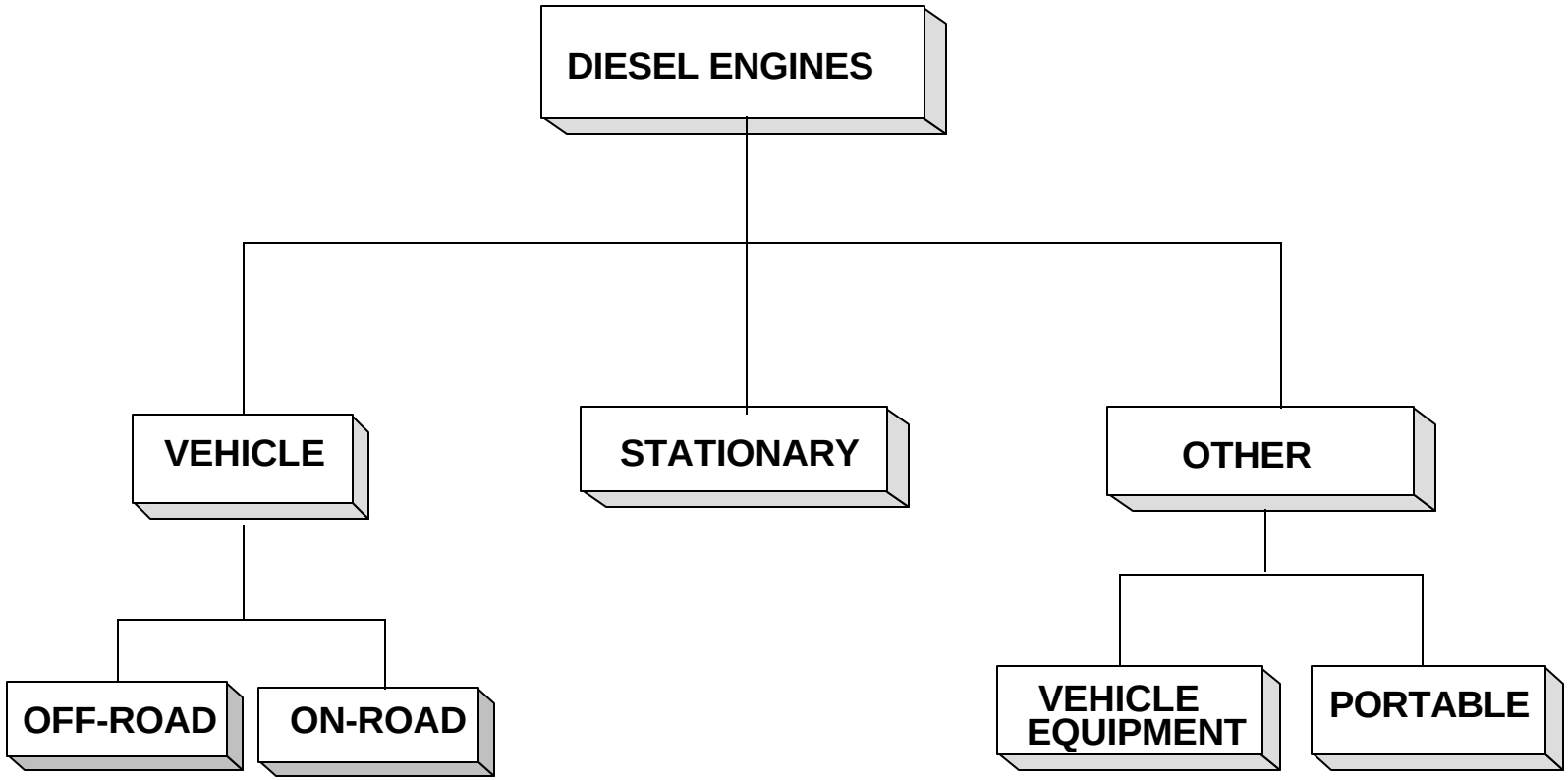
EPA Diesel Fuel Standards

- Limits on-road diesel fuel sulfur content to 15 ppm
  - Allows sulfur limit to be phased-in
  - Provides several compliance options for small refiners
    - Four year exemption from 15 ppm limit
    - sulfur credit trading
    - Three year exemption from Tier 2 gasoline sulfur limits
  - No changes to cetane or aromatics

Other ARB Diesel Fuel Action

- Particulate matter identified as a toxic air contaminant in August 1998
- Diesel risk reduction plan approved by the Board in September 2000

Risk Reduction Plan Addresses All Categories of Diesel-Fueled Engines



Proposed Amendments for California Diesel Fuel

- Lower CARB diesel sulfur limit to 15 ppm
- Applies to
  - On-road and off-road vehicle uses
  - Stationary sources (Air Toxic Control Measure)
- Necessary to implement diesel PM risk reduction plan

Proposed Amendments for California Diesel Fuel (Continued)

- No changes to aromatic hydrocarbon specifications

Proposed Amendments for California Diesel Fuel (Continued)

- Implementation concurrent with EPA rule - 2006
  - No phase-in
  - No provisions for small refiners

Proposed Amendments for California Diesel Fuel (Continued)

- Update diesel certification fuel specifications

Future Diesel Fuel Activities

- Monthly workshops
- Proposed hearing date in July 2001?
- Diesel certification fuel update in November 2001

Diesel Fuel Lubricity

Lubricity Concerns with Low Sulfur/Aromatics Diesel

Sweden

- 1991 - Experienced diesel fuel lubricity problems with low sulfur fuel

California

- 1994 Governor's Diesel Fuel Task Force recommended a minimum lubricity level
- Refineries voluntarily maintained this level
- No lubricity related fuel pump damage was documented

Diesel Lubricity Tests

- Two existing ASTM test methods:
  - Scuffing Load Ball on Cylinder Lubricity Evaluator (SLBOCLE)
  - High Frequency Reciprocating Rig (HFRR)
- Neither test predicts the lubricity of all additive/fuel combinations
- Both tests under predict lubricity effect of additives resulting in over-additization
- Tests don’t correlate well with each other

On-Going Efforts to Improve Lubricity Measurements

- ASTM Diesel Fuel Lubricity Task Force completing a major round robin program
- Objectives:
  - Acceptable precision
  - Responsive to all additive/fuel combinations
  - Correlation of measured lubricity levels to expected impacts on fuel injection equipment

ASTM Lubricity Guideline

- ASTM established a diesel fuel lubricity guideline as an appendix to their Diesel Fuel Oils Standard Specification (D 975-98a)
- Guideline defines levels which provide sufficient lubricity in all cases:
  - SLBOCLE values above 3,100 grams
  - HFRR method at 60ºC value below 450 microns

No Official Standard for Diesel Fuel Lubricity Exists

- Equipment manufacturers believe lubricity standard necessary with 15 ppm diesel sulfur standard
- ASTM will consider a lubricity specification when test issues are resolved
- California Division of Measurement Standards (DMS) supports a diesel lubricity specification

ARB Efforts

- Beginning investigation
- Status report November 2001
- Propose regulation in November 2002?

Diesel Engine Lubrication Oils

Sulfur Levels in Lubrication Oils

- Sulfur content of diesel engine lubrication oils range from 2,500 to 8,000 ppm
- Diesel engines consume lubrication oils as part of their normal operation
- Consider impact of lube oil sulfur on control technology

Source of Sulfur in Lubricant Base Oil

- Petroleum origin
  - 100 ppm up to 4,000 ppm of sulfur
  - Sulfur can be removed by hydrotreating
- Synthetic origin
  - Sulfur free

Source of Sulfur in Lubricant Additives

- Includes sulfur compounds to improve performance characteristics of lubricants
- Can contribute about 3,000 ppm sulfur
- Availability of non-sulfur replacements?

Sulfur Contribution of Lubrication Oils from On-Road HDV Exhaust

(Worst Case Estimate)

- Assume:
  - Nominal oil usage of 1 quart every 2,000 miles
  - Heavy duty diesel engine fuel usage of 6 miles per gallon
  - Lubrication oil with 8,000 ppm of sulfur
- 7 ppm maximum equivalent fuel sulfur contribution

Ash Content in Lubrication Oils Can Impact Particulate Filter Regeneration

- Lubrication oil ash is inorganic and non-combustible
- Ash comes from the additives
- Lubrication oil ash content has been increasing from increased additive rates
- Impacts particulate filter regeneration due to non-combustible ash deposits

Lubricants Work Group

- Industry/government work group
  - Part of DOE's Advanced Petroleum-Based Fuels - Diesel Emissions Control (APBF-DEC) Program
  - Established Spring 2000
  - Charter : study effects of sulfur and other constituents in lubricants on emission control devices and engine-out emissions

Lubricants Workgroup Has Defined a Three Phase Plan

- Request for proposal (RFP) issued and proposals being evaluated for first phase
  - 12 month program
  - Testing to characterize:
    - Lubricant basestock effects on engine-out emissions
    - Lubricant additives effects on engine-out emissions
- Follow-up work:
  - Study how these engine-out emissions impact diesel emission control system performance

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Electronic Reporting Compliance Methods

CaRFG3 Issues

Gasoline Certification Fuel

- Plan regulatory update to the CaRFG2 certification fuel specifications
- Planning additional workshops in the near future
- Will work closely with auto, oil, and ethanol industries and the ARB Mobile Source Control Division
- Scheduled for consideration by the ARB Board in November 2001

Current Key CaRFG2 Certification Fuel Specifications

Property	Range
T50	200-210 °F
T90	290-300 °F
Sulfur	30-40 ppmw
RVP	6.7-7.0 psi
Olefins	4-6 vol % max
MTBE	10.8-11.2 vol%
Ethanol	N/A
Benzene	0.8-1.0 vol %

MTBE Deminimus Levels

- Review current CaRFG3 MTBE deminimus limits
- Deminimus levels may need to be established for other ethers/alcohols which can be present as contaminants

Ongoing Permeation Emission Evaluation

- Contract awarded to investigate potential permeation emissions losses
  - Performed literature search for permeation rates with ethanol and non-ethanol gasolines
    - Confirms ethanol increases permeation emission losses
  - Gathering data on permeable fuel system materials in vehicle fleet to estimate statewide permeation emissions
  - Will design test program to evaluate permeation rates to increase available data
- Draft report to be available this month

Ongoing Work on Commingling

- Board prohibited use of MTBE beginning December 31, 2002
- Federal oxygen requirement still in place
  - Ethanol only allowable oxygenate
  - 70% of California fuel
- Board directed the staff to evaluate real-world impacts of mixing ethanol and non-ethanol gasoline

Evaluation of Real-World Impacts

- ARB Commingling study
  - Establish ARB/Industry workgroup
  - Evaluate consumer refueling practices
  - In-use vehicle fuel sampling program
- Results to be presented to Board in November 2001

Future Activities