

Public Transit Bus Fleet Rule Status Update



Sacramento, California
September 20, 2001

California Environmental Protection Agency



Air Resources Board

Outline

- ◆ Background
- ◆ Implementation Progress
- ◆ Alternative NOx Strategy
- ◆ Aftertreatment Technology
- ◆ Hybrid-Electric Bus Testing
- ◆ Summary
- ◆ Staff Recommendations
- ◆ Remaining Issues



Applicability

- ◆ Adopted February 2000
- ◆ Reduction of NOx and PM
- ◆ Transit Bus Fleet Rule
 - Applies to transit agencies
- ◆ New Engine Standards
 - Apply to engine manufacturers



Urban Bus Definition

- ◆ Heavy Heavy-Duty Diesel Engine (HHD) or Normally Powered by HHD
- ◆ 15 or More Passengers
- ◆ Intra-City Operation



Requirements

- ◆ Select Fuel Path by January 31, 2001
- ◆ 4.8 g/bhp-hr NO_x Fleet Average Plan due January 31, 2001
- ◆ PM Retrofits Starting January 1, 2003
- ◆ Low Sulfur Fuel (15 ppm or less) Starting July 1, 2002



Requirements

- ◆ New Engine Standards
 - 2002: 0.01 g/bhp-hr PM
 - 2004-2006: 0.5 g/bhp-hr NO_x
 - 2007 and beyond: 0.2 g/bhp-hr NO_x
- ◆ Zero-Emission Bus Demo Starting 2003
- ◆ Zero-Emission Bus Purchase in 2008



Resolution 00-2

- ◆ Implementation Progress
- ◆ Alternative NOx Strategy
- ◆ Status of Advanced Aftertreatment Systems for PM and NOx
- ◆ Progress on Development of Hybrid-Electric Bus Test Procedures



Fuel Path Selection

Air District	Diesel	Alternative-Fuel
San Joaquin	4	4
South Coast	7	11
Bay Area	13	2
San Diego	1	5
Sacramento	1	1
Others	17	4
Total	43	27



Fleet Composition

- ◆ January 31, 2001
 - 6,679 diesel buses (78%)
 - 1,866 alternative-fuel buses (22%)
- ◆ October 1, 2002 - Projections
 - 6,158 diesel buses (69%)
 - 2,754 alternative-fuel buses (31%)



NOx Fleet Averages

- ◆ 56 Reported Compliance with Standard
- ◆ 14 Supplied Insufficient Information or Miscalculated
- ◆ Staff is Working with the 14 Agencies to Resolve Non-Compliance



Alternative NOx Strategy

- ◆ Purchase Non-Complying Engines 2004-2006
- ◆ Apply to E.O. by June 30, 2001
- ◆ Achieve Greater NOx Emission Benefit through 2015 than if Purchased 0.5 g/bhr-hr NOx Engines in 2004-2006
- ◆ Demonstrate Advanced NOx Aftertreatment Technology



Exemption Applications

- ◆ 15 Submitted Applications by June 30
- ◆ 4 Submitted Plans
 - 1 complete and approvable plan
Santa Clara VTA
- ◆ 11 Did Not Submit Plans w/ Application
 - 5 submitted plans in last two weeks
- ◆ 4 Late Applications after June 30



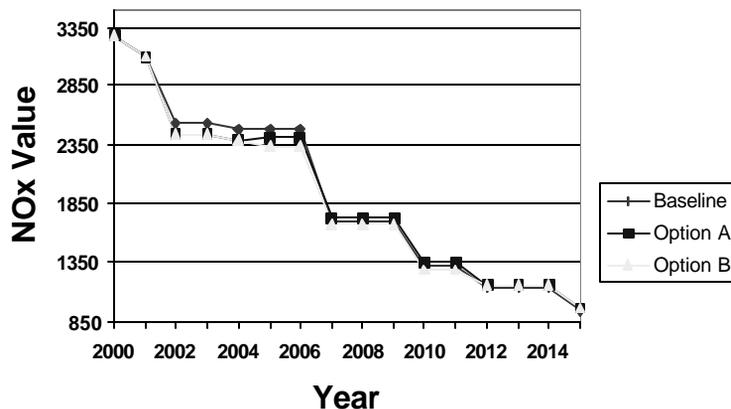
VTA Exemption Application

- ◆ Includes Baseline and 2 Plans
- ◆ Option A - Increase to 614 Buses (2005)
 - Repower 91 MY1992 buses
 - Purchase 14 new buses (2005)
- ◆ Option B - Maintain at 600 Buses
 - Repower 91 MY 1992 buses
 - Purchase 14 new buses (2005)
 - Plus: Retire buses early



VTA Exemption Application

VTA NOx Emission Benefits Comparison



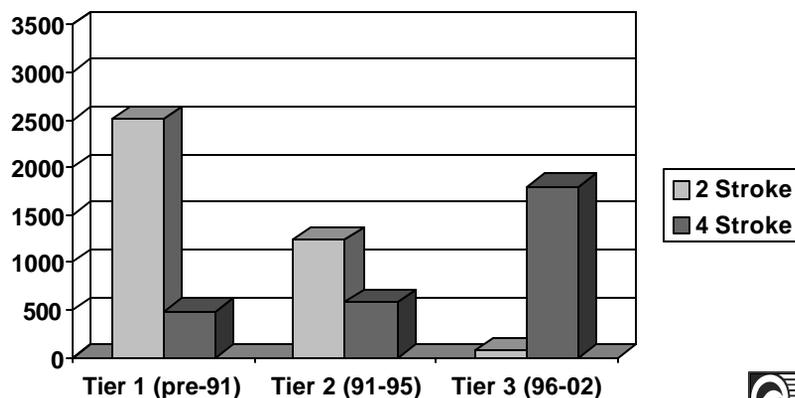
Advanced NOx Aftertreatment Demonstration Status

- ◆ No Transit Agencies Involved in NOx Aftertreatment Demo Programs
- ◆ EMA Indicates No NOx Demonstrations Currently for Transit Buses
- ◆ EPA Delayed Full Compliance with NOx Truck Standard until 2010



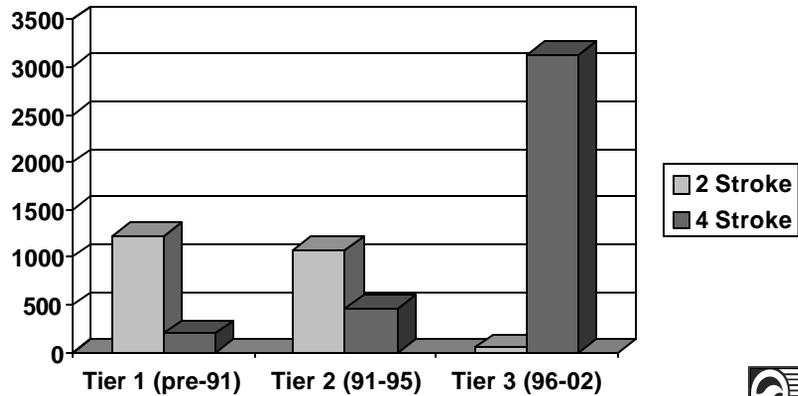
Fleet Composition 2001

Two and Four Stroke Engines (2001)



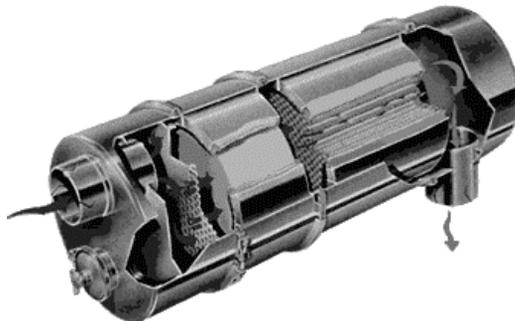
Fleet Composition 2002

Two and Four Stroke Engines (2002)



Diesel Particulate Filter Technology

- ◆ Reduce PM by 85% or more



- ◆ Passive = exhaust heat + catalyst
- ◆ Active systems = external heat source



Verified PM Aftertreatment Technology

Manufacturer	Engine	Model Year
Engelhard	Cummins M11	1995, 1996, 1997
	Cummins ISM	1998, 1999, 2000, 2001
Johnson Matthey	DDC S50 Bus	1999, 2000
	DDC S50 Truck	1999
	DDC S60	1998



NOx Aftertreatment Technology

- ◆ Selective Catalytic Reduction (SCR)
 - Primarily used in stationary applications
 - 50-80% reduction
- ◆ Exhaust Gas Recirculation (EGR)
 - Commercially available in DDC S50 at low reduction
 - Up to 50% reduction may be possible



NOx Aftertreatment Technology

- ◆ Lean NOx Catalyst
 - Used in combination with oxidation catalysts and filters
 - Up to 30% reduction with 7% fuel penalty
- ◆ NOx Adsorber
 - Up to 80% reduction with 4% fuel penalty
- ◆ Plasma Exhaust Technology
 - Up to 70% with 8% fuel penalty



Hybrid-Electric Bus (HEB)

- ◆ Benefits of Hybrid Technology
 - Added power for accelerations
 - Better fuel economy
 - Lower emissions
- ◆ Development of Test Procedures
 - SAE J1711HD procedures as a basis
 - ARB testing of HEBs
- ◆ Bring to Board late 2002



Reporting Summary

- ◆ Fuel Path Selection: All 70 Agencies
- ◆ NOx Fleet Average
 - 56 reported compliance with standard
 - 14 supplied insufficient information or miscalculated



Alternative NOx Summary

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 - 4 Submitted Plans
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- ◆ 4 Late Applications after June 30
- ◆ No Demonstrations of NOx Aftertreatment

Advanced Technology Summary

- ◆ PM Aftertreatment: 2 PM Filters Verified for Some Cummins and DDC Engines; More Verifications Under Consideration
- ◆ NOx Aftertreatment Technology Not Yet Being Demonstrated
- ◆ Hybrid-Electric Bus Test Procedures Development Underway



Staff Recommendations

- ◆ Transit Agencies to Commit Resources for NOx Demo by 12/31/01
- ◆ Demo in Progress by 12/31/02
- ◆ Joint or Individual Demo Project
 - Joint project must show 70-90% reduction potential



Remaining Issues

- ◆ NOx Fleet Average Shortfalls
- ◆ Late Applications and Plans for Alternative NOx Strategy
- ◆ PM for Two-Stroke and Older Engines
 - Update Board June 2002
- ◆ HEB Test and Certification Procedures
 - Proposal to Board in 2002

