THE CARL MOYER PROGRAM GUIDELINES PROPOSED REVISIONS 2005

WORKSHOP

August 18
Sacramento

On-Road Controls Branch
Mobile Source Control Division




CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
Air Resources Board

Webcast Communication Information

- Please send questions and comments to:
  - Email address: OnAir@arb.ca.gov

Today's Agenda

- Carl Moyer Program Background
- Off-Road Diesel Engine/Equipment
  - Off-Road Spark-Ignition Engine/Equipment
  - Airport Ground Support Equipment
- Transport Refrigeration Units
- Locomotives
- Marine Vessels

Carl Moyer Program
Background

- Provides grants to offset the incremental cost of lower emitting technologies
- Early introduction of low-emission technologies
- Carl Moyer Program's objective
  - Improve air quality
  - Supplement, not replace, regulations

Carl Moyer Program
Core Principles

- A state and local partnership
  - ARB sets guidelines
  - Local districts receive applications, make grants, and monitor projects
- Emission reductions must be real, quantifiable, surplus, and enforceable
- Environmental justice funding requirement

Carl Moyer Program
Eligible Emission Reductions

- Emission reductions must be real, quantifiable, surplus, and enforceable
  - Certified engines and/or verified retrofit kits
  - Cannot be used in alternative compliance strategies (e.g., ABT)
  - Cannot be used to comply with other regulations (e.g., fleet rules)
  - Cannot be used to comply with legally binding agreements (e.g., MOUs)

Carl Moyer Program Changes

- Increased and continued funding
  - Adjustment to Smog Check and tire fees through 2015
  - Local districts may increase motor vehicle registration surcharge by $2
- Program expansion
  - Add PM and ROG
  - Add light-duty vehicles
  - Add agricultural sources (HSC 39011.5)
  - Add fleet modernization program

Cost-Effectiveness
Proposed Formula

- Cost-Effectiveness ($/ton) =

$$\frac{\text{Annualized Cost}}{\text{NOx + ROG + (WF * PM}_c\text{)}}$$

Where:
- NOx = Annual NOx emissions (tpd)
- ROG = Annual ROG emissions (tpd)
- PM_c = Combustion PM (tpd)
- WF = weighting factor

- WF may be based on many factors
- Range of weighting factor for PM_c: 10 - 30
- Non-combustion PM not included
  - Guidelines criteria not available for non-combustion PM projects

Schedule

- Workshops on Carl Moyer Guideline Revisions
  - November/December 2004
  - April/May 2005
  - August 2005
- Release Proposed Project Criteria -- August 2005
- Release Proposed Guidelines -- Oct 2005
- Board Hearing -- Nov 2005

Carl Moyer Program

Off-Road Compression-Ignited Equipment

(including Large Spark-Ignited and Airport Ground Support Equipment)

Proposed Criteria

CI Off-Road Equipment
General Information

- Off-road CI engines: agricultural tractors, backhoes, excavators, trenchers, motor graders, etc.
- Eligible project types include new purchases, repowers and retrofits
- 8 percent of Carl Moyer Program funding used for off-road CI projects (excludes agricultural pumps)

CI Off-Road Equipment
Off-Road In-Use Control Measure

- ARB is developing a fleet rule for in-use off-road mobile equipment ≥ to 25 horsepower
- Scheduled in 2006
- May impact project criteria for Carl Moyer Program projects

CI Off-Road Equipment
Cargo Handling Equipment Regulation

- ARB is developing a control measure for cargo handling equipment at intermodal facilities
- Scheduled in November 2005
- May impact project criteria for Carl Moyer Program projects

CI Off-Road Equipment
Project Criteria

- General Requirements
  - Early or extra emission reductions
  - Cost-effectiveness of $14,300/weighted ton
  - Project life of at least 3 years
  - Obtain a 30% NOx reduction for new purchases
  - Obtain a 15% NOx reduction for repowers & retrofits
  - Vehicle must operate at least 75% of the time in California
  - Projects must be certified &/or verified by ARB

See project criteria handout for a complete list of proposed criteria

CI Off-Road Equipment
Project Criteria

- Funding available for off-road engines ≥25 hp
- PM retrofit required on repower projects if available and cost-effective
  - Must use highest retrofit level feasible
  - Full cost eligible for funding
- Baseline engine must be scrapped
  - Core charges may be included in grant award and cost-effectiveness analysis

See project criteria handout for a complete list of proposed criteria

CI Off-Road Equipment
Project Criteria

- Prioritize Tier 2/Tier 3 repowers
  - Proposing cost-effectiveness cap of $6000 per weighted ton for Tier 1 repowers
  - Must obtain Tier 2/Tier 3 repower exemption
    - Written statement of reason from engine manufacturer
    - Engine manufacturers may provide ARB with information on engines where Tier 2 or Tier 3 repowers are feasible or infeasible

See project criteria handout for a complete list of proposed criteria

CI Off-Road Equipment
Project Criteria

- Cost-effectiveness calculations
  - Use zero mile emission factors for emission rates for baseline and reduced technologies
  - Must use Tier and Model Year to determine appropriate emission factor
  - Do not include ROG reductions since ROG reductions are not verified and are small

See project criteria handout for a complete list of proposed criteria

Off-Road LSI and GSE Engines
Project Criteria

- ARB staff has proposed an LSI regulation
- Scheduled in September 2005
- Carl Moyer project criteria will be developed for off-road LSI and GSE categories pending the outcome of the LSI regulatory proposal
- Project criteria for off-road LSI and GSE will adhere to Carl Moyer Program requirements

See project criteria handout for a complete list of proposed criteria

Off-Road CI, LSI, and Ground Support Equipment

Criteria Discussion

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CI Off-Road Equipment

Example 1 - Tier 2 repower and retrofit

Baseline equipment information:

- Model Year: 1987 Caterpillar 3306
- HP: 300
- Activity: 1,500 hours
- Emission rates (g/bhp-hr): 10.2 NOx; 0.83 ROG; 0.38 PM
- Cost of rebuild: $11,500
- Load factor: 0.72

Reduced-emission engine information:

- Model Year: 2004 Caterpillar C9
- HP: 300
- Activity: 1,500 hours
- Emission rates (g/bhp-hr): 3.8 NOx; 0.10 ROG;0.09 PM
- 100% operation in California
- Cost of repower: $80,000

CI Off-Road Equipment
Example 1 - Tier 2 repower and retrofit

Retrofit information:

- DECS: Lubrizol Unikat Combifilter
- Level 3 verified reductions: 85% PM reduction
- Cost of retrofit: $25,000
- 100% operation in California

CI Off-Road Equipment
Example 1 - Emissions

Emissions Calculation – Baseline

- NOx =(10.2g/bhphr*300hp*0.72*1500hr/year)/907,200g/ton = 3.64 tons/yr
- ROG=(0.83g/bhphr*300hp*0.72*1500hr/year)/907,200g/ton = 0.30 tons/yr
- PM = (.38 g/bhp-hr*300 hp*0.72*1500hr/year)/907,200g/ton = 0.14 tons/yr

Emissions Calculation – Reduced

- NOx =(3.8g/bhp-hr*300 hp*0.72*1500hr/year)/907,200g/ton = 1.36 ton/yr
- ROG = (0.1g/bhphr*300hp*0.72*1500hr/year)/907,200g/ton = 0.04 tons/yr
- PM = (.09 g/bhp-hr*300 hp*0.72*1500hr/year)/907,200g/ton = 0.03 tons/yr

CI Off-Road Equipment
Example 1 – Emission Reductions

Repower emission reductions

- NOx Reductions = 3.64 tons/yr - 1.36 tons/yr
  = 2.28 tons/yr
- ROG Reductions = 0.30 tons/yr - 0.04 tons/yr
  = 0.26 tons/yr
- PM Reductions = 0.14 tons/yr - 0.03 tons/yr
  = 0.11 tons/yr

Retrofit emission reductions

- PM Reductions = 0.03 tons/yr*0.85
  = 0.026 tons/yr

CI Off-Road Equipment
Example 1 – Cost-Effectiveness

- Project Life = 5 years → CRF = 0.225
- Incremental cost =

  $105,000 - $11,500 = $93,500
- Annualized cost =

  ($93,500 * 0.225) = $21,038/year
- Project cost-effectiveness =
  ($21,038/year)/[(2.28 tons NOx/yr) +
  (0.26 tons ROG/yr) + (10 * 0.136 tons PM/yr)]
  = **$5,394/weighted surplus ton**

CI Off-Road Equipment
Example 2- Retrofit of Tier 2 engine

Baseline equipment information:

- Model Year: 2004 Caterpillar C9
- HP: 300
- Activity: 1,500 hours
- Emission rates (g/bhp-hr): 3.8 NOx; 0.10 ROG; 0.09 PM

Retrofit information:

- DECS: Lubrizol Unikat Combifilter
- Level 3 verified reductions: 85% PM reduction
- Cost of retrofit: $25,000
- 100% operation in California

CI Off-Road Equipment
Example 2 - Emissions

Emission Calculations- Baseline

- PM = (.09 g/bhp-hr*300hp*0.72*1500hr/year)/907,200g/ton = 0.03 tons/yr

CI Off-Road Equipment
Example 2 – Emission Reductions

- NOx Reductions = no benefit
- ROG Reductions = no benefit
- PM Reductions = 0.03 tons/yr * 0.85
  = 0.026 tons/yr

CI Off-Road Equipment

Example 2 – Cost-Effectiveness

- Project Life = 5 years → CRF = 0.225
- Incremental cost =

  $25,000 - $0 = $25,000
- Annualized cost =

  ($25,000 * 0.225) = $5,625/year
- Project cost-effectiveness = ($5,625/year)/[(0 tons NOx/year) + (0 tons ROG/year) + (10 * 0.026 tons PM/year)] = **$21,635/weighted surplus ton**

CI Off-Road Equipment
Example 2 – Eligible Grant Amount

- Project qualifies for partial incremental cost
- Eligible grant award:
  ($14,300 * 0.26)/0.225 = $16,524

Off-Road CI, LSI, and Ground Support Equipment

Sample Calculations

Discussion

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Carl Moyer Program

Transport Refrigeration Units

Proposed Criteria

Transport Refrigeration Units

- Transport refrigeration units (TRUs) refrigerate perishable goods in transit
- Internal combustion engines run the compressor.
  - TRU engine continues to cycle when tractor is parked or shut down
  - Typical TRU engine is between 9 and 38 hp

Transport Refrigeration Units
Regulations

- Engines < 25 horsepower covered by small off road emission standards
- Diesel engines ≥ 25 horsepower subject to off road engine emission standards
- TRU ATCM set in-use performance standards for PM emissions
  - Regulation phased in beginning in 2008

Transport Refrigeration Units

ATCM Phase-In

MY	In Use Compliance Year															
	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18	'19	'20
'01 & Older				L	L	L	L	L	L	L	U	U	U	U	U	U
'02					L	L	L	L	L	L	L	U	U	U	U	U
'03						U	U	U	U	U	U	U	U	U	U	U
'04							U	U	U	U	U	U	U	U	U	U
'05								U	U	U	U	U	U	U	U	U
'06				Potential					U	U	U	U	U	U	U	U
'07				Surplus						U	U	U	U	U	U	U
'08				Emissions							U	U	U	U	U	U
'09												U	U	U	U	U
'10													U	U	U	U
'11														U	U	U
'12															U	U
'13																

<25 hp 2013 and subsequent MYs must meet ULETRU 7 years after MY

Transport Refrigeration Units
Project Criteria

- General Requirements
  - Early or extra emission reductions
  - Cost-effectiveness of $14,300/weighted ton
  - Project life of at least 3 years
  - Obtain a 15% NOx reduction for repowers & retrofits
  - At least 75% of operation must be in California
  - Technology must be certified and/or verified by ARB

See project criteria handout for a complete list of proposed criteria

Transport Refrigeration Units
Project Criteria

- Carl Moyer projects are not eligible for delayed compliance under the TRU ATCM
- Alternate technologies (electric standby and pure cryogenic systems) considered on a case by case basis
- Must have an hour-meter or other method of tracking usage

See project criteria handout for a complete list of proposed criteria

Transport Refrigeration Units

Criteria Discussion

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Transport Refrigeration Units
Example - Repower

Baseline equipment information:

- Model Year: 1999
- HP: 37.8 hp
- Activity: 1,300 hours
- Emission rates (g/bhp-hr): 2.6 NOx; 0.65 ROG; 0.28 PM
- Cost of rebuild: $3,200

Reduced-emission engine information:

- Model Year: 2006
- HP: 37.8 hp
- Activity: 1,300 hours
- Emission rates (g/bhp-hr): 2.3 NOx; 0.26 ROG; 0.21 PM
- Cost of new engine: $4,000
- Cost of installation and engineering for new engine: $700
- 100% operation in California

Transport Refrigeration Units
Example - Emissions

Emissions Calculation – Baseline

- NOx =(2.6 g/bhp-hr*37.8hp*1300hr/year)/907,200g/ton = 0.14 tons/yr
- ROG =(0.65 g/bhp-hr*37.8hp*1300hr/year)/907,200g/ton = 0.036 tons/yr
- PM =(0.28 g/bhp-hr*37.8hp*1300hr/year)/907,200g/ton = 0.015 tons/yr

Emissions Calculation – Reduced

- NOx =(2.3 g/bhp-hr*37.8hp*1300hr/year)/907,200g/ton = 0.12 tons/yr
- ROG =(0.25 g/bhp-hr*37.8hp*1300hr/year)/907,200g/ton = 0.013 tons/yr
- PM =(0.21 g/bhp-hr*37.8hp*1300hr/year)/907,200g/ton = 0.011 tons/yr

Transport Refrigeration Units
Example – Emission Reductions

- NOx Reductions = 0.14 tons/yr - 0.12 tons/yr = 0.02 tons/yr
- ROG Reductions = 0.036 tons/yr - 0.013 tons/yr = 0.023 tons/yr
- PM Reductions = 0.015 tons/yr - 0.011 tons/yr = 0.004 tons/yr

Transport Refrigeration Units
Example – Cost-Effectiveness

- Project Life = 3 years → CRF = 0.360
- Incremental cost =
  $4,000 - $3,200 + $700 = $1,500
  Annualized cost =
  ($1,500 * 0.360) = $540/year
- Project cost-effectiveness =
  ($540/year)/[(0.02 tons NOx/yr) + (0.023 tons ROG/yr) + (10 * 0.004 tons PM/yr)]
  = **$6,506/weighted surplus ton**

Transport Refrigeration Units

Sample Calculation

Discussion

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Carl Moyer Program

Locomotives

Proposed Criteria

Locomotives
Background

- Types of Locomotives
  - Line-haul
  - Switchers
  - Passenger
- Railroad Definitions
  - Class 1 Railroads
  - Class 2 and 3 Railroads
  - Military and Industrial Railroads
- Control Requirements
  - Federal Standards
  - South Coast and Statewide MOU

Locomotives
Project Criteria

- General Requirements:
  - Early or extra emission reductions
  - Cost-effectiveness of $14,300/weighted ton
  - New Purchases - 30% NOx reduction
  - Retrofits & Repowers - 15% NOx reduction
  - Certified &/or verified by ARB
  - 75% operation in CA

See project criteria handout for a complete list of proposed criteria

Locomotives
Project Criteria

- Port plan or other voluntarily-adopted strategy
  - Projects eligible if not otherwise required
- ILD must be installed
  - ILD emission factors: 0.70 for switchers
    0.81 for line haul
- Old engine must be destroyed
- Contract life = project life
  - 3 year minimum project life
- Locomotive MOUs
  - Ensure funded locos not exchanged for dirtier locos to demonstrate compliance with MOUs?

See project criteria handout for a complete list of proposed criteria

Locomotives

Baseline Emissions and Cost

Locomotive Type	Repower		New Purchase	
	Baseline Emissions	**Baseline Cost**	**Baseline Emissions**	**Baseline Cost**
Line-haul	Based upon federal emission requirements for engine remanufacture	Remanufacture cost or $50,000, whichever is greater	Tier 2	Cost of new Tier 2 locomotive
Switcher	Tier 0 for Class 1 railroads	Remanufacture cost or $50,000, whichever is greater	Tier 0 for Class I railroads*	$300,000*
	Uncontrolled for Class III railroads		Uncontrolled for Class III railroads*	
Passenger	Uncontrolled	Remanufacture cost or $50,000, whichever is greater	Tier 2	Cost of new Tier 2 locomotive

Locomotives

Criteria

Discussion

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Locomotives

Example 1– Switcher Repower (Class III Railroad)

Baseline locomotive information:

- Locomotive Model year: 1971
- Emission rate (g/bhp-hr): 15.7 NOx, 1.0 ROG, 0.40 PM
- Activity: 1,000 hours per year
- Engine horsepower = 2,100 hp

Reduced-emission engine information:

- Engine model year: 2006
- Emission rate (g/bhp-hr): 6.6 NOx, 0.51 ROG, 0.19 PM
- Activity: 1,000 hours per year
- Engine horsepower: 2,000
- ILD emission reduction factor: 0.70

Locomotives
Example 1 – Emissions

Emission calculations – baseline:

- NOx = (15.7 g/bhp-hr * 1,000 hr/year * 2,100 hp)/907,200 g/ton = 36.3 ton/yr
- ROG = (1.0 g/bhp-hr * 1,000 hr/year * 2,100 hp)/907,200 g/ton = 2.3 ton/yr
- PM = (0.40 g/bhp-hr * 1,000 hr/year * 2,100 hp)/907,200 g/ton = 0.93 ton/yr

Emission calculations – reduced technology:

- NOx = (6.6 g/bhp-hr * 1,000 hr/year * 2,000 hp * 0.70)/907,200 g/ton = 10.2 ton/yr
- ROG = (0.51 g/bhp-hr * 1,000 hr/year * 2,000 hp *0.70)/907,200 g/ton = 0.8 ton/yr
- PM = (0.19 g/bhp-hr * 1,000 hr/year * 2,000 hp * 0.70)/907,200 g/ton = 0.29 ton/yr

Locomotives
Example 1 – Emission Reductions

- NOx Reductions = 36.3 tons/yr – 10.2 tons/yr = 26.1 tons/yr
- ROG Reductions = 2.3 tons/yr – 0.8 tons/yr = 1.5 tons/yr
- PM Reductions = 0.93 tons/yr – 0.29 tons/yr = 0.64 tons/yr

Locomotives
Example 1 – Cost-Effectiveness

- Project Life: 10 years → CRF = 0.123
- Incremental cost:

  $350,000 + $12,000 - $50,000 = $312,000
- Annualized cost:

  ($312,000 * 0.123) = $38,376/year
- Project cost-effectiveness: ($38,376/year)/ [(26.1 tons NOx/year) + (1.5 tons ROG/year) + (10 * 0. 64tons PM/year)] =

  $1,129/ weighted surplus ton

Locomotives

Example 2 – Green Goat Purchase (Class I Railroad)

Baseline locomotive information:

- Emission rate (g/bhp-hr): 11.3 NOx, 1.0 ROG, 0.40 PM
- Activity: 1,500 hours per year
- Engine horsepower = 2,200 hp
- ILD emission reduction factor: 0.70

Reduced-emission engine information:

- Engine model year: 2006
- Emission rate (g/bhp-hr): 4.8 NOx, 0.51 ROG, 0.15 PM
- Activity: 1,500 hours per year
- Engine horsepower = 2,200 hp
- ILD emission reduction factor: 0.70

Locomotives
Example 2 – Emissions

Emission calculations – baseline:

- NOx = (11.3 g/bhp-hr * 1,500 hr/year * 2,200 hp * 0.70)/907,200 g/ton = 28.8 ton/yr
- ROG = (1.0 g/bhp-hr * 1,500 hr/year * 2,200 hp * 0.70)/907,200 g/ton = 2.5 ton/yr
- PM = (0.40 g/bhp-hr * 1,500 hr/year * 2,200 hp * 0.70)/907,200 g/ton = 1.02 ton/yr

Emission calculations – reduced technology:

- NOx = (4.8 g/bhp-hr * 1,500 hr/year * 2,200 hp * 0.70)/907,200 g/ton = 12.2 ton/yr
- ROG = (0.51 g/bhp-hr * 1,500 hr/year * 2,200 hp *0.70)/907,200 g/ton = 1.3 ton/yr
- PM = (0.15 g/bhp-hr * 1,500 hr/year * 2,200 hp * 0.70)/907,200 g/ton = 0.38 ton/yr

Locomotives
Example 2 – Emission Reductions

- NOx Reductions = 28.8 tons/yr – 12.2 tons/yr = 16.6 tons/yr
- ROG Reductions = 2.5 tons/yr – 1.3 tons/yr = 1.2 tons/yr
- PM Reductions = 1.02 tons/yr – 0.38 tons/yr = 0.64 tons/yr

Locomotives
Example 2 – Cost-Effectiveness

- Project Life: 20 years → CRF = 0.074
- Incremental cost:
  $1,100,000 - $300,000 = $800,000
- Annualized cost:
  ($800,000 * 0.074) = $59,200/year
- Project cost-effectiveness: ($59,200/year)/ [(16.6 tons NOx/year) + (1.2 tons ROG/year) + (10 * 0.64 tons PM/year)] = **$2,446/weighted surplus ton**

Locomotives

Sample Calculations

Discussion

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Carl Moyer Program

Marine Vessels

Proposed Criteria

Marine Vessels
Background

- Types of marine vessels
  - Harbor craft – fishing vessels, tugs, tow boats, ferries, work boats, etc…
  - Oceangoing vessels – container ships, oil tankers, cruise ships, etc…
- Engine types
  - Propulsion
  - Auxiliary
- Control Requirements
  - ARB and Federal Standards
  - IMO Standards

Marine Vessels
Project Criteria

- General Requirements:
  - Early or extra emission reductions
  - Cost-effectiveness of $14,300/weighted ton
  - New Purchases - 30% NOx reduction
  - Retrofits & Repowers - 15% NOx reduction
  - Certified &/or verified by ARB
  - Emissions based on % operation in CA coastal waters

See project criteria handout for a complete list of proposed criteria

Marine Vessels
Project Criteria

- Port plan or other voluntarily-adopted strategy
  - Projects eligible if not otherwise required
- Contract life = project life
- Only engines with legible serial number are eligible
- Old engine must be destroyed
- Vessels with wet exhaust systems eligible for repower

See project criteria handout for a complete list of proposed criteria

Marine Vessels
Marine Shore Power

- Marine shore power or “cold ironing”
  - Reduced engine operation during hotelling
  - Plug into shore-side power while docked
- Technology in early stages
  - Projects evaluated on a case-by-case basis

See project criteria handout for a complete list of proposed criteria

Marine Vessels

Criteria

Discussion

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Marine Vessels

Example 1– Tugboat Propulsion Engine Repower

Baseline engine information:

- Engine model year: 1975
- Engine horsepower: 1,200
- Emission rate (g/bhp-hr): 11.2 NOx, 0.9 ROG, 0.38 PM
- Activity: 95,000 gallons per year
- Fuel consumption rate: 20.8 bhp-hr/gal

Reduced-emission engine information:

- Engine model year: 2005
- Engine horsepower: 1,200
- Emission rate (g/bhp-hr): 7.6 NOx, 0.7 ROG, 0.27 PM
- Activity: 95,000 gallons per year

Marine Vessels

Example 1– Emissions

Emission calculations – baseline:

- NOx = (11.2 g/bhp-hr * 95,000 gal/year * 20.8 bhp-hr/gal)/ 907,200 g/ton = 24.4 ton/yr
- ROG = (0.9 g/bhp-hr * 95,000 gal/year * 20.8 bhp-hr/gal)/ 907,200 g/ton = 2.0 ton/yr
- PM = (0.38 g/bhp-hr * 95,000 gal/year * 20.8 bhp-hr/gal)/ 907,200 g/ton = 0.83 ton/yr

Emission calculations – reduced technology:

- NOx = (7.6 g/bhp-hr * 95,000 gal/year * 20.8 bhp-hr/gal)/ 907,200 g/ton = 16.6 ton/yr
- ROG = (0.7 g/bhp-hr * 95,000 gal/year * 20.8 bhp-hr/gal)/ 907,200 g/ton = 1.5 ton/yr
- PM = (0.27 g/bhp-hr * 95,000 gal/year * 20.8 bhp-hr/gal)/ 907,200 g/ton = 0.59 ton/yr

Marine Vessels
Example 1– Emission Reductions

- NOx Emission Reductions =
  24.4 tons/yr – 16.6 tons/yr = 7.8 tons/yr
- ROG Emission Reductions =
  2.0 tons/yr – 1.5 tons/yr = 0.5 tons/yr
- PM Emission Reductions =
  0.83 tons/yr – 0.59 tons/yr = 0.24 tons/yr

Marine Vessels
Example 1– Cost-Effectiveness

- Project life: 5 years → CRF = 0.225
- Incremental cost:
  $250,000 + $2,500 - $100,000 = $152,500
- Annualized cost:
  ($152,500 * 0.225) = $34,312/year
- Project cost-effectiveness: ($34,312/year)/ [(7.8 tons NOx/year) + (0.5 tons ROG/year) + (10*0.24 tons PM/year)] = **$3,207/weighted surplus ton**

Marine Vessels

Sample Calculations

Discussion

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Carl Moyer Program

Other Issues

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Carl Moyer Program

- Please provide written comments by September 2, 2005
- For more information, visit the Carl Moyer Program web page
  - www.arb.ca.gov/msprog/moyer/moyer.htm

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