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
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) =

\[
\frac{\text{Annualized Cost}}{\text{NOx} + \text{ROG} + (\text{WF} \times \text{PM}_c)}
\]

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)
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
ARBI 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
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
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
Email address: OnAir@arb.ca.gov
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
Emissions Calculation – Baseline

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

Emissions Calculation – Reduced

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

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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
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
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
Emission Calculations- Baseline

PM = (0.09 g/bhp-hr * 300 hp * 0.72 * 1500 hr/year) / 907,200 g/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
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

Email address: OnAir@arb.ca.gov
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

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<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
Email address: OnAir@arb.ca.gov
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 * 37.8 hp * 1300 hr/year) / 907,200 g/ton
  = 0.14 tons/yr
- ROG = (0.65 g/bhp-hr * 37.8 hp * 1300 hr/year) / 907,200 g/ton
  = 0.036 tons/yr
- PM = (0.28 g/bhp-hr * 37.8 hp * 1300 hr/year) / 907,200 g/ton
  = 0.015 tons/yr

Emissions Calculation – Reduced

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

Draft – Do not cite or quote – numbers may change
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
Email address: OnAir@arb.ca.gov
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
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

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<th>Locomotive Type</th>
<th>Repower</th>
<th>New Purchase</th>
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<td>Baseline Emissions</td>
<td>Baseline Cost</td>
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<td><strong>Line-haul</strong></td>
<td>Based upon federal emission requirements for engine remanufacture</td>
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<td><strong>Passenger</strong></td>
<td>Uncontrolled</td>
<td>Remanufacture cost or $50,000, whichever is greater</td>
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</tbody>
</table>
Locomotives

Criteria
Discussion
Email address: OnAir@arb.ca.gov
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 * 0.64 tons 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

Draft – Do not cite or quote – numbers may change
Locomotives
Example 2 – Emissions

Emission calculations – baseline:

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

Emission calculations – reduced technology:

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

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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

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Emission calculations – baseline:

- NOx = \( \frac{11.2 \text{ g/bhp-hr} \times 95,000 \text{ gal/year} \times 20.8 \text{ bhp-hr/gal}}{907,200 \text{ g/ton}} \) = 24.4 ton/yr
- ROG = \( \frac{0.9 \text{ g/bhp-hr} \times 95,000 \text{ gal/year} \times 20.8 \text{ bhp-hr/gal}}{907,200 \text{ g/ton}} \) = 2.0 ton/yr
- PM = \( \frac{0.38 \text{ g/bhp-hr} \times 95,000 \text{ gal/year} \times 20.8 \text{ bhp-hr/gal}}{907,200 \text{ g/ton}} \) = 0.83 ton/yr

Emission calculations – reduced technology:

- NOx = \( \frac{7.6 \text{ g/bhp-hr} \times 95,000 \text{ gal/year} \times 20.8 \text{ bhp-hr/gal}}{907,200 \text{ g/ton}} \) = 16.6 ton/yr
- ROG = \( \frac{0.7 \text{ g/bhp-hr} \times 95,000 \text{ gal/year} \times 20.8 \text{ bhp-hr/gal}}{907,200 \text{ g/ton}} \) = 1.5 ton/yr
- PM = \( \frac{0.27 \text{ g/bhp-hr} \times 95,000 \text{ gal/year} \times 20.8 \text{ bhp-hr/gal}}{907,200 \text{ g/ton}} \) = 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

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Marine Vessels

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Other Issues

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♦ 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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