4th Public Workshop to Discuss Development of Regulations for Ocean-going Ship Main Engines and Auxiliary Boilers

Proposed Regulatory Language

March 5, 2008
Sacramento, CA

California Environmental Protection Agency
AIR RESOURCES BOARD

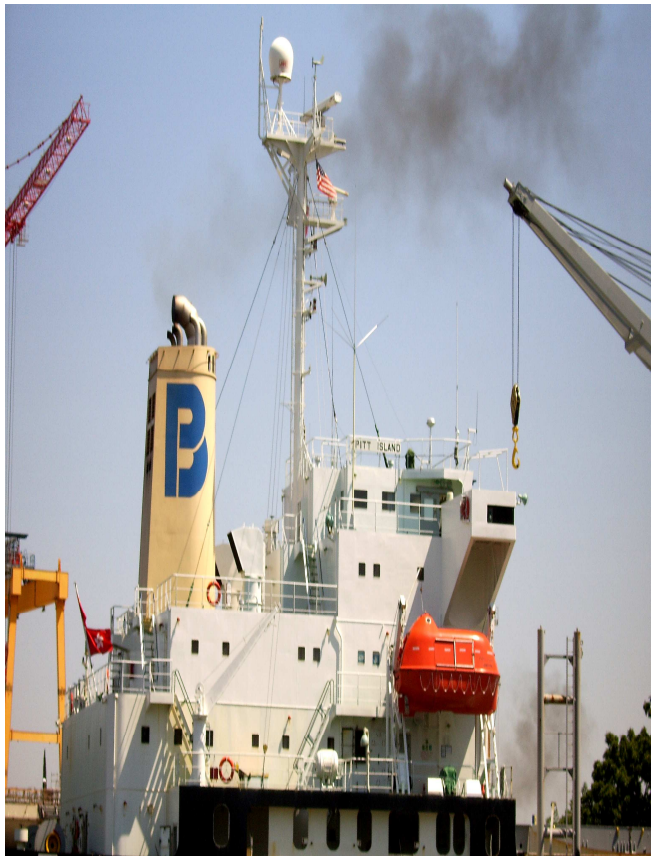
Overview

- Recap
- Activities Since Sept. 07 Workshop
- Proposed Changes to Proposed Regulation
- Emission Reductions
- Costs
- Next Steps

Email Questions to coastalrm@calepa.ca.gov (during workshop only)

Emissions from Ships Impact Public Health and Air Quality

- Air pollution is a serious public health concern
- Marine vessels are a large source of California's NOx & PM emissions
- Multiple drivers for action
- Number of statewide strategies to reduce emissions from ships



Goals for Proposed OGV Main Engine Regulation

- **Achieve significant emissions reductions from ocean-going vessels**
  - **require use of cleaner fuels as soon as possible**
  - **align main engine and auxiliary engine rules**
- **Address Federal District Courts decision on auxiliary engine rule**

Activities Since Sept. 07 Workshop

- Individual meetings with stakeholders
- Lifecycle Analysis of GHG impacts
- Continued evaluation of technical and operational issues associated with changing fuels
- Modified regulatory proposal
- Finalized inventory
- Developed preliminary cost estimates

Individual meetings with stakeholders

- **Many stakeholders, including USCG, believe it will be more successful and feasible if distillate is introduced in a two step process**
  - **MGO or 0.5 %S MDO**
  - **[0.1 or 0.2] %S MGO/MDO**
- **Fuel viscosity may be most challenging technical issue**
- **No long-term engine impact study on routinely changing fuels in today's 2-stroke main engines**

Individual meetings with stakeholders

- **Several fuel-related concerns**
  - **not enough known about fuel properties of at very low sulfur levels (<500 to 100 ppm)**
  - **flashpoint issues at very low sulfur fuels**
  - **lubricity**
  - **global fuel availability**
  - **fuel delivery and on-board fuel management to avoid contamination**

Current Findings

- **Current finding indicate**
  - **for most vessels, changing fuel from HFO to distillate in main engine is feasible**
  - **there are technical and operational challenges but they can be overcome**
- **Global fuel availability and clean fuel delivery infrastructure is being evaluated**
- **Careful on-board fuel management needed to maintain fuel sulfur requirements**
- **Fuel switchover procedures need to address fuel temperature levels and corresponding fuel viscosity**

Proposed Changes to Draft Regulatory Proposal

OGV Main Engine Draft Regulatory Proposal

- **Applicability**
- **Exemptions**
- **Definitions**
- **In-use operational requirements**
- **Non-compliance fee**
- **ACE**
- **Recordkeeping**

Draft Regulatory Language

Key Changes

- **Retained requirements for auxiliary boilers**
- ***Selected a two step implementation timeframe and fuel sulfur limit***
- **Retained provision for purchasing compliant fuel in California**
- ***Excluded steam ships (main propulsion boilers)***

Draft Regulatory Language

Applicability

- **All ocean-going vessels (U.S. and Foreign-flagged, excludes OGV tugs)**
- **Main engine on OGVs designed primarily to provide propulsion**
- **Auxiliary boilers on OGVs designed to produce steam for uses other than propulsion**
- **All vessels operating within 24 nautical miles of the California coast**

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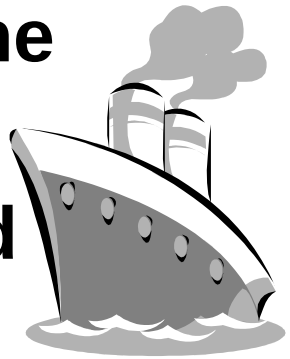
Exemptions

- **Retained the safety exemption**
- **Retained the temporary experimental research exemption**
- ***Exempted boilers used for propulsion (Steamships)***
- **Most exemptions are aligned with the auxiliary engine fuel rule**
- **Other exemptions have not changed significantly in latest proposal**



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Definitions

- ***"Steamship" definition added***
- **Other definitions have not changed significantly in latest proposal**
- **Most definitions are aligned with the auxiliary engine fuel rule**

Draft Regulatory Language

In-use operational requirements

Two Phase Approach

- ***Phase 1 July 1, 2009 In-Use Requirement***
  - *use MGO or*
  - *use MDO (0.50% sulfur limit)*
  - *main engines and auxiliary boilers*
- ***Phase 2 January 1, 2012 In-Use Requirement***
  - *use MGO [0.1 to 0.2% sulfur limit]*
  - *use MDO [0.1 to 0.2% sulfur limit]*
  - *main engines and auxiliary boilers*

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Two Phase Approach: Pros

- **Allows us to begin requirement sooner**
- **Greater emissions reductions compared to proposed single phase approach**
  - **by including auxiliary boilers and moving up start date**
- **Phase 1 MGO/MDO currently available at most ports worldwide**
- **Many stakeholders believe a two step approach will be more successful and feasible**
  - **includes many ship operators and Coast Guard**
- **Allows fuel delivery industry time to address availability and infrastructure**
- **Actual average fuel sulfur level of in-use distillates shown to be significantly lower than expected**
- **Allows shippers to use a fuel in Phase 1 in that they have had experience using on OGVs**

Two Phase Approach: Cons

- **Will require amendment to auxiliary engine rule**
- **Phase 1 fuel sulfur level and timing not consistent with EU Directive for use at berth**
- **Fuel availability may still be an issue in 2012 for [0.1 to 0.2%] sulfur distillate**

In-use operational requirements

Phase 2 fuel sulfur level: 0.1% vs. 0.2%?

- **Advantages of requiring 0.1 %S MGO/MDO**
  - **aligns with sulfur requirements for EU rules, proposed Boxer bill and EPA proposal to IMO**
  - **provides ~2% greater PM and ~4% greater SOx reductions**
- **Disadvantages of requiring 0.1 %S MGO/MDO**
  - **delivery infrastructure and availability still under evaluation**
  - **fuel properties at very low sulfur levels need additional study**

In-use operational requirements

Phase 2 fuel sulfur level: 0.1% vs. 0.2%?

- **Advantages of requiring 0.2%S MGO/MDO**
  - **better global fuel availability**
  - **aligns with POLA/POLB CAAP, proposed Boxer bill and EPA proposal to IMO**
  - **less concern with sulfur contamination in fuel delivery stream**
- **Disadvantages of requiring 0.2% S MGO/MDO**
  - **does not align with EU rules**
  - **provides slightly less emissions reductions (2% PM, 4% SOx)**

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Noncompliance Fee in Lieu of Meeting Requirements

Option to Pay Noncompliance Fee

- **Reasons beyond vessel Master's control**
  - **unexpected redirection to a California port**
  - **inability to purchase complying fuel *(provision to purchase fuel in California)***
  - **fuel found to be noncompliant enroute to California**
- **Extension needed for vessel modifications**
- **Vessel modifications needed on infrequent visitor**

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Unable to purchase compliant fuel prior to entering Regulated CA Waters

- **Provision to purchase compliant fuel in CA**
  - ***begins at Phase 2 in January 1, 2012 and ends Dec. 31, 2014***
  - ***waive noncompliance fee***
  - ***one time per calendar year per ship***
  - ***if compliant fuel is purchased and compliance begins at first port after entering Regulated California Waters***
  - ***must be meet phase 1 requirements during noncompliant portion of voyage***

Preliminary Estimates of Emission Reductions

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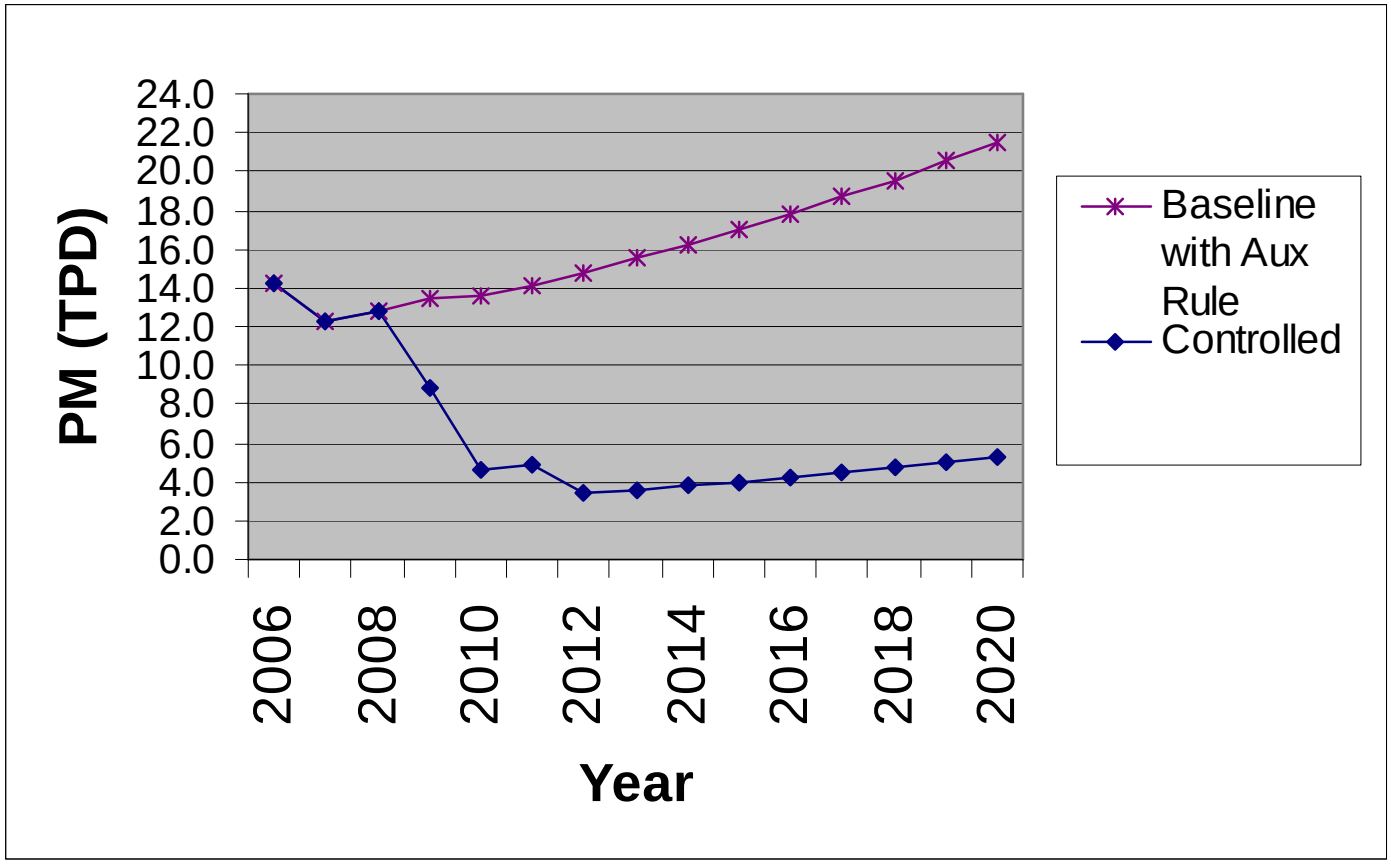
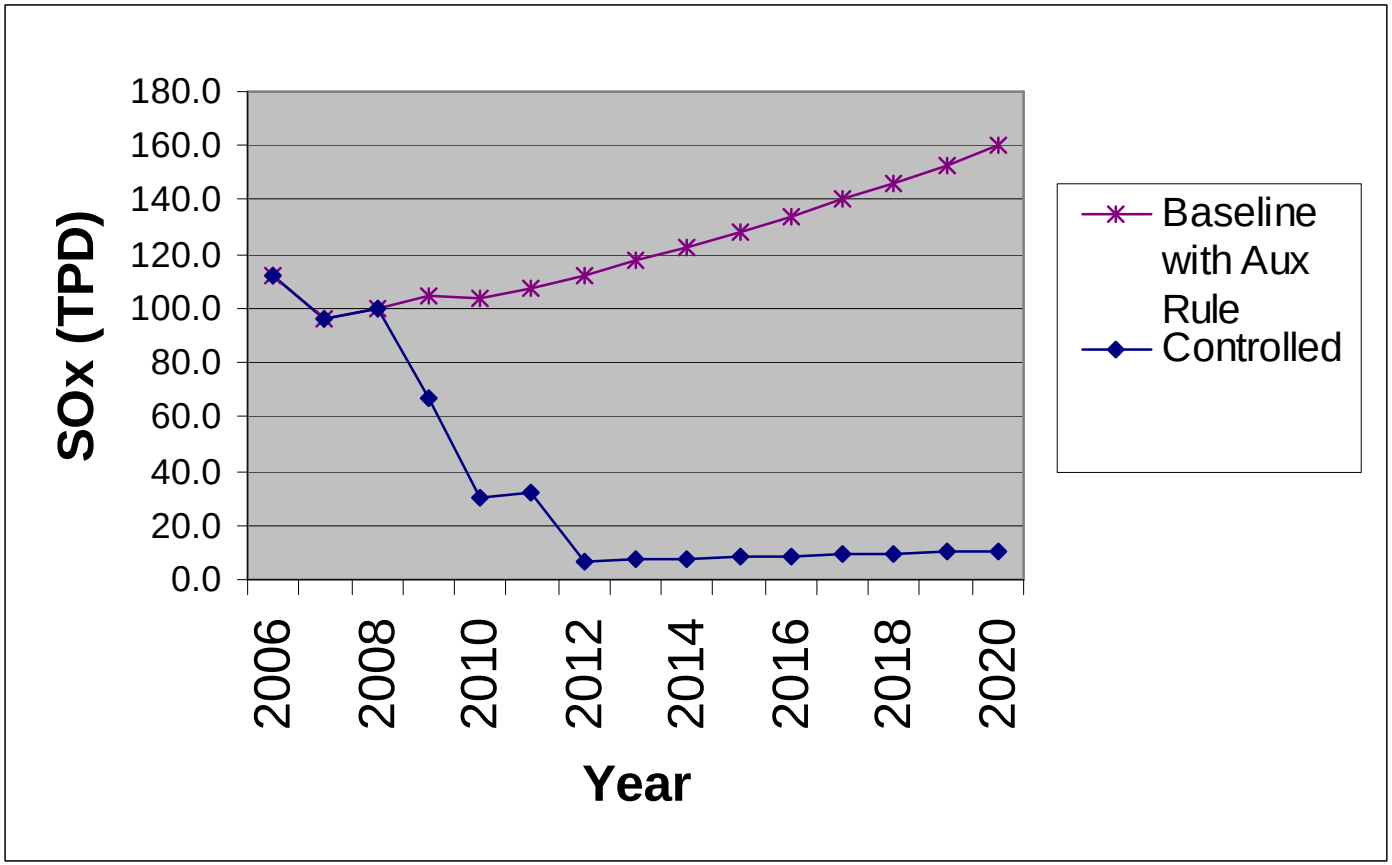
PM Emissions for Proposed Main Engines and Auxiliary Boilers (Includes Auxiliary Rule)



Baseline includes Auxiliary Engine Rule
Main Rule includes main engine and auxiliary boiler
24 NM Boundary

Preliminary Estimates of Emissions Reductions

SOx Emissions for Proposed Main Engines and Auxiliary Boilers (Includes Auxiliary Rule)



Baseline includes Auxiliary Engine Rule
Main Rule includes main engine and auxiliary boiler
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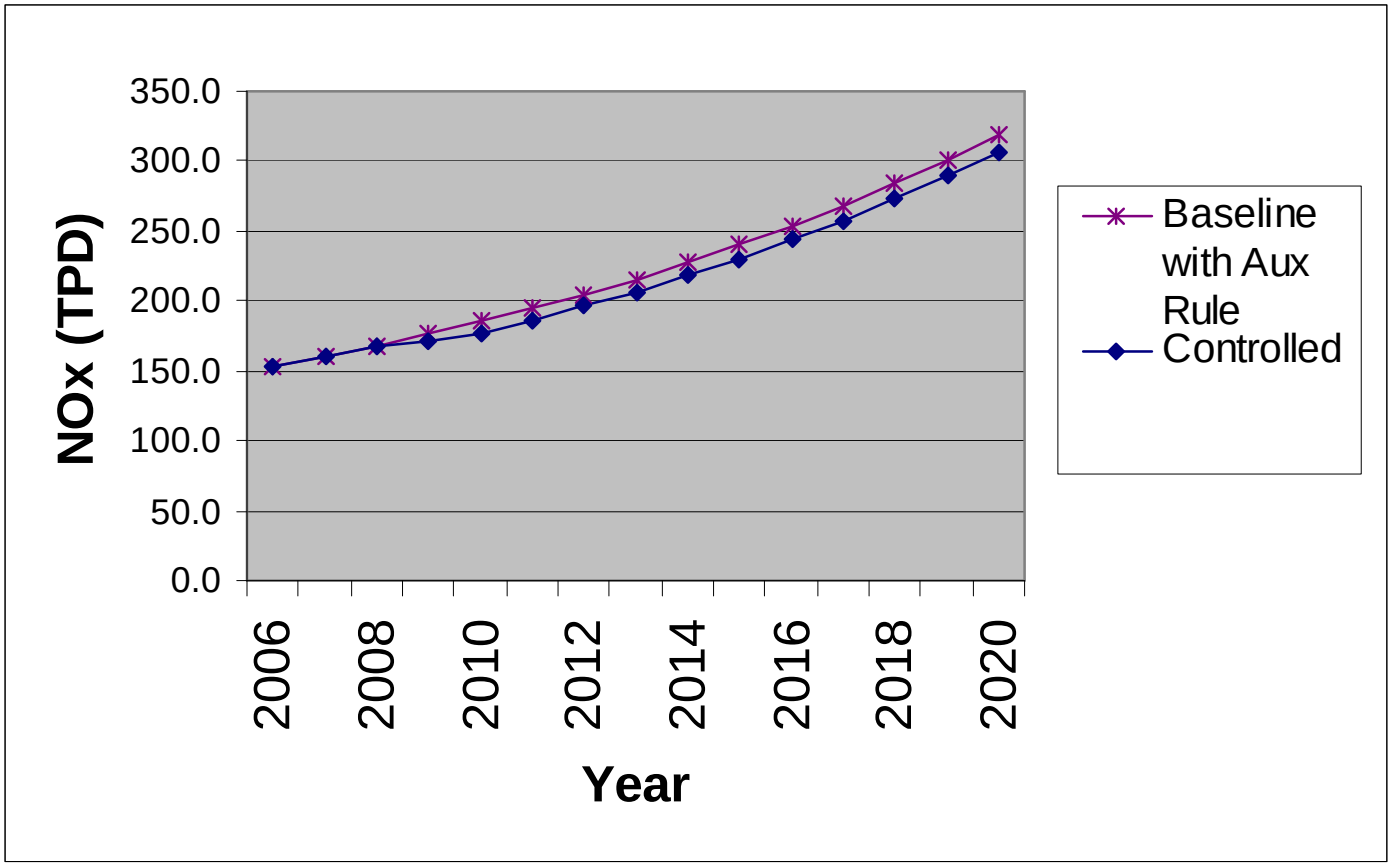
Preliminary Estimates of Emissions Reductions

NOx Emissions for Proposed Main Engines and Auxiliary Boilers (Includes Auxiliary Rule)



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Preliminary Cost and Cost Effectiveness Estimates

Preliminary Cost Estimates

Assumptions (for year 2010)

- Capital costs for vessel modifications (2006 Ship Survey)
  - **462 vessels (22%) will require retrofits to comply with rule**
  - **average retrofit cost is $215,000 per vessel annualized for 5 years**
- Fuel Costs
  - **price differential $397/tonne (Bunkerworld IFO 380 to MGO)**

Preliminary Cost Estimates

2010 Estimated Main Engine/Boiler Emissions and Fuel Usage (TPD)

	Baseline			Controlled		
Pollutant	Main	Aux Boiler	Total	Main	Aux Boiler	Total
PM10	11	1	13	2.8	0.3	3.1
NOx	129	3	132	121	3	124
SOx	76	26	102	14	9	23
CO2	4485	1522	6007	4263	1447	5710
Fuel Used	1411	479	1889	1339	455	1794

Preliminary Cost Estimates

- **Recurring annual cost (fuel): $249 million**
- **Annualized Capital Costs: $22.9 million**
- **Total Annual Cost: $272 million**
- **Cost Effectiveness-$47/lb PM**

Preliminary Cost Estimates

- **Typical added cost for a single POLA/POLB visit for a container ship is $49,500 (Main engine and auxiliary boilers)**
- **Represents ~2.4 percent of total trip cost ($2.06 million)**
- **Cost Per TEU: $9.90**
- **Regulation costs are small portion of overall ship operating cost**

Next Steps

Next Steps

- Continue technical discussions with stakeholders
- Finalize fuel availability study
- Review data from Maersk's Voluntary Fuel Switch Initiative
- Continue to investigate the impacts of changing fuels
  - lubricity study and fuel properties
  - fuel pump bench testing
  - long term study on engine Impacts
- Finalize Cost Estimates
- Board consideration – June 2008

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