Public Workshop to Consider Amendments to the Requirements for New Emergency Standby Engines in the Airborne Toxic Control Measure for Stationary Compression Ignition Engines

Sacramento, California
March 1, 2010

California Environmental Protection Agency

Air Resources Board

Overview

- Background
- Engine Manufacturers Association Request
- ARB Response and Analysis
- Potential Amendments
- Data Gaps and Next Steps

Background

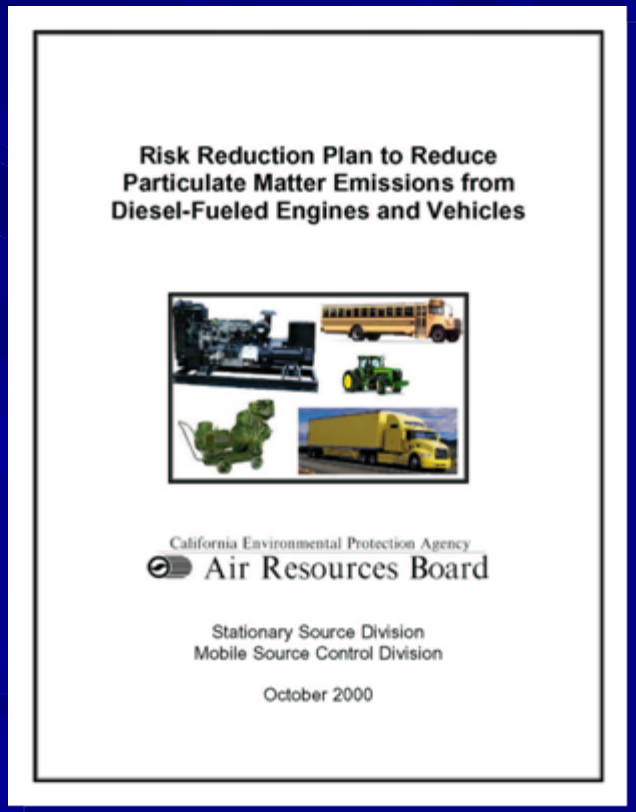
- Diesel PM and Risk Reduction Plan
- Stationary Engine ATCM
- Federal NSPS Requirements

Diesel PM is A Serious Public Health Concern

- Linked with adverse health impacts such as:
  - premature death
  - respiratory disease
  - reduced lung function in children
  - cardiovascular disease
  - cancer

Diesel Risk Reduction Plan Identifies Strategy to Reduce Diesel PM Exposure in California

- Comprehensive plan
- Three-prong approach
  - Reduce Emissions from New Engines
  - Clean-Up Existing Engines
  - Provide Low Sulfur Fuel (<15 ppm) to Enable Aftertreatment Technology
- Included measures for stationary engines



Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles

California Environmental Protection Agency
Air Resources Board

Stationary Source Division
Mobile Source Control Division

October 2000

Stationary Engine Airborne Toxic Control Measure

- Adopted by the ARB (2004) and implemented by the local air pollution control districts
- Applies to emergency standby engines and prime engines
- Establishes
  - Emission Standards and Operating Requirements
  - Fuel Use Requirements
  - Reporting Requirements
- Reduces diesel PM, NMHC, CO and NOx

ATCM Requirements for New Emergency Standby Stationary Diesel Engines

- Meet diesel PM emission limit of 0.15 g/bhp-hr or off-road engine standard, whichever is more stringent
- Meet NOx, NMHC, CO off-road engine certification standards for model year of engine
- Limit M&T hours to 50/year, no limit on emergency hours
- Direct-drive diesel fire pump engines provided 3-year extension
- More stringent requirements for emergency standby engines used in demand response programs

Federal NSPS Emission Standards for New Stationary Emergency Standby Engines

- Promulgated July 11, 2006
- Emission limits based on most stringent off-road standards that do not require after treatment
  - New engines ≥75 bhp will meet 0.15-0.30 g/bhp-hr PM and 3.0-4.8 g/bhp-hr NMHC + NOx standards
  - New engines ≥ 50 and < 75 bhp will meet 0.30 g/bhp-hr PM and 3.5 g/bhp-hr NMHC + NOx standard
- New fire pumps also not required to meet after treatment based standards

Key Differences Between NSPS and ATCM for New Emergency Standby Engines

- ATCM requires new engines to meet Tier 4 standards when they are more stringent than the 0.15 g/bhp-hr limit
  - Requires after treatment for PM (diesel particulate traps) and NOx (selective catalytic reduction)
- NSPS doesn't require after treatment
  - Most new engines will meet Tier 2 or Tier 3 for PM and NOx
  - Requires certified engines

Expected After Treatment Required Tier 4 Interim and Final

(NMHC+NOx/CO/PM in g/bhp-hr)

Maximum Power	2007	2008	2009	2010	2011	2012	2013	2014	2015+
50≤hp< 75	5.6/3.7/ 0.30	3.5/3.7/0.22					DPF		
75≤hp<100		3.5/3.7/0.30				0.14/2.5/3.7/0.01* (DPF)			DPF + SCR
100≤hp<175	3.5/3.7/0.22								
175≤hp<300	3.0/2.6/0.15				0.14/1.5/2.6/0.01* (DPF)			DPF + SCR	
300≤hp<600									
600≤hp≤750									
750hp<GEN ≤1200hp	4.8/2.6/0.15				0.30/2.6/2.6/0.07* (DPF)				DPF + SCR
GEN>1200 hp					0.30/0.50/2.6/0.07*(DPF + SCR)				

* Standards given are NMHC/NOx/CO/PM in g/bhp-hr.

Tier 2 Tier 3 Tier 4 Interim / Final

Engine Manufacturers Association Request

(Presentation by EMA Representative)

ARB Response and Analysis

ARB Actions

- Agreed to re-evaluate feasibility of Tier 4 engines for new emergency standby applications
  - Technical feasibility, emissions and costs impacts
- Formed ARB-District Workgroup
- Identified potential amendments
  - Limit amendments to new emergency standby engine requirements
  - Minor clarifications
- Not proposing any amendments to requirements for prime engines, in-use emergency standby, new and in-use ag engines

Technical Feasibility of Diesel Particulate Filters on Emergency Standby Engines

- Proven technology in E/S installations
  - ~300 installations in California
  - 16+ manufacturers make DPFs for E/S applications (9 verified by ARB for E/S)
  - Includes both passive and active systems
- May require more monitoring and maintenance
  - Ensure filters are periodically regenerated (accumulated PM is burned off)
  - Disposal of ash

DPF Costs

- Capital Cost of $38 per hp
  - Based on 2003 staff report
  - Includes equipment purchase, installation, emissions testing, permit cost
  - Recent staff analysis demonstrated cost estimate is still valid (if not somewhat high for current systems)
- Maintenance Cost of $4-$5/hp per Year
  - Based on recent staff analysis
  - Includes parts replacement, catalyst washing, labor cost to maintain DPF

Technical Feasibility of Selective Catalytic Reduction Technology on Emergency Standby Engines

- SCR technology commonplace for power plants
- Requires specific exhaust temperature and urea or ammonia injection to function
  - Catalyst not functioning during warm-up
  - Exhaust temperature 260 to 540°C
  - Urea/ammonia injected once temperature reached

Challenges with SCR on Emergency Standby Engines

- Temperature difficult to reach under typical M & T operation (low load, short time), don't realize expected NOx reductions
- Additional maintenance requirements for handling and storage of urea/ammonia
  - Degradation of urea (2 years)
  - Urea crystallization
- Size constraints

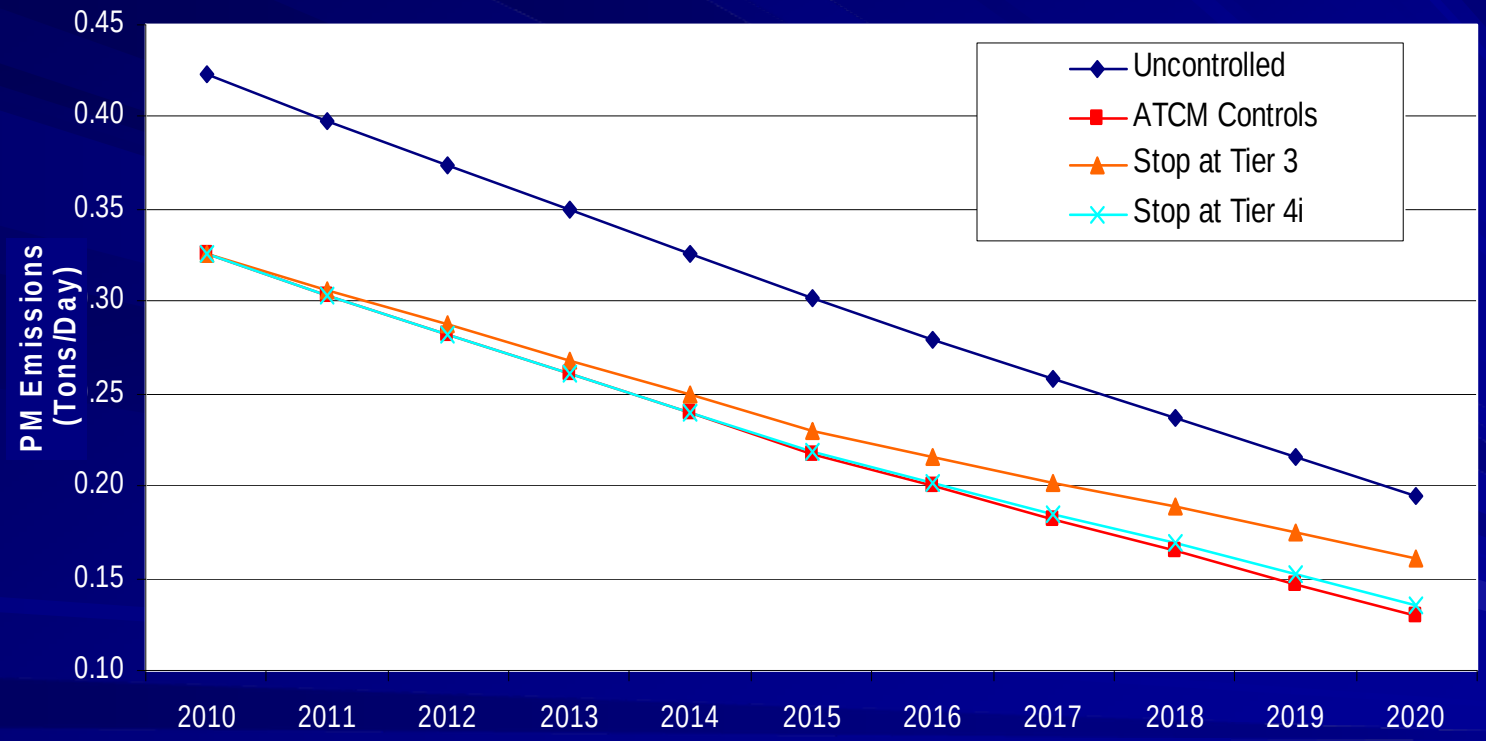
SCR Technology Not Widely Applied to Emergency Standby Operations

- No SCR systems verified for emergency standby operation
- ~10 installs in California
  - Most on very large hp engines
- Preliminary feedback on experiences to date:
  - Under full load, takes ~10 minutes to reach SCR operating temperature
  - At low loads, takes ~20-40 minutes to reach SCR operating temperature
  - Encountered problems with urea crystallization and leakage
  - Does not always reach necessary temperature during emergencies due to low loads
- SCR technically feasible but requires careful management and does not reduce NOX during typical M&T runs (low loads)

SCR Costs

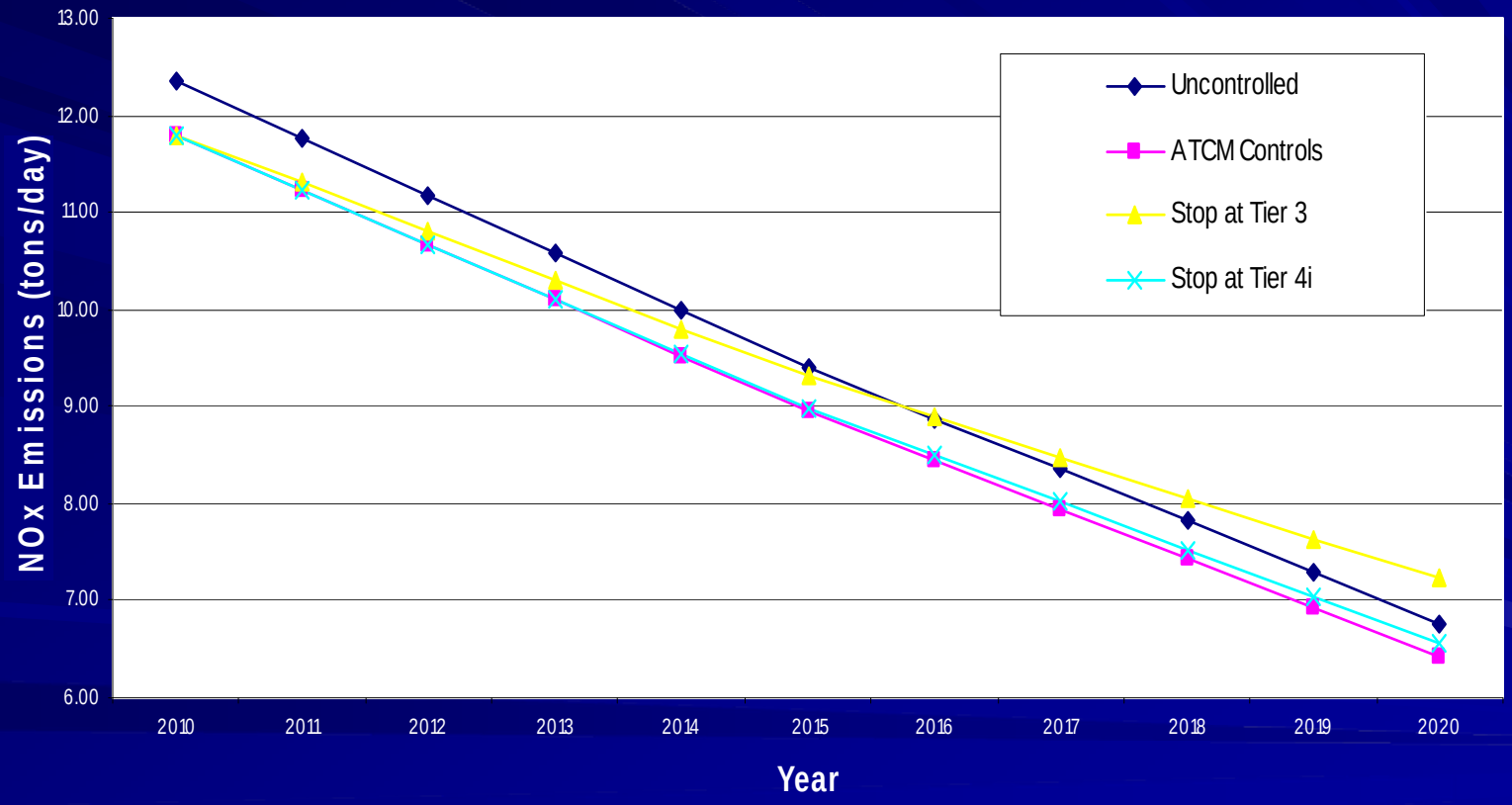
- Capital Cost of $60-150 per hp
  - Based on ARB staff investigation
  - Includes equipment purchase, installation
- Maintenance Cost of $3-$10/hp per year
  - Includes urea solution, labor, parts, and on-site testing

Comparison of Alternative Standards for New Emergency Standby Engines Diesel PM Emissions (TPD)*



* Diesel PM emissions include emissions from both prime and emergency standby engines

Comparison of Alternative Standards for New Emergency Standby Engines NOx Emissions (TPD)*



* NOx emissions include emissions from both prime and emergency standby engines

Estimated Cost Effectiveness Comparison of DPF and SCR on Emergency Standby Engines

- U.S. EPA estimated cost effectiveness as part of NSPS development
  - **Capital costs only**
  - **50 hr/year operation**
  - **Assumes 100% load**
  - **25 year DPF/SCR lifetime**
- DPF cost effectiveness = $50-350/lb PM*
- SCR cost effectiveness = $90-170/lb NOx

*CE varies with horsepower range, values based on attributing all the costs to PM for DPF and to NOx for SCR reductions

Findings

- DPFs in emergency standby applications are feasible and cost effective
- Tier 4i standards achieves important PM and NOx benefits
  - Most emergency standby engines located in populated areas that are nonattainment for federal/State ozone and PM2.5 standard
  - Retains ~85% of expected emission reductions from current ATCM
- SCR in emergency standby applications more challenging
  - Recommend limit application of SCR to very large engines
  - Revisit feasibility of SCR at future date once more experience in other applications

Potential Amendments

Proposed Amendments for Discussion

- Forego Tier 4f and require Tier 4i for new emergency standby engines
  - Preserves diesel PM reductions and health benefits
  - Retains majority of NOx reductions
  - More cost effective for operators
- Retain Tier 4f in certain applications
  - Engines in demand response programs
  - Other?
- Consider aligning with NSPS for direct drive fire pumps
  - Do not require after treatment based standards

Other Minor Amendments

- Consider extending exemption for emergency standby engines at Command Destruct sites to cover both landing and launch activities
- Identify any modifications to definitions needed to support amendments

Data Gaps and Next Steps

Data Gaps and Needs

- Data Needs
  - Feasibility and costs of obtaining UL/FM certification on direct drive fire pumps that have DPFs
  - Ability of OEM to provide engines that meet Tier 4i for emergency applications
  - Verify technology to meet Tier 4i NOx for engines > 1200 bhp
  - Identification of situations where Tier 4f appropriate

Next Steps

- Obtain additional data/information
- Additional public workshop in late May early June timeframe
- Release of Initial Statement of Reasons on June 3, 2010
- ARB Board Consideration July 22-23, 2010

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http://www.arb.ca.gov/diesel/statport.htm