Strategies to Reduce In-Use Emissions from Heavy-Duty Vehicles: Developing a Heavy-Duty Vehicle Inspection and Maintenance Program

Presentation for the North Central Texas Council of Governments (NCTCOG) Heavy-Duty Diesel Vehicle Inspection and Maintenance Working Group
April 18, 2019
Outline

• California’s emission challenges
• CARB’s existing heavy-duty vehicle (HDV) programs
• HD I/M SIP commitment, program goals
• Potential heavy-duty vehicle inspection and maintenance (HD I/M) program elements
• HD I/M program development and next steps
California Faces Greatest Air Quality Challenges in U.S.
On-Road Vehicle Emissions in California

- **NOx**
  - Heavy-Duty Diesel Trucks 14,001+ lbs, 55%
  - All Other On-Road Vehicles, 45%

- **Diesel PM 2.5**
  - Heavy-Duty Diesel Trucks 14,001+ lbs, 70%
  - All Other On-Road Diesel Vehicles, 30%

Emission Year 2023 using EMFAC 2017 Model
CARB’s Heavy-Duty Vehicle Programs

Manufacturer Engine and Vehicle Requirements
- New engine standards
- Warranty and in-use compliance
- On-board diagnostics (OBD)

In-Use Truck Rules
- Retrofits
- Accelerated Vehicle Turnover

Vehicle Inspection Programs
- Heavy-Duty Vehicle Inspection Program (HDVIP)
- Periodic Smoke Inspection Program (PSIP)

Advanced Clean Technologies
- Advanced technology rules
- Advanced technology demos
- Financial incentive and loan programs
Increasingly Stringent Heavy-Duty Engine Standards

Emission Standards for New Heavy-Duty Engines Since 1990

- Reductions in new engines standards since 1990:
  - ~97% NOx
  - ~98% PM

- 2010+ MYs equipped with aftertreatment: selective catalytic reduction systems and diesel particulate filters

- Must ensure emission controls are working properly to maintain low emissions
Heavy-Duty Vehicle On-Board Diagnostics (OBD)

• HD OBD implemented starting with 2013 model year engines (vehicles > 14,000 lbs.)
  • Emission thresholds phased-in during 2013 – 2015 model years

• Intended as tool for inspection and maintenance
  • Monitors performance of emission control systems
  • Allows for quick identification of potential emissions issues and provides diagnostic information for repairs
Current Inspection Programs

**HDVIP**: Roadside inspections by CARB enforcement staff for excessive smoke and tampering

**PSIP**: Annual self-testing for California fleets of two or more vehicles

Requires vehicles to meet opacity limits to operate in California
Board Approved HDVIP and PSIP Amendments

- DPF-equipped vehicles:
  - 5% opacity
- Non DPF-equipped vehicles:
  - 20% - 40% opacity depending on model year and technology
- PSIP voluntary OBD submittal
  - Fleets can choose to submit a vehicle’s OBD data to CARB in lieu of performing annual PSIP smoke opacity test
- Changes effective mid-2019
In-Use NOx Emissions Remain High

- Many HD vehicles operate with malfunctioning emissions controls
  - NOx emissions well above engine certification standards
- More needs to be done to reduce in-use NOx emissions
CARB’s roadside data collection
- 11% of trucks had an illuminated Malfunction Indicator Light (MIL)

Repairs are needed to keep emissions at certified level
- UC Riverside study demonstrated
  - 50% - 75% NOx reductions achieved via repairs
State SIP Strategy Commitment for San Joaquin Valley (SJV)

- SJV needs emission reductions by 2024 to meet federal ambient air quality standards:
  - 32 tons per day NOx beyond what current regulations expected to achieve
- HD I/M is one of the largest NOx reduction measures for SJV SIP 2024 target:
  - NOx reductions: 6.8 tons per day
  - PM$_{2.5}$: <0.1 tons per day
Future Program Goals

• Maintain low emissions throughout a vehicle’s life
• Ensure emissions control systems are functioning properly
• Ensure proper maintenance practices are followed
• Ensure quick and adequate repair of malfunctioning parts
Possible Program Elements

- Conduct periodic inspections
- Require periodic OBD data submission from fleets
  - Several options for OBD data collection and transmittal
- Measure real world emissions
  - Remote sensing / plume capture for “dirty screening” and program validation
- Require Certificate of Compliance to operate in California
- Hold DMV registration for non-compliant vehicles
- Encourage training and education re: diagnosing and repairing emissions systems
Possible Inspection Methods

• Periodic scans of the engine’s OBD system for malfunctions

• Remote sensing devices (RSD) / Plume capture

OBD and RSD / plume capture can work together
OBD System Inspection Options

• Kiosks
  • Drive up, plug in, and transmit data

• Station-based
  • Testing at a physical station

• Dongles
  • Transmit data via the cellular network

• Telematics
  • Fleet/vehicle software subscription service
  • Many fleets already enrolled in a telematics program

• Mobile inspectors
  • Third-party verifiers go to fleet facilities
  • Possibly via a state contractor
Remote Sensing Devices (RSD) and Plume Capture Technologies

• Emissions snapshot in real-time
• Potential uses
  • “Dirty Screen” – identify high emitters when coupled with Automatic License Plate Recognition (ALPR)
  • Program validation – monitor real-world emissions; gauge program success
Current Roadside Emissions Measurement Technologies

• **RSD**
  
  - Uses light source, light reflection, light signal detection, and signal analysis algorithm to determine emissions
    - HEAT’s EDAR system (Differential Adsorption LIDAR)
    - University of Denver’s FEAT system, or similar (IR, UV)
    - OPUS

• **Plume capture**
  
  - Exhaust is pulled through a sampling inlet to a manifold connected to analytical instruments
    - PEAQS (CARB in-house system)
    - UC Berkeley’s “overpass” system
    - On-highway measurement system (University of Denver’s HD “tent”)
Training and Education

• Fleet Owners
  • Establish education and training programs on preventative maintenance
    • Encourages fleet owners to implement best maintenance practices and perform timely repairs of malfunctioning equipment

• Mechanics/Technicians
  • Ensure that technicians are trained to diagnose and repair emissions systems for complete and durable repairs
HD I/M Program Development, Next Steps

- 1st public workshop held on February 11, 2019
- 1st external workgroup meeting tentatively mid-May 2019
- Examples of possible workgroup discussion topics:
  - OBD data and how it is currently used by fleets for preventative maintenance
  - Enforcement methods for in-state and out-of-state vehicles
  - Remote OBD data submission methods: security and fraud prevention strategies
  - Remote sensing/plume capture devices to identify high emitters and to assess program effectiveness
  - Inspection methods for non-OBD vehicles
  - Training for fleets, repair technicians, drivers
- Next public workshop: ~late summer/early fall 2019
- Board hearing: tentatively 2021
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