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Air Resources Board

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Gray Davis
Governor

DATE: May 9, 2003

TO: ALL INTERESTED PARTIES

SUBJECT: TRUCK IDLING REDUCTION WORKSHOP

The Air Resources Board (ARB) will be conducting a public workshop on June 4, 2003 to discuss a regulatory proposal to limit truck idling from new 2007 and later model year on-road heavy-duty diesel vehicles. The proposal requires on-road heavy-duty diesel vehicles (gross vehicle weight rating > 14,000 lbs.) to be equipped with idle shut down timers that will turn off the engine if it is left to idle for more than 5 minutes. The proposal allows trucks with sleepers the option to use automatic start-stop systems or other alternative idle reduction technologies. At the workshop, the ARB staff will discuss the proposal, respond to questions, and receive comments. An agenda of the workshop and a draft of the proposal are attached for your information.

The workshop details are as follows:

Date: June 4 2003
Time: 9:00 a.m. – 12:00 p.m.
Location: Annex 4 Conference Room
9528 Telstar Avenue
El Monte, California 91731

The workshop facility is accessible to persons with disabilities. If special accommodations are needed, please contact Margaret Dawson at (626) 575-6632 by May 28, 2003. Persons with hearing or speech impairments can contact us by using our Telephone Device for the Deaf (TDD) at (916) 324-9531, or (800) 700-8326 for TDD calls from outside of Sacramento. For technical questions, please contact Daniel Hawelti at (626) 450-6149 or Stephan Lemieux at (626) 450-6162. To subscribe to our mailing list, please enroll at http://www.arb.ca.gov/listserv/truckidling/truckidling.htm

Sincerely,

//s//

Robert H. Cross, Chief
Mobile Source Control Division

Attachment

California Environmental Protection Agency
Air Resources Board

Public Workshop to Discuss Proposed Solution to Reduce Truck Idling

Workshop Agenda

I. Introduction

II. Staff Presentation

III. Discussion of Staff's Proposal

IV. Public Comments

V. Item Schedule

Staff's Draft Proposal

Background:

To date, the ARB's heavy-duty emission control program has focused on engine emission standards and vehicle smoke inspection without specifically targeting idling emissions. The majority of idling emissions are from heavy-duty diesel vehicles. The ARB staff recognizes that emissions from idling trucks pose a significant air quality problem. Idling emissions are particularly significant at idling "hotspots" such as truck stops, travel centers and rest areas where truck drivers stop to rest for long hours. Also, they are significant at warehouse/distribution centers and port terminals where long waiting periods are required. The health concerns in particular become more serious when these "hotspots" are located in communities that are already disproportionately impacted by air pollution. Consequently, it is important that idling emissions are controlled from trucks.

Amount of Truck Idling

Heavy-duty vehicles (HDV) operate a significant amount of the time at idle. Truck drivers keep the engine running at idle during layover hours, to heat or cool the cab/sleeper compartment of the truck, to provide power to operate on-board appliances, and to keep the engine block and oil warm to avoid cold engine start-up problems during the winter season. Other reasons for idling include power to drive auxiliary devices, mask outside noise, and operator habit.

The motivations and truck idling practices vary among truck operators with the season and geographic locations. Little statistical data exist about the amount of truck idling. One source, a study by the Department of Energy (DOE), quoting industry sources, indicates that the average long-haul truck in the United States idles an average of 6 hours per day (h/day), 303 days a year (Stodolsky et al., 2000). However, the ARB conducted its own analysis on truck activity data and came up with significantly different estimates as explained below.

The ARB began to model idling emissions with its EMFAC2000 emissions inventory model, version 2.02 released in November of 2000. The idle time incorporated in EMFAC2000 was derived from truck activity data collected using GPS data loggers (Battelle, 1999). This idle time only included idling activity associated with idle events defined as key-on to key-off events with no appreciable distance traveled. According to this definition, the EMFAC2000 average idle time for HDVs with GVWR between 14,000 and 33,000 lbs. (medium-heavy duty vehicles) was 6 minutes per day (min/day) while that of HDVs with GVWR greater than 33,000 lbs. (heavy-heavy duty vehicles) was 13

min/day. This type of activity is indicative of a truck in queue to either pick-up or drop-off a shipment and does not represent the extended idling of trucks typically observed at truck stops, rest areas or distribution centers. The ARB then refined its analysis of the second by second activity data to include, in addition to the key-on to key-off idle events, idle events that occur before the start of a trip, idle events that occur after the end of a trip and idle events that occur in the middle of a trip. This analysis revealed that idling of heavy-heavy duty vehicles (HHDV) was underestimated in EMFAC2000. As a result, the ARB revised the average idle time of HHDVs to 105 min/day in EMFAC2002, version 2.2 released in September of 2002 (ARB, 2002). This estimate is a fleet average that includes all long-haul as well as short-haul HHDVs with idling time greater than or equal to 5 minutes, in contrast to the DOE's estimate that only applies to long-distance traveling HDDVs, which are more likely to idle for an extended period of time. With regard to medium-heavy duty vehicles (MHDV), staff has not yet modified the idle activity but it is expected to increase significantly. Thus, all emissions inventory estimates in this document are based on the EMFAC2002 model and assumes the revised average idle time of 105 min/day for HHDVs and an average idle time of 6 min/day for MHDVs.

The motivations for truck idling are varied. A pilot survey on truck idling trends, conducted in Northern California, indicate that the majority of the drivers run their engines at idle mainly for heating (67%) and air conditioning (83%) purposes (Brodrick et al., 2001). A smaller percentage of the surveyed drivers (13%) indicate they run the engine at idle for other reasons when they did not need climate control, while none of them reported they idle the engine to prevent engine start-up problems. This result indicates that in California, heating and air conditioning devices alone can be used to substantially reduce truck idling.

Emissions Impact

Idle emission rates, incorporated in California's EMFAC2002 emissions inventory model, are shown in Table 1. These emission rates, except for particulate matter emission (PM) rates, were obtained from tests conducted by West Virginia University. PM rates are taken from the U. S. EPA particulate model (PART 5 model), which are based on data collected from manufacturers (U. S. EPA, 1995) and consistent with data acquired from recent HDV testing project.

Table 1: EMFAC2002 - Idle Emission Rates (grams/hour)

	HC	CO	NO_x	CO_2	PM Idle Emission Rates	
Heavy-Duty Diesel Vehicles (all model years)	3.48	26.3	80.7	4098	Pre 1988	5.370
					1988-90	3.174
					1991-93	1.860
					1994+	1.004

Based on the above emission factors and the average idling time of 105 min/day for HHDVs and 6 min/day for MHDVs, the 2010 statewide NOx emissions attributed to idling of California registered HDVs are estimated to be 24 tons per day (Table 2). Table 2 also shows 2010 South Coast Air Basin emissions from idling trucks.

During idling, fuel consumption rates vary depending on engine speed and load on the engine. Studies have shown that, under various combinations of engine speed and heating and air conditioning loading, fuel consumption rates to vary between 0.4 to 1.2 gallons per hour (Lambert et al., 2001). MHDVs consume less fuel during idling than HHDVs, since they have smaller engines under lesser loads than HHDVs. The fuel consumption estimates in Table 2 assume diesel fuel consumption rates of 1 gallon per hour (gal/hr) and 0.6 gal/hr for idling HHDVs and MHDVs, respectively.

Table 2: Baseline Idling Emissions – CY 2010

	Statewide		South Coast Air Basin	
	MHDVs (14,001 to 33,000 lbs.)	HHDVs (> 33,000 lbs.)	MHDVs (14,001 to 33,000 lbs.)	HHDVs (> 33,000 lbs.)
CA-Registered Vehicles	200,087	150,560	77,447	57,544
NO_x (tpd)	**1.7**	**22.6**	**0.7**	**8.6**
ROG (tpd)	0.09	1.23	0.04	0.47
PM (tpd)	0.03	0.42	0.01	0.16
CO (tpd)	0.3	7.4	0.2	2.8
Diesel Fuel Consumption (gal/day)	12,005	263,480	4,647	100,702

Source:EMFAC2002, Ver. 2.2

Technology Options To Reduce Truck Idling:

A significant amount of the emissions produced and fuel consumed during idling of HDDVs can be reduced by installing one of several idle control technologies that provide heat, air conditioning and electric power. These technologies include idle limiting devices, auxiliary devices and truck stop electrification.

(a) Idle Limiting Devices

Idle limiting devices range from systems that automatically shut down an engine after a specific idle time to systems that automatically stop and restart the engine as necessary to maintain the engine and cab/sleeper temperatures, and battery voltage within pre-set limits. Most of the later model year engines have an idle shutdown timer built into their electronic control software that enables the engine to shut off if left to idle for more than the programmed time. However, in most vehicles, the shutdown timers are not activated in-use. With regard to automatic start/stop systems, they are currently offered as a factory option by several manufacturers, including Detroit Diesel Corporation, Cummins Inc., Caterpillar Inc. and Mack Trucks Inc. To date, Detroit Diesel alone has over 60,000 of these systems installed on its engines nationwide. For the automatic start/stop system to work, the driver has to set the parking brake with the transmission in neutral, and must have the ignition key in the "on" position with the hood/engine compartment closed. The system is disabled by turning off the ignition or if the vehicle is driven. Customers can choose between two options, either an "engine only" mode or a "cab comfort" mode. The "engine only" mode monitors engine oil temperature and battery voltage, while the "cab comfort" mode includes monitoring of engine mode parameters as well as cab/sleeper temperature. One drawback of this system is the periodic start/stop engine operation that can disrupt the operator sleeping in the cab/sleeper. Depending on the truck manufacturer, the system retails between $1,200 to $2,000. The aftermarket version retails between $2,000 to $2,500, installed.

(b) Auxiliary Devices

Auxiliary devices that could be used as alternatives to truck idling include direct-fired heaters and auxiliary power units (APU).

Direct-fired heaters are used to provide heat to both the cab/sleeper and engine, or just one or the other. They are small, inexpensive and consume much less diesel fuel and have a higher heating efficiency than an idling diesel engine. The drawbacks of this technology are its inability to provide cooling and its use of the truck's battery power for operation. Cost of direct-fired heaters range between $1,000 to $3,000 each.

An APU uses a small gasoline or diesel fueled engine to provide electricity to charge the truck's batteries, heat and cool the cab/sleeper compartment and heat the vehicle's engine. The fuel consumption of diesel fueled APUs range from 0.08 to 0.3 gal/hr (Stodolsky et al., 2000). This is a significant fuel savings compared to the vehicle's engine idling fuel consumption rate of 0.4 to 1.2 gal/hr. Emission reductions are also significant. Tests conducted by the U.S. EPA indicate that an APU's NOx emissions can be 89 to 94% less than an idling diesel engine (EPA420-R-02-025). The cost for an APU ranges between $5,000 to $8,000. The drawbacks are their high initial cost, additional weight and maintenance requirements.

An auxiliary power source that has a promising future in eliminating truck idling emissions is the fuel cell APU. A fuel cell produces electricity by converting the chemical energy of fuel directly to electrical power in a controlled chemical reaction. Fuel cells are clean and efficient. They can provide sufficient power to heat or cool a cab/sleeper compartment and run onboard electrical equipment. However, technical and economic issues, such as availability and infrastructure of a suitable fuel, the production costs of the units, and integration of the units with other onboard truck systems need to be overcome before these systems can become cost-effective for commercial truck operators.

(c) Truck Stop Electrification (TSE)

The development of an electrical power infrastructure at truck stops is another option to reduce idling emissions. Under this option, trucks would be provided with 110 Volt AC electrical power at truck stops to run the air conditioning, heating and onboard appliances. This requires truck stops to be equipped with electrical outlets throughout the parking spaces and trucks would need to be equipped or retrofitted with inverter/chargers and electrical power connections. The inverter/chargers are used to charge the truck batteries and to convert the truck batteries' 12V DC to 120V AC power for all onboard appliances. Currently, AC power inverters that are built into the truck are offered as a factory option by Freightliner, Volvo and International. The cost for inverter/chargers is approximately $1,400 per truck while a TSE infrastructure installation costs approximately $1700 to $2500 per truck parking space. Drawbacks of the TSE system include the high initial truck stop infrastructure cost, cost for equipment add-ons to trucks, and its availability, which is limited to truck stops only.

An alternative to the TSE system that does not need truck modifications has been recently introduced by IdleAire Technologies. This system provides 110 V AC electrical power for on-board appliances, an externally mounted, individual thermostatically-controlled, heating and air conditioning unit and hook-ups for basic telephone, internet and television (access to cable/satellite) services at each truck parking space. The unit

is connected to the truck through a console mounted to the truck window using a template insert. The console contains all the necessary connections and controls, including a card reader for the billing system. Currently, the basic services cost a driver about $1.25 per hour. The infrastructure cost is approximately $8,000 per parking space and may vary depending on number of parking spaces installed. The drawbacks are higher installation and maintenance costs and its availability limited to truck stops only.

The Proposed Solution

Emissions and fuel consumption from idling heavy-duty diesel trucks are significant, and so far, voluntary measures designed to reduce idling have not proven to be effective. In California, the negative impacts of truck idling could be minimized significantly by using one of the many available alternative technologies that provide heat, air conditioning and electricity. The ARB staff believes that the most effective idle reduction technologies are those that can be available to meet operator needs at any location idling occurs. As discussed earlier, the costs of these technologies vary widely, from $8,000 for an APU to $1,000 for the automatic start/stop system. Although the cost of these technologies can be recovered within 1 to 3 years from fuel and maintenance savings, truck owners and operators have not been receptive to these solutions. Reasons given for the low penetration of idle reduction technologies, such as the APUs, are the high initial cost, added weight and maintenance requirements. The ARB staff evaluated all the pros and cons of the available idle reduction technologies and their impacts on the California trucking business. Also, since this is a California only requirement, the ARB staff is particularly sensitive not to unduly place the California trucking business at a disadvantage relative to the 49-state trucking businesses. Cognizant of these issues, the ARB staff therefore plans to propose the following requirements:

- Require all new 2007+ model year heavy duty diesel vehicles (GVWR > 14,000 lbs.) to be equipped with an idle shutdown timer that turns off the engine after an expiration of 5 minutes of idle time. The shutdown timers must be tamper resistant and non-adjustable.

- For trucks with sleepers, allow the option for engines to be equipped with the automatic start/stop system. Under this option, the automatic start/stop system must achieve a minimum reduction of 50% idling time during ambient temperature of 95°F, under a specified cab temperature setting. This requirement may also include humidity and solar radiation load factors. To achieve this, truck manufacturers may be required to design a more efficient air conditioning system and a better insulated cab/sleeper compartment.

- Allow the option to use auxiliary power units to reduce idling. Engines used to power the auxiliary devices must meet all the truck's auxiliary power needs and meet California's emission standards for small off-road engines.

- Tie the idle limiting device as part of the heavy-duty on-board diagnostics system, to be implemented in the 2007+ model year, so that whenever there is a malfunction, the "check engine" light is illuminated.

- Incorporate a functional inspection of idle limiting devices in the Heavy-Duty Vehicle Inspection Program, commonly known as the HDVIP program.

Emissions Benefits:

The emission reductions calculated by staff assume the use of the less effective idle reduction strategies proposed and depends on the amount of idling reduced by the idle shut down timer and the automatic start/stop system. It is difficult to quantify with certainty an average reduction using these technologies as no data exist on such activity of trucks. The idle time reduced by the automatic start/stop system varies from truck to truck for many reasons. The ambient temperature and humidity are huge factors that affect the amount of idling time. For the same ambient conditions, drivers may also have widely different idling cycles simply because they prefer different temperature settings. Drivers may also differ in the rate they drain the batteries depending on the power needs to operate on-board accessories. Idling time is also influenced by the differences in the efficiencies of the air conditioning systems used by the heavy-duty truck manufacturers. Consequently, the amount of engine run time required to raise or reduce the cab/sleeper temperature by a certain amount may be different between any two trucks. Similarly, the differences in the insulating capabilities of the various cab/sleeper compartments of the heavy-duty trucks may also affect the amount of engine run time needed to achieve and maintain a desired temperature. Taking all these factors into consideration, industry sources indicate that an automatic start/stop system may reduce idle time, on average, by 50%. It is also not possible at this stage to adequately quantify the emission reductions from the proposed requirements since the number of new truck sales with sleepers in California is not known. However, data collected by staff from a few truck manufacturers indicate that trucks with sleepers account for approximately 20% of California new truck sales. Staff has used this percentage of trucks with sleepers to estimate the emission reductions from the proposed requirements. Therefore, assuming a 50% reduction with the automatic start-stop system from trucks with sleepers and a 95% reduction for the rest of the trucks with idle-shutdown timers, statewide NOx emissions would be reduced by

approximately 5 tpd in 2010 and 18 tpd in 2020. Table 3 below shows the statewide and South Coast Air Basin emission reductions in 2010, 2015 and 2020.

Table 3. Emission Reductions (tpd) from 2007+ Model Year California-registered HDVs

Assumptions:	
Percent of Trucks w/ sleepers	20%
Percent reduction using auto start/stop system	50%
Percent reduction using idle shutdown timer	95%

SOUTH COAST AIR BASIN - REDUCTIONS (TPD)
2007+ MODEL YEAR Vehicles - GVWR > 14,000 lbs.

	CY 2010			CY 2015			CY 2020		
	MHDV	HHDV	HHD+MHD	MHDV	HHDV	HHD+MHD	MHDV	HHDV	HHD+MHD
NOx	**0.13**	**1.88**	**2.02**	**0.31**	**4.44**	**4.75**	**0.49**	**6.75**	**7.24**
ROG	0.01	0.10	0.11	0.02	0.25	0.26	0.03	0.37	0.40
PM	0.00	0.03	0.03	0.00	0.06	0.06	0.01	0.08	0.09
CO	0.05	0.61	0.66	0.10	1.44	1.55	0.16	2.20	2.36
CO2	0.01	0.10	0.11	0.02	0.23	0.24	0.03	0.34	0.37

STATEWIDE REDUCTIONS (TPD)
2007+ MODEL YEAR Vehicles - GVWR > 14,000 lbs.

	CY 2010			CY 2015			CY 2020		
	MHDV	HHDV	HHD+MHD	MHDV	HHDV	HHD+MHD	MHDV	HHDV	HHD+MHD
NOx	**0.36**	**4.52**	**4.88**	**0.82**	**10.71**	**11.53**	**1.25**	**16.68**	**17.93**
ROG	0.02	0.25	0.26	0.05	0.59	0.63	0.07	0.91	0.98
PM	0.00	0.06	0.06	0.01	0.14	0.14	0.02	0.21	0.23
CO	0.12	1.47	1.59	0.27	3.49	3.76	0.41	5.44	5.85
CO2	0.02	0.23	0.25	0.04	0.54	0.58	0.07	0.84	0.91

References:

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