APPENDIX B: FLEET AVERAGE EMISSION LEVEL REQUIREMENTS
Part 2

Fleet Average Compliance Scenarios

APPENDIX B, Part 2:
COMPLYING WITH THE FLEET AVERAGE REQUIREMENTS

This section describes the fleet average concept, provides compliance strategies, and presents example compliance scenarios.

Staff is proposing fleet average emission requirements for large and mid-size fleets. The most common setting for a large fleet is a distribution facility/warehouse or a large manufacturing facility. Operators that have multiple facilities statewide will likely fall into the large fleet category as well (for example, a home improvement warehouse may only have three or four forklifts per site, but could have dozens of sites statewide). A mid-size manufacturing facility or agricultural packing warehouse is a typical example of a mid-size fleet operator.

Staff proposes that large fleets meet more stringent fleet average emission levels than the mid-size fleets because large fleets have greater flexibility and financial ability when incorporating combinations of emission-reduction strategies to achieve a prescribed level. The strategies would include zero-emission technologies (such as electric forklifts), lower-emission standards (such as new equipment certified to optional lower-emission standards), and in-use reductions (such as retrofit systems).

The fleet average emission level would be more stringent for the forklift portion of the fleet than for the non-forklift portion of the fleet. This reflects two observations. First, electric-powered forklifts are readily available for use in many applications and already comprise a major market share of California sales. The availability of electric equipment is not as prevalent in the other applications in which LSI engines are used. Second, because forklifts are the most prevalent equipment type in the LSI category, retrofit kits and new equipment certified to optional lower-emission standards is more likely to be available as fleets seek to comply with their fleet average. Non-forklift equipment covered under the fleet average includes sweepers and scrubbers, industrial tugs, and airport ground support equipment. Under the staff proposal, LSI equipment outside of these four equipment types would not be included in the fleet average due to their relatively small emissions contributions.

The fleet average would be determined for the four types LSI equipment, both forklift and non-forklift using the certification levels of 2001 and newer LSI engines and the retrofit verification levels of engines with retrofit kits. Low usage equipment, defined as equipment that is used 250 hours per year or less, would be exempted from large and mid-size fleets for the purposes of the fleet average calculation. However, the emissions from this equipment would need to be addressed through retrofit, repower, replacement, or retirement by January 1, 2011.

Small fleets are defined as those fleets with one to three pieces of equipment. A small independent lumberyard is a good example of such a fleet. Small fleets would be exempt from the fleet average requirement.

1. Fleet Average Compliance Options

Equipment users can employ a variety of techniques to achieve prescribed fleet average emission levels. New procurements can be zero- or lower-emission LSI equipment. Existing or in-use equipment can be retrofitted with one or more of the same control technologies that have been incorporated into new lower-emission LSI engines. Fleet owners may also repower older equipment with new or lower-emission used certified engines or purchase used equipment with lower-emission certified engines. Details of each of these options follow.

1.1 Zero-Emission Equipment

The simplest and most effective way to reduce a fleet's average emission level is through procurement of zero-emission equipment, especially forklifts. Electric forklifts are most typically used in indoor materials handling applications that do not require large lift capacities (i.e., warehouse/retail operations). Applications where electric forklifts are used extensively include confined spaces, cold storage and food retail (primarily grocery stores).

Although electric forklifts are primarily designed for indoor operations, a number of manufacturers are also including equipment features that enable electric models to be used in a wider variety of environments. These features include pneumatic (air filled) tires that allow the forklift to be used on unimproved surfaces, waterproof trucks and sealed electronics compartments to make them water resistant for outdoor conditions, and alternating current motors that provide greater lift and travel speeds. Electric forklifts compete directly with LSI forklifts for many of the same work applications.

Electric forklifts have no exhaust emissions and extremely low upstream (power plant) emissions. Thus, electric forklifts can provide significant air quality benefits. The Electric Power Research Institute (EPRI) has prepared several reports on electric forklifts that identify other benefits in addition to improved air quality. Electric forklifts can have lower life-cycle costs when compared with LSI models. This is due to lower maintenance costs, lower fueling costs, and a longer useful life. Although the initial capital cost of an electric forklift is higher than that of a comparable LSI forklift, the incremental cost can be recovered during the useful life. Because of the financial benefits to the end user, electric forklifts are already prevalent in some markets.

Electric forklifts include electric motor trucks with cushion or pneumatic tires (referred to as Class 1 forklifts); electric motor narrow aisle trucks (Class 2); and electric hand trucks or hand/rider trucks (Class 3) (ITA, 2005). Class 1 electric forklifts are available in a wide variety of lift capacities from 3,000 pounds to 20,000 or more pounds. According to market data evaluated by the ARB, most Class 1 forklifts sold today in the U.S. are in the 3,000-6,000 pound lift capacity range. Class 1 forklifts typically perform duties similar to LPG-powered Class 4 and 5 forklifts. The use of Class 2 forklifts has the added benefit of allowing warehouses to more easily convert to cost-saving narrow aisle operation. For the purposes of calculating the fleet average, fleet owners would be

able to assign an emission level of zero (0.0) to Class 1 and Class 2 forklifts. Fleet operators would not be allowed to count Class 3 trucks toward their fleet average, because Class 3 trucks do not traditionally replace Class 4 or 5 forklifts.

In general, an electric forklift can operate from one to two shifts before needing to be recharged. Some multi-shift operations employ battery swapping or fast charging to support the use of a 100 percent electric fleet. However, staff recognizes that facility or duty-cycle constraints may preclude some users from moving toward a 100 percent battery electric fleet.

In the future, another zero-emission option, the fuel-cell forklift, is expected to be commercially available. Numerous fuel-cell, battery, and traditional industrial truck manufacturers are now partnering to integrate fuel cells into industrial truck operations. Several of these partnerships are expecting to commercialize their technologies in the next several years. Benefits of fuel-cell and opportunity fast charging technologies include time-savings from the elimination of battery changes, no loss in lift capacity or drop in power as the shift progresses, and, in the case of fast charging, longer battery life. Also, with fuel-cell forklifts, dedicated battery-charging areas can be eliminated, freeing up valuable floor space.

1.2 New Equipment Certified to Optional Lower-emission Standards

The zero-emission options discussed above will not meet the needs of all operators. However, fleet operators can still achieve the fleet average standards through procurement of new lower-emission equipment that is cleaner than both the current and future standards. Based on current certification data as well as discussions with manufacturers, ARB staff believes that LSI manufacturers will be able to offer forklifts at emission levels significantly below these current standards. A discussion of the technologies expected to achieve even lower levels is contained in section 4 of the staff report.

Under the proposal, model year 2007 and subsequent engines could be certified to optional tiered new engine standards of 0.1, 0.2, 0.4, 0.6, 1.0, and 1.5 g/bhp-hr. A January 20, 2005, Manufacturers Advisory Correspondence already provides that manufacturers can voluntarily certify their 2005 and 2006 model year engines to these interim lower-emission standards up to 2.0 g/bhp-hr, and one major manufacturer has already submitted two engine applications to the ARB for early certification to the 2.0 g/bhp-hr level. These engines will provide equipment users with greater flexibility in meeting the proposed fleet average emission levels.

1.3 In-Use Controls

One of the most expedient ways to reduce LSI fleet emissions is to retrofit in-use engines. This entails modifying or upgrading components on the engine and/or fuel system with ARB verified retrofit emission control systems. An example of a retrofit emission control system is a closed-loop fuel control system coupled with a three-way

catalytic converter, which could be added at the time of scheduled engine maintenance. Such systems have demonstrated an ability to reduce emissions by 75 percent or more.

As an alternative to retrofits, LSI equipment users may repower or replace existing engines or equipment with new engines or used equipment that are certified to lower-mission standards. By using this strategy the users would have the option to either replace their in-use uncontrolled engine with an engine that is certified to a 3.0 g/bhp-hr HC+NOx or lower-emissions standard, or purchase a used piece of certified equipment. Both of these are cost-effective strategies for lowering emissions from in-use equipment.

2 Fleet Average Compliance Scenarios

The main advantage of the proposed fleet average requirement is that it allows individual fleet users the flexibility to tailor their compliance strategy to the specific needs of their fleet. Some fleets may decide to purchase additional electric forklifts, others may prefer to modernize their fleet, and still others may pursue lower-emission equipment. Some fleets, primarily those with a substantial percentage of electric equipment, may not need to take any additional steps. Given this flexibility, it is impossible to precisely determine how fleets will comply. However, the staff has developed a few scenarios for illustrative purposes.

One factor that will significantly impact a fleet average value is the number of uncontrolled LSI engines. Uncontrolled forklifts have emissions of approximately 12 g/bhp-hr HC+NOx, while controlled LSI equipment meets a level of 3.0 g/bhp-hr. Uncontrolled engines were phased out by 2004, but some 2004 equipment was equipped with uncontrolled engines from the 2003 model year. The scenarios discussed below assume that by 2009, fleets have no uncontrolled equipment, i.e., all uncontrolled equipment has been retrofitted, repowered, replaced, or retired. The scenarios also assume an average fleet turnover of seven years. According to ARB's inventory, over 88 percent of the forklifts within California are seven years old or newer. Operators of fleets with a shorter fleet turnover rate (more modern fleets) will likely find it easier to comply with the requirements, while those with fleets with a longer turnover rate (older fleets) will likely have to take additional measures to comply.

By January 1, 2009, without being subject to fleet standards, a typical baseline fleet with a uniform seven-year turnover rate that has converted its uncontrolled equipment and has no electric equipment would have a fleet average of 2.7 g/bhp-hr HC+NOx. As proposed in Table 3.0, a large fleet would be required to meet a standard of 2.4 g/bhp-hr and a mid-sized fleet would be required to meet a standard of 2.6 g/bhp-hr.

2.1 Large Fleets

Under the staff proposal, large fleets would need to meet a fleet-average emission requirement of 2.4 g/bhp-hr by January 2009. The simplest and most effective way to meet the requirement would be to establish a modest electric equipment component. A

fleet could achieve the 2.4 g/bhp-hr requirement by ensuring that approximately 11 percent of the equipment procured annually since 2002 is electric.

Fleets would not have to rely on electric equipment to meet the fleet average requirement - they can also comply by procuring lower-emission equipment. Newer fleets (those that more routinely replace older equipment) would have the easiest time complying with the requirements. Older fleets with longer turnover rates would have to be more aggressive in their procurement of lower-emission equipment to comply with the requirements. A fleet with a seven-year procurement cycle (and no electric equipment) could meet the proposed January 2009 fleet average standard of 2.4 g/bhp-hr standard by procuring 2.0 g/bhp-hr equipment in 2006 (one year early) and cleaner 1.0 g/bhp-hr equipment in 2008.

To meet the proposed 2011 fleet average requirement of 1.7 g/bhp-hr, a fleet would have to reduce their fleet average by 23 percent over the 2011 baseline. Again, the easiest way for a fleet to achieve the requirement is to incorporate electric equipment. A fleet with uniform turnover and a 23 percent electric component beginning in 2004 would meet the requirement. A fleet choosing not to incorporate any electric equipment would need to be more aggressive in their purchasing of lower-emission equipment. In addition to what they had done to meet the 2009 fleet average requirement, a fleet with a typical seven-year turnover rate would have to procure 1.0 g/bhp-hr equipment in 2009.

Finally, to meet the proposed 2013 fleet average requirement of 1.1 g/bhp-hr, a fleet would have to reduce their fleet average emission level by 27 percent over the 2013 baseline. As such, a fleet that incorporated a 27 percent electric component into their normal procurement cycle beginning in 2006 could meet the requirement. A fleet choosing not to incorporate any electric equipment would need to continue being more aggressive in their procurement of lower-emission equipment. In addition to what they had done to meet the 2009 and 2011 fleet average requirements, the fleet with a seven-year procurement cycle would have to additionally procure 0.4 g/bhp-hr equipment in 2012.

2.2 Mid-Size Fleets

Under the proposal, mid-size fleets would need to meet a fleet average emission level requirement of 2.6 g/bhp-hr. As with large fleets, mid-size fleets may meet the requirement through procurement of electric or lower-emission equipment. Since mid-size fleets may have less flexibility than large fleets have, their requirements are less stringent. Thus, they can comply with a smaller electric component or longer procurement cycle.

A typical mid-size fleet may achieve the 2.6 g/bhp-hr requirement with a uniform seven-year turnover rate by procuring four percent electric equipment each year beginning in 2002. The same fleet may also meet the standard without incorporating any electric equipment as long as they are on a typical seven-year procurement cycle

and procure 2.0 g/bhp-hr equipment in 2006 (one year early). A fleet choosing to be on a longer eight-year procurement cycle would have to be more aggressive, procuring 2.0 g/bhp-hr equipment in 2006 and 1.5 g/bhp-hr equipment in 2008.

To meet the proposed 2011 fleet average requirement of 2.0 g/bhp-hr, a fleet would have to reduce their fleet average by nine percent over the 2011 baseline. A fleet with uniform turnover and a nine percent electric component purchase beginning in 2004 would meet the requirement. A fleet choosing not to incorporate any electric equipment might need to be more aggressive in purchasing lower-emission equipment. In addition to actions taken to meet the 2009 fleet average requirement, the fleet with a seven-year turnover rate would need to continue to procure complying equipment. The fleet with an eight-year turnover rate would have to procure 1.0 g/bhp-hr equipment in 2009 (in addition to what they had done to meet the 2009 fleet average requirement).

Finally, to meet the proposed 2013 fleet average requirement of 1.4 g/bhp-hr, a fleet would have to reduce their fleet average emission level by 7 percent over the 2013 baseline. As such, a fleet that incorporated a 7 percent electric component purchase into their normal procurement cycle beginning in 2006 could meet the requirement. A fleet on a six-, seven-, or eight-year procurement cycle could still comply with the requirement without incorporating any electric equipment and without procuring lower-emission equipment after 2009 as long as they had procured appropriate lower-emission equipment to meet the 2009 and 2011 requirements.

2.3 Non-Forklift Fleets

The fleet standards for non-forklifts are set to be conservative while still requiring the fleet to retrofit, repower, or retire uncontrolled equipment. This allows compliance with the fleet average through a steady turnover of the fleet with an eight-year life. It also allows for some non-availability of retrofit systems in the early years. Any availability of equipment meeting optional lower-emission standards in this category will make compliance with the proposed standards easier.