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## Proposed LSI Regulatory Concepts (May 17, 2004)

Mail-out 04-10, dated April 30, 2004, describes the efforts of the Air Resources Board (ARB) to develop regulations to control oxides of nitrogen (NO<sub>x</sub>) and hydrocarbon (HC) emissions from Large Spark Ignition (LSI) equipment. As described in the mail-out, staff will be conducting the first LSI regulatory development workshop on May 26, 2004. Detailed below is additional information, including staff regulatory concepts, for discussion at the workshop.

At the April 21, 2004 LSI Engine Workgroup meeting, ARB staff presented potential regulatory options that could be used to reduce emissions from off-road LSI engines greater than 25 horsepower. Staff developed those options based upon research materials and information received from the major constituencies within the working group – the propane industry, the engine manufacturers, control device manufacturers, and zero emission forklift proponents – through three prior working group meetings and dozens of conference calls. The options presented included requirements for:

- the purchase or use of electric forklifts,
- the retrofit, re-power, or retirement of in-use LSI engines,
- the establishment of a user or manufacturer fleet average,
- the promotion of advanced technologies,
- the establishment of more stringent emission standards for new LSI engines, and
- the retrofit of certain diesel forklifts.

Staff has combined elements of several of these options into three proposed regulatory concepts for consideration. Those concepts are: a Manufacturer Lower Emission Standard, an Electric Forklift Requirement, and a Fleet Average Requirement. All of these concepts additionally require some form of fleet retrofits. Each of the concepts is discussed in detail below.

### **Manufacturer Lower Emission Standard and Retrofit Requirement**

#### *Summary*

The Manufacturer Lower Emission Standard would require engine manufacturers to meet a 2.0 gram per brake horsepower-hour (g/bhp-hr) NO<sub>x</sub>+HC certification standard in 2007 and 2008 for off-road LSI engines 25 horsepower and greater. This requirement is consistent with current requirements implemented by the United States Environmental Protection Agency (U.S. EPA). This concept would also require a 1.0 g/bhp-hr certification standard in 2009 and beyond. Staff is also considering setting this standard at the U.S. EPA 'Blue Sky' emission level, but with additional time for compliance.

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In addition to requiring manufacturers to meet a lower emission standard, this concept would require that fleets retrofit uncontrolled in-use LSI engines. Specifically, fleets of more than three units would be required to reduce emissions of all uncontrolled engines to either meet a 3.0 g/bhp-hr NO<sub>x</sub>+HC emission level or a baseline emissions reduction of 80 percent. This will be referred to as a Level 2 Emission Reduction. All uncontrolled LSI engines would be required to have a Level 2 Emission Reduction retrofit, a re-power, or be retired by the end of 2008.

Small fleets of one to three units would have until the end of 2010 to achieve a Level 2 Emission Reduction for all uncontrolled LSI engines, again through the use of retrofit, re-power, or retirement.

As a lower cost retrofit compliance option, staff is also proposing to establish a Level 1 Emission Reduction retrofit (typically a catalyst only installation) at a 15 percent NO<sub>x</sub> reduction. In recognition of the decreased emission benefit of a Level 1 Emission Reduction retrofit, staff would require that any LSI engine retrofitted to achieve a Level 1 Emission Reduction must be either upgraded to a Level 2 Emission Reduction or retired by the end of 2010.

For leased equipment, staff is considering that the term “fleet” applies to the equipment owner (the lessor). This may make enforcement more difficult since the LSI engines are widely disbursed, but lessees may not be in the position to modify equipment they don't own. Any final retrofit requirements will take the effect of typical three to five year lease cycles into consideration.

### *Discussion*

A preliminary technical analysis of the potential for LSI engines to meet lower emission standards indicates that these standards are likely to be feasible and cost-effective. In addition, this concept is the most straightforward and is analogous to most ARB regulations – develop and implement lower emission standards as they become technologically feasible and cost-effective. Consequently, this concept is also likely to be the easiest to enforce. This concept, however, raises several issues and concerns. First, as emission standards become lower, it becomes more critical to ensure that fuel quality meets mobile source specifications. Some concerns of poor fuel quality remain, which could create in-use compliance issues for this equipment at lower emission levels. In addition, manufacturers of LSI engines and equipment have encouraged ARB and U.S. EPA to have consistent standards in order to lower their compliance costs. This concept would create lower California standards starting in 2009.

A rigorous retrofit requirement will be a necessity in any regulatory concept. On average, uncontrolled LSI engines (all equipment prior to 2001 and some equipment from 2001 through 2003) have emissions greater than 12 g/bhp-hr

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NO<sub>x</sub>+HC. Current LSI engines have emissions of 3.0 g/bhp-hr and in 2007 the U.S. EPA requirement lowers that to a maximum of 2.0 g/bhp-hr. It is apparent that the uncontrolled LSI engines and forklifts contribute a significantly disproportionate share of emissions per unit compared to current forklifts.

Staff estimates that Level 2 Emission Reduction retrofit equipment, consisting of a three-way catalyst and a closed-loop system would cost approximately \$3,000. This would provide cost-effective emission benefits within 1-2 years of use. A Level 1 Emission Reduction system would cost significantly less than a Level 2 Emission Reduction system, and would also be cost-effective within one to two years of use.

### **Electric Forklift Requirement and Retrofit Requirement**

#### *Summary*

The Electric Forklift Requirement would apply to fleet owners. Under this concept, fleets of three or more would be required to increasingly convert their fleet to electric units. Specifically, staff assumes that the electric component of the fleet would grow, in 10 percent increments, from 2007 until 2010. The fleet would be required to remain at 40 percent electric beyond 2010.

**Fleet Electric Composition**

Year	2007	2008	2009	2010
Electric Composition (percent)	10	20	30	40

As with the Manufacturer Lower Emission Standard, fleets would have to achieve a Level 2 Emission Reduction for their uncontrolled LSI engines by the end of 2008 through the use of retrofit, re-power, or retirement. Fleets could also choose to utilize a Level 1 Emission Reduction retrofit but would be required to either upgrade the forklift to Level 2 Emission Reduction or retire it by the end of 2010.

Small fleets would be exempt from the electric procurement requirement, but would be required to achieve a Level 2 Emission Reduction for their uncontrolled LSI engines by the end of 2010 through the use of retrofit, re-power, or retirement.

#### *Discussion*

The requirement for the purchase of electric forklifts appears to be technologically feasible in most circumstances as well as cost-effective. However, the requirement raises pragmatic issues. Although many fleets do run all-electric equipment in a wide variety of applications, staff believes some

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facilities cannot reasonably be expected to convert to electric forklifts due to infrastructure or other working environment constraints. Staff envisions that if an electric forklift requirement is pursued, there would need to be an alternative compliance option for these fleets. One alternative compliance option would link this requirement with a lower emission standard, i.e., fleets that did not meet the percentage electric requirement could only operate equipment meeting low-emission standards. Another alternative compliance option would be to combine with a stringent fleet average emission requirement (as described below) that could only be met through the use of forklifts meeting low-emission standards.

The Electric Forklift Requirement could pertain only to fleets operating in areas with severe or extreme ambient air quality non-attainment status. Staff also envisions that fleets opting to replace more than 10 percent of their fleet each year with electric forklifts could be exempt from requirements to retrofit in-use uncontrolled LSI engines provided that the uncontrolled LSI engines would all be replaced with compliant units by 2010.

### **Fleet Average Requirement**

#### *Summary*

The final concept staff is considering is a Fleet Average Requirement that applies to the fleet owner. Under this requirement, progressively more stringent fleet emission levels would be implemented. Fleet owners would have flexibility to meet the requirement with any combination of retrofits, conventional engines, lower-emission engines, and zero-emission forklifts in order to achieve the levels prescribed in the following table.

Year	2007	2010	2015
Intermediate Fleets (4 to 25 units)	3.0	2.0	1.5
Large Fleets (26 or more units)	2.5	1.5	1.0

Staff is still reviewing the intermediate fleet emission level requirement, which is currently less stringent than the requirement for large fleets, to see if the levels are appropriate.

Small fleets would be exempt from the fleet average component of this concept, but would be required to achieve a Level 2 Emission Reduction for all uncontrolled LSI engines through the use of retrofit, re-power, or retirement by the end of 2010.

Smaller electric forklifts such as the Class 3 hand or hand/rider trucks or pallet trucks would be excluded from the fleet average.

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### *Discussion*

The benefit of the fleet average emission level requirement is to provide the LSI fleet owner with additional flexibility. Fleet managers decide which of several options will allow them to meet the requirement while best suiting their operations. Take, for example, a large fleet with a five-year turnover. The fleet owner, deciding that electric forklifts could be incorporated into the fleet's operations, could meet the 2007 requirement of 2.5 g/bhp-hr solely by ensuring that 11 percent of their fleet is electric and that any uncontrolled forklifts are retrofitted. Alternatively, the same fleet owner could determine that electric forklifts were not feasible for the fleet's operations. The fleet owner could instead meet the 2007 requirement by ensuring that all equipment procured through normal purchase activities met a 2.0 g/bhp-hr emission level in 2006 (introducing the U.S. EPA requirement one year early) and 1.5 g/bhp-hr emission level in 2007.

Similarly, a fleet owner planning to use electric forklifts to meet the 2010 requirement of 1.5 g/bhp-hr could do so with a fleet that was no greater than 32 percent electric, lower if sub-2.0 g/bhp-hr LSI equipment were available in the years 2007 through 2010. The non-electric fleet owner could also meet the 2010 requirement through a continued procurement of low emission equipment as introduced above. 2008 and 2009 procurement would have to continue to meet the 1.5 g/bhp-hr emission level; 2010 procurement would have to meet a 1.0 g/bhp-hr emission level.

Finally, the fleet owner planning to use electric forklifts to meet the 2015 requirement of 1.0 g/bhp-hr could do so with a fleet that was 50 percent electric. Again, this number would be lower if sub-2.0 g/bhp-hr LSI equipment were available in the years 2011 through 2015. The non-electric fleet owner could meet the 2015 requirement through the purchase of equipment meeting a 1.0 g/bhp-hr emission level from 2011 through 2015. That means some equipment could exceed that level if federal Blue Sky or lower emission equipment were available.

The fleet average concept has several clear advantages and several clear concerns. From a fleet users standpoint, this concept provides the most flexibility and compliance options. Those fleets that choose to use primarily electric will easily comply with the proposed standards. Those that choose to remain with internal combustion lifts can achieve the same emission reductions through other mechanisms. However, that flexibility would also make this concept the most difficult for the fleet owner in terms of compliance. While a Manufacturer Lower Emission Standard would be transparent to the fleet owner, the fleet average concept would require some research, planning, paperwork and reporting. In addition, since manufacturers would not be required to produce low-emission forklifts, the fleet owner would be counting on market forces to entice manufacturers to voluntarily certify and sell a low-emission forklift.

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From an air quality standpoint, this concept raises an enforcement concern. Auditing thousands of fleets is not a practical option. Therefore, the ARB would need to maintain a strong outreach to fleets as well as rely on random audits and strong enforcement penalties to ensure compliance.

### **Additional Concepts**

The following concepts are being highly considered by staff; however, at this time, it is not clear how the concepts would be integrated into the above concepts.

While primarily intended to address forklifts – which contribute more than three-quarters of non-preempted uncontrolled LSI emissions – where practical, the regulations would also be applied to other types of LSI equipment like sweepers, tractors, tugs etc. based on their existence in fleets and number of units.

An additional component of any of the three concepts is a requirement that diesel forklifts, below a lifting capacity not yet established, achieve a Level 3 particulate matter (PM) reduction as specified by the diesel retrofit verification protocol. It may be appropriate to add diesel forklift requirements to this rulemaking in order to address all forklifts in one rulemaking package. The diesel forklift requirements would discourage fleet owners from purchasing diesel forklifts to avoid the other proposed requirements, but could also provide fleet owners with more options in a fleet average scenario.

To ensure progress continues toward greater penetration of zero and near-zero forklifts, a requirement could specify that equipment manufacturers demonstrate advanced technology. Such a demonstration might include fuel cell forklifts, advanced electric forklifts or near zero forklifts (e.g., 0.1 g/bhp-hr NO<sub>x</sub>+HC).

Staff is interested in comments relevant to all of the concepts proposed.

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