

# Validation of Technologies to Reduce Emissions at Ports

White Paper #2

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This white paper is one of a series written for the U.S. EPA, Sector Strategies Program, in support of its partnership with the American Association of Port Authorities (AAPA). AAPA's Harbors, Navigation, and Environment Committee has expressed a desire to work collaboratively with EPA to address the issues discussed in this paper. The purpose of this white paper is to clarify current practice and concerns and to propose recommendations for follow-on activities that will support improved environmental performance.

## **1. Introduction**

Marine vessels emit large amounts of nitrogen oxide (NO<sub>x</sub>) and particulate matter (PM) emissions. In 2001, marine vessels accounted for 8 percent of the mobile source NO<sub>x</sub> emissions and 9 percent of the mobile source fine particulate (PM-2.5) emissions nationwide.<sup>1</sup> Marine emissions at ports are generally classified as off-road or non-road mobile emission sources. Marine emissions are primarily from diesel engines operating on ocean going vessels, tugs and tows, dredges, and other vessels operating within a port area. Land-based port emissions can also be significant. Land-based port emission sources include yard tractors, cranes, container handlers, and forklifts, as well as heavy-duty trucks and locomotives operating within a port area.

Marine vessels and port handling equipment can offer opportunities for emission reduction strategies. The Environmental Protection Agency (EPA) allows states to take credit for such emission reductions in their state implementation plans (SIPs), if such reductions can be proven. If a state claims a reduction in a SIP that doesn't materialize, it must make up the emission reductions from other sources. It is unlikely that states will claim emission reductions that have not already been verified by either the EPA or the California Air Resources Board (ARB). Verification of emission reductions may also be needed by ports to fulfill their voluntary emission reduction efforts or as part of a general conformity determination.<sup>2</sup>

Technology verification can be accomplished through EPA's Environmental Technology Verification (ETV) process or ARB's Diesel Emissions Control Strategy Reduction Procedure.<sup>3</sup> These procedures verify the emission reductions for a given technology when used on a given engine family and certify those results. Without such validation from either EPA or ARB, ports and states take a risk that such technology will not provide the emission reductions that they claim and that the reduction will have to be made up through other methods.

In this white paper, the EPA and ARB verification processes are discussed and contrasted. Since most states want verified technologies used in SIP emission reductions, the cost and difficulty of verifying new technologies is an issue. This paper is intended to help port officials and air agencies understand the processes involved and makes recommendations as to improvements in the processes.

## **2. EPA's Environmental Technology Verification Process (Voluntary)**

This section summarizes the EPA ETV process that applies to port emissions sources – specifically, the ETV process that works in conjunction with the Office of Transportation and Air Quality's (OTAQ) Voluntary Diesel Retrofit Program (VDRP). Technology must be verified for each engine family on

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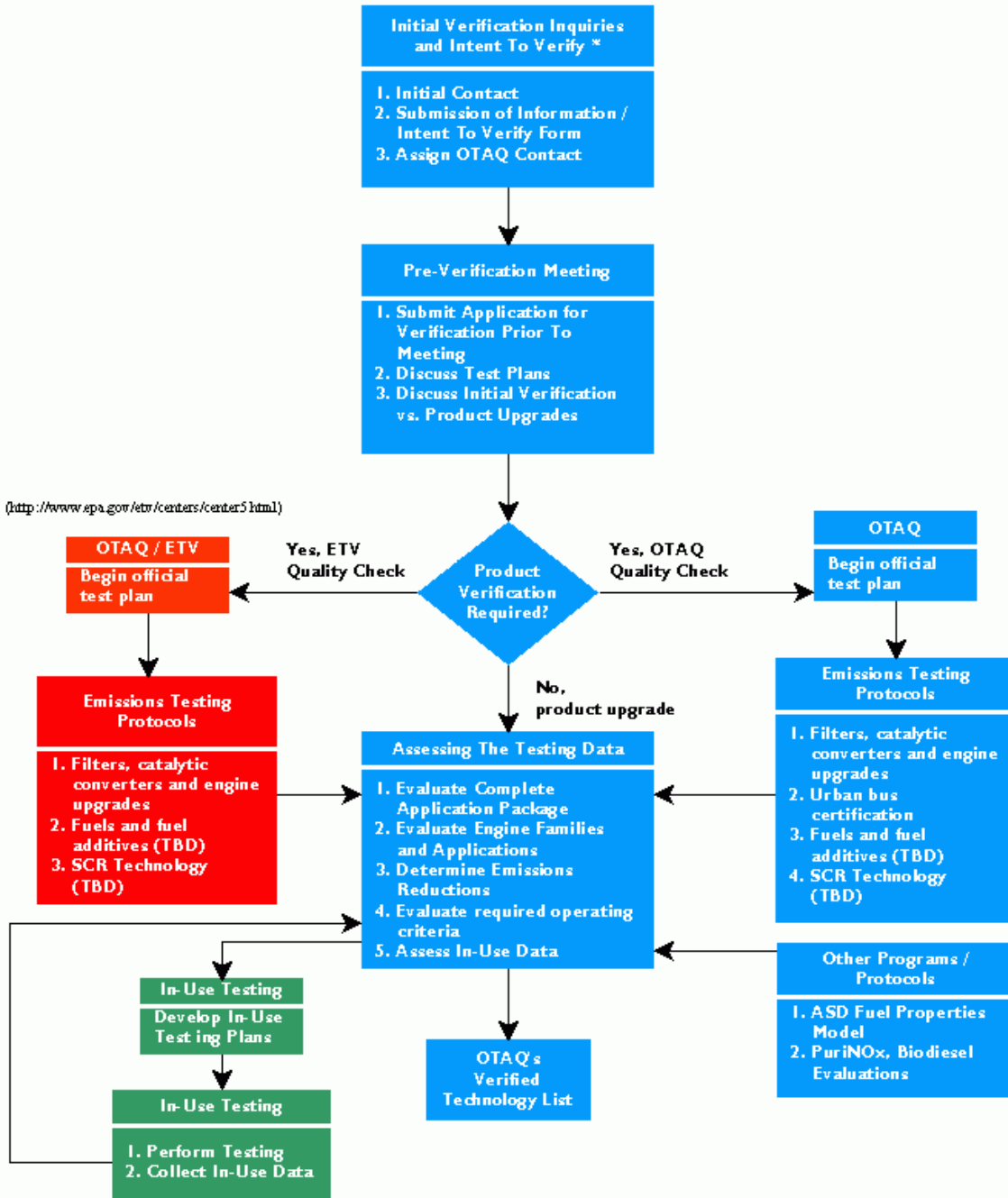
<sup>1</sup> National Emission Inventory, U.S. EPA.

<sup>2</sup> See White Paper #1 for a discussion of general conformity issues at ports.

<sup>3</sup> Texas also has a verification program through the Texas Emissions Reduction Program. Texas does not necessarily accept emission reductions for equipment verified solely by ARB.

which it will be used. The steps laid out below are part of that process, and a flowchart of the process is shown in Figure 1.<sup>4</sup>

**Figure 1. EPA OTAQ Retrofit Technology Verification Process**



\* For those manufacturers of retrofit technologies that travel through the OTAQ / ETV route for their emission testing, please note that you may contact ETV staff directly to begin the verification testing process. However, in order for OTAQ to have a complete understanding of all technologies currently undergoing the verification process, we request that you contact an OTAQ Retrofit Team member to submit the Technology Information and Intent to verify form.

<sup>4</sup> Further details can be found on the Internet at <http://www.epa.gov/otaq/retrofit/retrofittech.htm>

The OTAQ/ETV program can verify emission reductions from aftertreatment technologies, engine rebuilds, engine upgrades, conversion of any engine to a cleaner fuel, early replacement of older engines with newer cleaner engines, use of cleaner fuel, and/or emission reducing fuel additives (without engine conversion). At this point, the process has been used mostly for on-highway vehicle technologies, but is being expanded to encompass non-road engine technologies as well. Technologies for marine engines would also follow the OTAQ/ETV process using specified test procedures in 40 CFR. For some marine applications, laboratory testing may not be feasible due to the inordinate size of the engine itself. The OTAQ/ETV team will work with the applicant to develop a test plan that will verify the effectiveness of the emission control technology.

### **Step 1. Intent to Verify**

To show intent to verify a new product, the applicant must start by contacting the OTAQ VDRP. An OTAQ staff member will gather information from the applicant, give guidance about the verification procedure, and help with paperwork. An EPA Retrofit Team member will be assigned to the project.

### **Step 2. Application for Verification and Pre-Verification Meeting**

A formal “Application for Verification” is required, providing EPA with information used to evaluate the technology. This form is used for new products, changes to products that are already verified, and applications to increase the scope of a previously approved technology (e.g., adding engine types). After the application is completed, OTAQ and the manufacturer meet to discuss both lab and in-use testing.

### **Step 3. Determination of Verification Testing Route**

OTAQ will determine whether or not a product should properly be classified as a new product, requiring full verification, or an existing verified product with upgraded components, which does not require full verification.

In the second case, the manufacturer must demonstrate that the product achieves at least the same level of reductions as when originally verified. If the manufacturer wishes to claim increased emissions reductions, full verification will generally be required.

If full verification is required, OTAQ will determine whether the manufacturer can submit testing data directly to OTAQ (OTAQ-only path) or go through a laboratory that is evaluated under the ETV program and determined to be capable of performing the Federal Test Procedure (ETV path). A manufacturer is typically allowed to submit test data directly to OTAQ if the manufacturer has been through a similar test protocol recently for which compliance documents were submitted to EPA, can demonstrate the ability to perform the tests at the manufacturer’s facility and prepare the documentation to EPA specifications, and is willing to undergo quality audits. Otherwise the manufacturer must work with a laboratory that is qualified under the ETV program and capable of performing the Federal Test Procedure (FTP) to perform the tests and prepare the documentation. Testing is performed for total PM, hydrocarbons, NOx, nitrogen dioxide (NO<sub>2</sub>), carbon monoxide (CO), and carbon dioxide (CO<sub>2</sub>).

After successful completion of the verification process along the “ETV path,” a manufacturer may be qualified to follow the “OTAQ-only path” for future submittals.

### **Step 4. Begin Testing**

Those manufacturers on the ETV path will work directly with a qualified laboratory to perform the testing and quality control procedures outlined during meetings with OTAQ. Generic testing protocols have been

developed jointly with a variety of stakeholders including laboratories, engine and retrofit device manufacturers, fuel and fuel additive producers, state and local government representatives, environmental organizations, and OTAQ. Protocols have been developed to evaluate particulate filters, catalytic converters, engine modifications, fuels and fuel additives, and selective catalytic control systems. These protocols generally involve a series of baseline tests followed by tests with the new technology installed to determine emission reduction capability. Tests are performed on both new and “vintage” products that have been aged to a specified durability period. After completion, results are submitted directly to ETV and then to OTAQ.

Most often, manufacturers on the OTAQ-only path will follow a protocol identical to the one used by the ETV path. Data from the manufacturer’s laboratory could also be used in the OTAQ-only path provided the tests were performed with proper emissions measuring equipment over the proper test cycles for the engines in question. The applicant could then bypass the ETV laboratory evaluation and submit test results directly to OTAQ. In some cases there may be no established ETV protocol, and OTAQ will then work with the manufacturer to develop new protocols. For upgrades, there is a streamlined testing process to ensure that any changes do not adversely affect emissions.

### **Step 5. Evaluate Testing Data**

After lab testing is complete, OTAQ will evaluate test results and assign emissions reduction levels for the technology. If the technology manufacturer wishes to verify a particular technology for more than one engine family (or groups of engine families), separate levels may be assigned for each family or group as appropriate. These levels may be adjusted downward to account for testing uncertainty and application on untested engine models. Additional in-lab and on-site tests that reduce this uncertainty can be applied to increase the emissions reduction levels.

### **Step 6. Addition to the Verified Technology List**

After the OTAQ verification process is complete, the new technology is added to the OTAQ VDRP Verified Technology List. This list describes the emission reduction capability of the product, lists compatible engine family(s) and family group(s) and associated emission reduction levels, and defines operating criteria and limitations. Similar information is supplied by OTAQ in an official letter to the manufacturer. Sample letters can be viewed on the Verified Technologies List Internet site.<sup>5</sup>

### **Step 7. In-Use Testing**

As retrofit technologies are introduced into the market and as states begin to rely on these technologies to improve their air quality and generate credits for their SIPs, it becomes increasingly important to verify the field performance of the products. The following in-use testing requirements are part of the OTAQ Verification Process and the responsibility of each retrofit manufacturer. Total PM, hydrocarbons, NOx, NO<sub>2</sub>, CO, CO<sub>2</sub>, exhaust temperature, and backpressure must be measured. Failure to prove acceptable in-use performance will result in loss of emission credits and removal from the Verified Technology List.

#### ***In-Use Testing Phases***

There are two phases to the in-use testing program. In each phase, units in normal field operation must have reached a certain age prior to being tested. All testing is the responsibility of the retrofit technology manufacturer and shall begin within one month after an adequate number of engines<sup>6</sup> have become

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<sup>5</sup> See <http://www.epa.gov/otaq/retrofit/retroverifiedlist.htm>

<sup>6</sup> This threshold is approximately 500 engines, although in limited installations the number can be less.

available for each phase, unless a previous agreement has been made with EPA.

- Phase 1 - Test units aged to 25 percent of the designated durability testing period
- Phase 2 - Test units aged to 75 percent of the designated durability testing period

### ***In-Use Testing Methods***

The actual test method to be used will depend upon the retrofit product. For all products it is important that identical, rigorous, repeatable test procedures be used in testing on both unmodified engines and engines with the retrofit technology. For example, using a chassis dynamometer for the unmodified engine test and a mobile emissions detection system for the with-retrofit-technology test would be unacceptable. One must be able to compare the test results directly. It is also important to have OTAQ pre-approval of the in-use test method to be used. OTAQ allows the manufacturer to specify the testing cycles and test plan, and will approve them if reasonable.

#### ***1) Sampling Plan***

The unmodified test engine sample should be representative of the distribution of the technology across the various applications and uses to which it has been applied. Engines to be tested are to be selected randomly and the sample should include a mix of end-user entities and a mix of mileage accumulations. Manufacturers must include, along with the test results, a description of any unscheduled maintenance and its expected emissions effect.

#### ***2) Test Cycles***

While the retrofit manufacturer may propose which type of emissions testing equipment to use for in-use testing, the required test cycles and protocols for each type of equipment are generally well defined. Highway engine dynamometer tests must be conducted over the Federal Test Procedure (FTP) transient test cycle. The Urban Dynamometer Driving Schedule (UDDS) test cycle, or other pre-approved test cycle, is required for chassis dynamometer tests. Nonroad engines that are tested using the engine dynamometer will be tested using the applicable non-road FTP test cycle. All tests using mobile emissions sampling systems must be conducted over conditions that reflect normal operation for the engine/truck/equipment being tested.

#### ***3) Testing***

In general, in-use testing is not required to begin until at least 500 units have been sold. However, in cases with limited installations, OTAQ would work with the manufacturer to determine when in-use testing should be initiated. Initially four engines must be selected for in-use testing (this number may be reduced in situations with limited production, such as marine applications). The engines must have mileage or hour accumulations greater than 25 percent (for Phase I) or 75 percent (for Phase II) of the minimum durability testing periods. The minimum durability for on-highway vehicles is 50,000 miles. For non-road engines, EPA is currently developing minimum durability periods; it is expected these will coincide with those developed by ARB.

If all four in-use tests pass, testing is complete. A unit passes if testing shows that it reduces emissions of the target pollutants by at least 75 percent of its original OTAQ Verification Process reduction. For testing beyond the initial four units, a 70 percent pass rate must be achieved. In the case of a failed test for which the failure can be attributed to the product and not to maintenance or other engine related problems, two or more additional units must be evaluated, up to a total of ten.

#### **4) Failures**

If the 70 percent success rate is not achieved in ten tests (less for limited production), then dynamometer testing is required. The manufacturer may request an extension of the in-use testing program in order to achieve a 70 percent success rate in lieu of dynamometer testing. EPA would then determine at what point during the extension dynamometer testing should be performed. If the manufacturer demonstrates a 70 percent success rate during the extension, in-use testing would cease. In the event dynamometer testing is required, the sampling plan would be repeated. Retrofit technologies that fail dynamometer testing will be removed from the Verified Technology List.

#### **5) Test Results**

Test results for all phases are to be submitted to EPA using the format provided. Test results provided electronically are normally much easier to process than paper submissions. The results must be submitted to EPA within three months after the completion of testing. Should EPA determine strong bias in testing, EPA may require corrective action, such as additional in-use testing of non-represented engines.

### **3. ARB Diesel Emissions Control Strategy Verification Procedure (Regulation)**

The following steps outline the ARB Diesel Emissions Control Strategy Verification Procedure. This procedure is discussed in detail in an ARB report, “Proposed Regulation for the Verification Procedure for In-Use Strategies to Control Emissions from Diesel Engines.”<sup>7</sup> A flowchart of the process is shown in Figure 2. In California, EPA’s methods are superceded by ARB’s and the EPA certification is often used by ARB as partial satisfaction of ARB’s procedure.

#### **Step 1. Application Process**

First the applicant must submit a proposed verification testing protocol for approval by ARB. In addition to a description of the technology and a testing protocol, the applicant may submit any existing data to determine if testing requirements have been partially satisfied. The proposal must be focused on a single “emissions control group,” defined as a class of engines and set of applications with similar duty cycles.

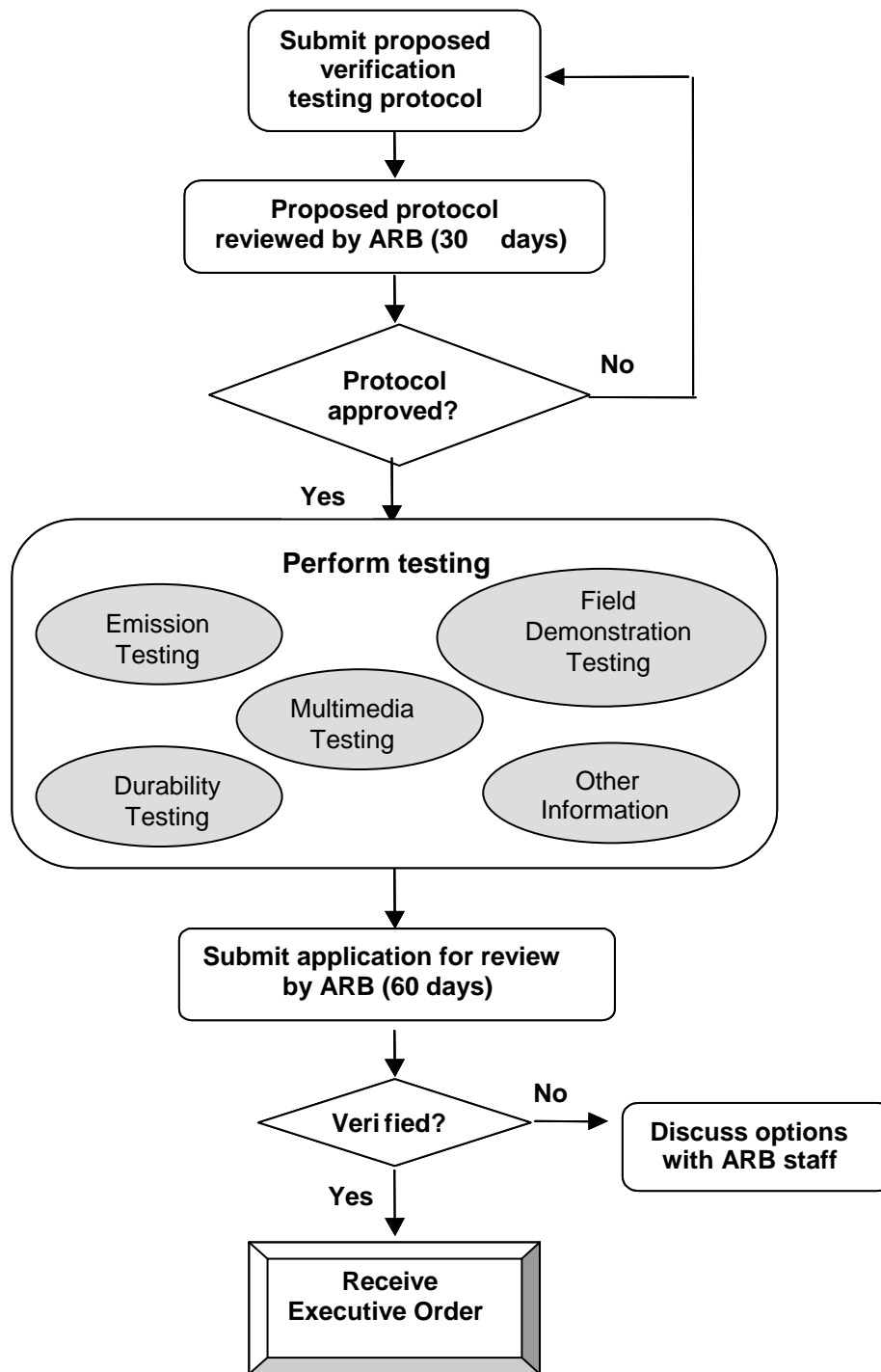
#### **Step 2. Emission Testing**

The applicant then must test the diesel emission control strategy using a test cycle approved by ARB. The test cycle will depend on the engine class and intended application. At a minimum, total PM, hydrocarbons, NO<sub>x</sub>, NO<sub>2</sub>, CO, CO<sub>2</sub>, exhaust temperature, and backpressure (for particulate filter systems) must be measured. Additional measurements may be required if there is reason to believe that a technology may cause an increase in nanoparticle formation, hazardous air pollutant formation, or other changes in emissions.

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<sup>7</sup> This report is available on ARB’s website at <http://www.arb.ca.gov/regact/dieselryv/dieselryv.htm>

**Figure 2. ARB's Diesel Emission Control Strategy Verification Procedure**



### **Step 3. Durability Testing**

The control strategy must show continued effectiveness at both the beginning and end of a durability period defined by ARB. This testing can be done either in a laboratory or in the field; however, if it is performed in a laboratory, additional field-testing will be required. It is at this point when an ARB

approved third party must provide a written statement describing the performance and any maintenance issues or problems associated with the technology. As a rule, the same test cycle must be used at the beginning and end of the durability period, although “substantial test data” from previous test studies may be substituted for the initial tests.

ARB may give conditional verification after 33 percent of the durability period, but full verification cannot occur until the durability period is complete and final test results have been submitted. The minimum durability period for on-road engines is 50,000 miles. The minimum durability period for off-road engines is 1000 hours, except stationary emergency generators, which have a minimum durability period of 500 hours.

#### **Step 4. Multimedia Assessment**

Diesel emission control strategies that rely on fuel changes either through additives or through use of alternative diesel fuels must undergo an evaluation of multimedia effects (such as effects on water quality). No diesel emission control strategy that relies on the use of an additive or alternative fuel may be verified unless a multimedia evaluation has been performed that determines such use will not cause a significant adverse impact on the public health or the environment.

#### **Step 5. Field Demonstration**

Successful operation of the technology must be demonstrated in the field on at least one vehicle or engine in each emission control group. Typically the field demonstration period is a minimum of 200 hours or 10,000 miles. This period is different for emergency generators and could be different for other, unusual engine uses. The field demonstration requires a written statement from an ARB-approved third party similar to step 3 above. If the durability testing is performed in the field, then the separate field demonstration requirement may be waived.

When a technology fails to perform adequately in the field, it is the responsibility of the applicant to prepare a report explaining the circumstances of the failure.

#### **Step 6. Determination of Emission Reduction**

Each verified technology is classified as to its emission reduction capability. The various classification levels are given in Table 1.

**Table 1. ARB Emission Reduction Classifications**

<b>Pollutant</b>	<b>Reduction</b>	<b>Classification</b>
PM	< 25%	Not Verified
	≥ 25% and < 50%	Level 1
	≥50% and < 85%	Level 2
	≥ 85% or ≤ 0.01 g/bhp-hr	Level 3
NOx	< 15%	Not Verified
	≥ 15%	Verified in 5% increments

The emission reduction of a control technology will be determined by ARB based on the average of all valid emission and durability test results. Once the percent emission reduction of the technology is determined, emission reductions will be calculated based on appropriate baselines. If absolute PM emissions are reduced to 0.01 grams per brake horsepower-hour (g/bhp-hr) or lower, then a simple

average of test results is used.

Once an emission reduction classification is assigned, an official letter is sent to the manufacturer by ARB that identifies the classification level and the conditions for the product's use to qualify for reduction credits.

### **Step 7. In-Use Compliance**

After 50 units have been sold in the California market, ARB requires in-use compliance testing, which occurs in two phases. In the first phase, units are tested after one year of use or when they are within three months of their first scheduled maintenance, whichever comes first. The test procedure must be identical to that used in the original verification, unless another method is approved by ARB, and must be performed on at least four units. If a unit fails, two more units must be tested up to a maximum of ten units. Passing is defined as performing up to 90 percent of the lower bound of the verified level. If at least four units and at least 70 percent of all units tested pass, then the technology is in compliance.

To perform the second phase, the applicant must perform the same test procedures on units that are between 60 and 80 percent of their minimum warranty period as defined by the ARB. Failure in either of the two tests will require an investigative report by the applicant.

### **Step 8. Other Requirements**

ARB's technology verification program includes a number of additional requirements, including the following:

- Any control system that replaces a muffler must provide the minimum level of noise attenuation.
- The applicant must provide an appropriate label, owner's manual, fuel and oil requirements, and any other information ARB may deem necessary.
- There is a cap on NO<sub>2</sub> reductions equal to 20 percent of baseline NO<sub>x</sub> emissions.
- The applicant must provide a warranty covering manufacturing defects and performance for a period at least as long as a minimum duration determined by ARB based on engine size and intended application. Warranty requirements are provided in the California Code of Regulations Title 13, Chapter 14, Section 2707.
- There are additional testing and reporting requirements for fuel additives pertaining to health effects and possible damage to equipment.
- Alternative fuels must be shown to not adversely affect the performance of diesel engines or cause any premature wear.

## **4. Program Differences**

ARB has developed a description of differences between their program and OTAQ's VDRP. The most relevant differences are summarized here:

- OTAQ's program is voluntary whereas ARB's is regulatory in nature.
- ARB verifies technologies at the levels shown in Table 1 above. OTAQ assigns percent reductions to hydrocarbon, CO, NO<sub>x</sub>, and PM emissions.

- ARB will verify any retrofit technology. OTAQ has protocols only for oxidation catalysts, particulate filters, engine modification, selective catalytic reduction, and fuel additives/alternative fuels. However, OTAQ will work with manufacturers of other technologies to develop an appropriate evaluation method.
- ARB requires a review of possible multimedia effects for fuel-based technologies.
- ARB allows chassis dynamometer tests while OTAQ allows only engine dynamometer tests. However, OTAQ allows chassis dynamometer data to support the expansion of the initial verification to cover additional engine families and engine groupings.
- The durability periods are different for all classes of engines except those used in vehicles 33,000 lbs gross vehicle weight (GVW).
- ARB requires testing at the end of the durability period while OTAQ requires testing at 25 percent and 75 percent of the durability period.
- ARB sets minimum warranty periods while OTAQ allows manufacturers to set them.

ARB has indicated that technologies verified by OTAQ are acceptable to them if the following conditions are met:

- The warranty period meets ARB's minimum requirements.
- Durability tests cover the entire durability period.
- A field demonstration is included in the test.
- The same engine test is used throughout the in-use compliance test program.

Both ARB and OTAQ generally claim that they are working to decrease differences between the two systems. At present, OTAQ has only verified on-road technologies, but is expanding their program to verify off-road engine technologies as well. OTAQ is adopting many of ARB's protocols for off-road technology verification.

## **5. Costs, Time Scales and Difficulties**

According to Research Triangle Institute (RTI), an approved ETV testing laboratory, testing a single engine for OTAQ's VDRP would cost between \$50,000 and \$100,000 and take about six months from the time of initial contact. (This is the cost for initial testing of a truck size engine and does not include field testing.) About three months of this time is dedicated to data review and assignment of reduction levels. In the case of new protocols being required, RTI suggested that the process could take from seven to eight months. These estimates do not include in-use testing, nor does it include the cost of the engine or the fuel. Larger engines would cost more to test.

ARB has developed a more inclusive cost estimate for the entire Diesel Emissions Control Strategy Verification Procedure, including in-use testing. ARB estimates costs of \$312,000 – \$660,000 for engine testing and \$406,500 – \$862,500 for chassis testing. These estimates assume that all testing would be unique to their own verification program. Actual testing costs could be considerably lower if data from other programs, such as OTAQ's, could be applied to ARB's.

To confirm these costs, we contacted two manufacturers of emissions control technologies – Donaldson Company, which manufactures filter systems, and Lubrizol, which manufactures PuriNox emulsified fuel. Although neither would give a firm testing cost, both corroborated that a sum in the hundreds of

thousands of dollars was accurate. They both agreed that cost was a major issue that could keep potential suppliers of pollution mitigating equipment out of the market.

According to an engineer at Donaldson Company, better collaboration between ARB and OTAQ could result in both verification processes costing only 20 percent more than one program alone. Currently, however, costs were running much more than that, though still less than the full cost of both. This means that total costs to be verified by both systems could be as much as \$1 million.

There was general consensus that the ETV path was probably increasing the cost of verification with OTAQ. One manufacturer pointed out that although OTAQ offers both the ETV and OTAQ-only paths to compliance, currently very few retrofit technology manufacturers would be eligible for the OTAQ-only path. Furthermore, there is currently only one laboratory that has been evaluated under the ETV program and found to be capable of performing the FTP (Southwest Research Institute in San Antonio, TX), which limits competition and tends to drive testing prices up.<sup>8</sup> However, as any laboratory is eligible to apply to be included in the program, other qualified laboratories are expected to be included in this process in the near future (upon successful demonstration of the capability to perform the FTP).

Lubrizol and Donaldson did not agree on which process was more expensive or more difficult. Because of California's requirement that manufacturers of alternative fuel systems study possible multimedia effects, Lubrizol spent much more and took far longer to get through ARB's process than OTAQ's. Donaldson, on the other hand, found that ARB was more willing to accept outside data and the ARB process had less uncertainty. Both companies reported times much longer than the six months suggested by RTI, but this may be due to the fact that Lubrizol approached EPA before a protocol for fuel additives existed, and Donaldson's diesel oxidation catalyst muffler with crankcase emission control was the first product to go through ETV. Additional delay was caused by the need to develop a test plan to evaluate the crankcase emission control system as part of the Donaldson application process. It is likely that testing could proceed more quickly now that collaboration between OTAQ and ARB has improved.

Some complaints were registered about the emission reduction levels assigned by OTAQ. First, they were seen as being too precise given the level of uncertainty. Second, they were seen as being too conservative. For example, filter systems produced by Engelhard and Johnson-Matthey are assigned PM reduction levels of 60 percent by OTAQ while they are considered Level 3 technologies by ARB (greater than 85 percent reduction of PM). One possible reason suggested for this difference is the fact that non-road applications in particular are tested on a transient cycle rather than a steady-state basis. Donaldson claims that very specific levels are being assigned based on a very limited number of tests. Lubrizol claims that OTAQ uses an enormous amount of data.

## **6. Conclusion and Recommendations**

Most state air quality agencies are reluctant to take SIP credit for technology that reduces emissions at ports unless the technology has been validated by EPA or ARB. The EPA and ARB technology validation procedures differ in a number of important ways. Some of the most important differences are ARB's allowance of chassis dynamometer testing (EPA requires engine dynamometers), ARB's requirement for a review of multimedia effects of fuel-based strategies, and differences in timing of durability testing. Because of these differences, manufacturers of emission reduction equipment often incur significant costs (as much as \$1 million) to obtain the necessary validation from both agencies. There are concerns that these costs may be hindering the development of new emission reduction technologies that could assist ports in meeting environmental mandates.

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<sup>8</sup> Note that when third party data is required, ARB will accept it from a variety of sources, including Southwest Research Institute.

Discussions with manufacturers of emission reduction equipment suggest that manufacturers view the ETV programs as a cause of unnecessarily high additional product development costs. But it should be noted that the manufacturers interviewed went through verification when the ETV programs were just starting out, and it is quite possible that the programs are operating more smoothly now.

*Recommendation 1* – The most desirable ETV program improvement identified by manufacturers is greater reciprocity between the EPA and ARB systems. Ideally, it would be necessary to verify a technology just once, either through OTAQ or ARB, and have the verification accepted by both agencies. Donaldson suggested that more companies would then gravitate toward ARB’s program. Lubrizol would not state a preference but did receive verification from OTAQ much more quickly. In addition to reducing costs to manufacturers, greater reciprocity might encourage more research and development focused on emission reduction technologies.

*Recommendation 2* – Barring complete reciprocity, there is a need to better integrate the two systems. One manufacturer recommended bringing together both OTAQ and ARB as early in the process as possible and then starting with the ETV path as the baseline testing. It was felt that this process should then be acceptable to both agencies.

*Recommendation 3* – It was suggested by manufacturers that the use of more testing labs might reduce ETV costs or otherwise help to streamline the process, although both companies expressed satisfaction with Southwest Research Institute. It is recognized that very few laboratories are capable of performing the Federal Test Procedure, and that testing by a reputable laboratory is very important in the legitimacy of the process and needs to continue to be a requirement of any verification process. It is recommended that EPA consider ways to encourage participation in the ETV process by other qualified labs.

*Recommendation 4* – In order to improve the verification of emissions control technologies at ports, there is a need for more appropriate emissions test cycles for port equipment. It is recommended that EPA spearhead the development of test cycles for dock equipment that realistically represent the operating patterns of this equipment.

## References

California Air Resources Board, “Proposed Regulation for the Verification Procedure for In-Use Strategies to Control Emissions from Diesel Engines, Staff Report: Initial Statement of Reasons,” March 29, 2002. Available online at <http://www.arb.ca.gov/regact/dieselrv/dieselrv.htm>

EPA Office of Transportation and Air Quality, “EPA’s Voluntary Diesel Retrofit Program, Retrofit Technology Verification Process.” Available online at <http://www.epa.gov/otaq/retrofit/retrofittech.htm>