Proposed Carl Moyer Program Guidelines for Voluntary Repair of Vehicles

Note: For the August 31, 2006 workshop, only the proposed new sections of Carl Moyer Guidelines are presented. These would be incorporated into the existing parts Chapter XI of the 2005 Carl Moyer Program Guidelines to form the proposed, revised Carl Moyer Guidelines for Board consideration.

With legislation signed into law in 2004 (AB 923), vehicle repair of vehicles (VRV) programs are now fundable under the Carl Moyer Program, and air districts have expressed interest in funding VRV identified as high emitting vehicles as an alternative to vehicle retirement.

ARB staff is proposing the following criteria for inclusion in the Carl Moyer Program Guidelines for VRV programs as an additional option for reducing emissions from high emitting vehicles.

I. Key Elements of Voluntary Repair of Vehicles Programs

Ensuring that the emission reductions are real, quantifiable, enforceable, and surplus is critical to the success of the Carl Moyer Program. In addition, reductions must be cost-effective as defined in the Carl Moyer Program Guidelines. Vehicle repair is a new category for the Carl Moyer Program, and it presents a number of unique challenges in ensuring that these guiding principles are met.

Vehicle repair projects must achieve surplus emission reductions to receive funding under the Carl Moyer Program. Vehicle owners routinely pay for repairs on their own vehicles. Simply shifting the cost of repairs from the owner to the State does not, in and of itself, result in surplus emission reductions. Surplus emission reductions are achieved only by: (1) funding repairs that would not have occurred otherwise; and (2) accelerating repairs so they occur earlier than they would have otherwise. Distinguishing repairs that would only occur with State funding from those that would have happened in the absence of the Carl Moyer Program ("anyways reductions") is a challenge. Staff is proposing project criteria that attempt to prevent funding these "anyways reductions" and is proposing that districts evaluate in their VRV program plans how their programs would prevent funding repairs which would have occurred in absence of the program.

Also critical to the success of vehicle repair projects is ensuring that emission control system failures are correctly diagnosed and repaired so that real emission reductions are achieved. Staff is proposing project criteria requiring systematic diagnosis and repair in accordance with standard industry protocols to ensure that vehicles are correctly and efficiently repaired.

During the development of these guidelines, air district representatives encouraged ARB to provide flexibility for districts to develop specialized programs to address unique, local circumstances. District staff also voiced concern that if the program criteria are too prescriptive, districts may be overly limited in designing programs. ARB

staff agrees that districts need flexibility in designing programs provided they incorporate sufficient controls to ensure the emission reductions are real, quantifiable, enforceable, and surplus. ARB staff has incorporated this flexibility into the guidelines.

Another key element in VRV programs is that vehicle owners rights must be protected. ARB staff has included consumer protection provision elements in the guidelines.

The major program criteria are broadly described below along with a discussion of some of the issues staff considered. The detailed criteria are listed in the next section, Proposed Project Criteria for VRV Programs.

A. Vehicle Eligibility

ARB staff is proposing vehicle eligibility requirements that attempt to ensure the VRV programs achieve surplus emission reductions and do not discourage vehicle owners from continuing to conduct the routine vehicle maintenance that they would normally conduct in the absence of State-funded repair programs.

To ensure emission reductions from VRV programs are surplus to the Smog Check program, vehicles must be outside of their biennial Smog Check window in order to participate.

To ensure that only functional, actively used vehicles participate, vehicles must be continuously registered for 24 months and be driven to the repair location to participate. Funding repairs on vehicles that would be naturally retired otherwise or resuscitating vehicles that were not being used would not achieve surplus emission reductions.

Only vehicles identified through remote sensing, high emitter profile, or equivalent program would be eligible. VRV programs would not be open to “walk ins” (i.e, vehicles not identified as possible high emitters) because this would create a disincentive for people to keep up with routine vehicle maintenance.

In addition, staff is proposing that a vehicle’s participation in a repair program be limited to once in its lifetime. This would prevent a situation where the program is essentially paying for what should be routine maintenance by funding repair after repair on the same vehicle. Also, if vehicles are in need of multiple repairs over time, those may be better candidates for retirement, so the second time a vehicle came through the program retirement would be its only option.

During the development of these guidelines, stakeholders raised the issue of whether vehicles not yet subject to Smog Check (i.e., those vehicles under 6 years old) should be eligible for VRV programs. ARB staff is proposing that vehicles under the manufacturers warranty would not be eligible. Staff believes that State funds should not be used to repair these vehicles because manufacturers are obligated to pay for these repairs.

There is a small fraction of high mileage, newer vehicles no longer under warranty that may be identified as high emitters. Staff has reservations about including these vehicles in voluntary repair programs because these vehicles have the highest likelihood of being repaired anyway. However, staff is proposing to allow districts the option of including these vehicles in their VRV programs. Staff is proposing two requirements to mitigate the potential for funding repairs that would have happened anyway. First, districts must describe in their VRV program plans how their programs would prevent funding repairs which would have occurred in the absence of the program. Second, while vehicles less than five years old are more than one year away from requiring a Smog Check, staff is proposing that the credit life for these vehicle repairs be limited to one year (the credit life used for older vehicles) to discount for the fact that some of these emission reductions might have occurred in absence of the program.

During the development of these guidelines, some stakeholders suggested that State-funded voluntary repair programs only be made available to low income vehicle owners because they are least financially able, and therefore least likely, to make the repairs in absence of State funding. ARB staff acknowledges this concern. However, it's been ARB policy with respect to the Carl Moyer Program to provide a broader level of guidance sufficient to ensure that emission reductions are real, quantifiable, enforceable, and surplus. ARB leaves decisions on how Carl Moyer Program funds should be distributed to the air districts administering the program at the local level. ARB staff agrees that this is an issue that air districts should consider at they design VRV programs.

B. Repair Requirements

A guiding principle for the vehicle repair requirements is that vehicles must be systematically diagnosed and repaired by licensed Smog Check technicians to ensure that repairs are durable and real emission reductions are achieved. Systematic diagnosis and repair are the key to successful repair programs. Quick and inexpensive repairs which temporarily mask more serious problems do not result in long lasting emission reductions. For example, replacing a catalytic converter without fully diagnosing whether a problem upstream in the emission control system led to the failure may only result in a short term fix.

The proposed program criteria require that vehicle diagnostics and repairs be conducted by licensed Smog Check technicians at licensed Smog Check stations in accordance with accepted industry protocols and all California laws and regulations governing automotive repair. ARB staff has based its proposed repair criteria on the protocols used in the Bureau of Automotive Repair's (BAR's) Consumer Assistance Program. ARB encourages air districts pay careful consideration to the need for systematic diagnosis and repair protocols as they develop contracts with the Smog Check stations to perform the testing, diagnosis, and repair services. The contracts should include the appropriate detail in the scope of work to ensure that stations follow systematic diagnosis and repair protocols.

To ensure repairs are durable, the repairs must bring emissions below the Smog Check pass/fail emission standards in order to be creditable. This requirement aims to prevent partial repairs that may be short lived. This requirement may lead to State funds spent to diagnose and attempt repairs that do not result in a creditable emission reduction. We refer to these as stranded costs. The cost-effectiveness criteria provide guidance how districts would account for these costs.

In addition, only repairs directly related to reducing a vehicle's emissions would be fundable. This program is not intended to pay for routine maintenance (such as oil changes, etc.) which would continue to be a vehicle owner's responsibility.

A second guiding principle is that vehicle owners rights must be protected. The proposed program criteria require vehicle owners' authorization for all repairs and require districts to provide an independent party to handle complaints or disagreements that may arise between the vehicle owner and the repair station. Repair stations must follow all California laws and regulations governing automotive repair.

C. Evaporative System Repairs

The proposed program criteria would provide districts the option of testing vehicles identified as potentially high emitting for ROG or NOx exhaust for evaporative emissions, if they choose, and repairing vehicles with failing evaporative emission control systems. One challenge associated with testing vehicles' fuel evaporative systems is that the test equipment is still under development. At this time, the low pressure fuel evaporative test is not a part of the Smog Check program. BAR is in the process of developing regulations to add a low pressure fuel evaporative test to the Smog Check program, but at this time, no equipment has been certified by BAR. However, several manufacturers' equipment are undergoing certification. Staff proposes that only equipment that has been submitted for certification be used in VRV programs that test for evaporative emissions. In the future, once equipment has been fully certified by BAR, ARB staff would propose requiring that only certified equipment be used.

Calculating the emission reductions associated with fuel evaporative system repairs presents a challenge because the low pressure evaporative testing equipment does not directly measure a mass-based emission rate. Consequently, the emission benefits associated with evaporative repairs cannot be measured directly via pre and post repair tests. Instead, staff is proposing to base the emission reductions on pilot studies by the ARB and others that quantified in the laboratory the benefits of repairing vehicles which failed the low pressure evaporative test.

D. Particulate Matter Repairs

The South Coast Air Quality Management District has indicated that it plans include particulate matter (PM) testing and repair as part of its program. ARB staff supports the

goal of reducing PM emissions from the light- and medium-duty fleet. ARB is funding research into measuring PM emissions in light-duty vehicles. However, PM testing and repair presents several challenges. The Smog Check ASM test does not measure PM, so quantifying pre- and post-repair PM levels in order to quantify reductions is not straightforward. There is not an established method to measure PM emissions from vehicles in a road side setting.

If a PM component is include in a district program, the district's VRV program plan must specify the procedure/analytical approach/equipment that would be used to measure PM. The plan must also outline how the district intends to evaluate and validate that its proposed method of quantify PM emissions in the field correlates with scientifically accepted methods of measuring PM emissions in the laboratory.

E. Calculating Emission Reductions

Estimates of the emission reductions achieved by repairing vehicles identified between Smog Checks as high emitters would be based on Smog Check acceleration simulation mode (ASM) tests performed on the vehicles immediately before and after the repairs. In order to ensure the post-repair test gives an accurate measure of the vehicle's emissions, it must be a full test, not a "fast pass" mode test. The "fast pass" testing option truncates as soon as the vehicle's emission levels stabilize below the pass/fail emission standards for the vehicle even if the full test period has not been completed, so it may not provide a test result that is directly comparable to the pre-repair test.

A small subset of the light and medium duty vehicle population cannot be tested on a dynamometer. This included all wheel drive and 4 wheel drive vehicles. If districts choose to include vehicles not testable under the ASM test in their VRV programs, these vehicles may be given a two speed idle (TSI) Smog Check test to determine emissions.

In order to ensure that the calculated emission reductions are surplus to the Smog Check program, the credit life of the repair is the period of time between the repair and the vehicle's next scheduled Smog Check. At that time, the Smog Check program would have forced the reductions to occur, so they would no longer be surplus. On average, vehicles are one year away for their next biennial Smog Check, so staff is proposing a default credit life of one year for repairs. As noted above, staff is also proposing a one year credit life for vehicles less than five years old. While these vehicles are more than one year away from requiring a Smog Check, staff is proposing the shorter credit life to discount for the fact that some of these emission reductions may have occurred in the absence of a VRV program because these are the vehicles that would be most likely to be repaired anyway. Staff is proposing a one year credit life for evaporative repairs as well.

The one year credit life for repairs would be an exception from the three year minimum project life in the Carl Moyer Program, reflecting the unique nature of vehicle repair projects. ARB has set a three year minimum project life for other source categories to

ensure emission reductions are surplus, particularly for projects funded in advance of regulatory compliance deadlines where engine owners know they will need to repower or replace their equipment. Vehicle repair is unique because, in absence of being identified via RSD or a similar technology, motorists would not know their vehicles need repairs until the time of their next Smog Check. By accelerating repairs a year before the Smog Check program would have required them, surplus reductions are achieved.

The proposed criteria represent ARB staff's recommended methodology for calculating emission reductions. ARB staff also recognizes that districts may develop VRV that narrowly focus on subsets of the high emitting vehicle population. This may include targeting only vehicles with very high mileage to targeting the vehicles that are furthest away from their next scheduled Smog Check. In some of these cases, elements of the default calculation methodology may not be appropriate. ARB staff is proposing to allow districts to propose modifications to the default calculation methodology, where necessary, to reflect unique elements of their program. Any proposed modifications to the default methodology would need to be included in the districts VRV program plan. The plan would need to document that the proposed modifications are technically sound and justified. The district must receive approval by the ARB to use an alternative methodology.

F. Cost Effectiveness

Evaluating the cost-effectiveness of repair programs presents unique challenges not seen in other Carl Moyer Program source categories. For all other categories, potential grant recipients submit applications in advance. During the application period, each project is evaluated to ensure that it meets the Carl Moyer Guidelines' project criteria and cost-effectiveness limits, and only projects that are cost-effective may receive funding. Each individual project must meet the cost-effectiveness limit.

For voluntary repair programs, the cost-effectiveness cannot be fully evaluated during the application period. In order to assess whether a vehicle is a good candidate for State-funded repairs, a Smog Check technician must take time to systematically diagnose the vehicle. Technicians may find that some fraction of vehicles are either not repairable or would be prohibitively expensive to repair and consequently are not good candidates to receive State-funded repairs. While no emission reductions would be achieved from these vehicles, State funds would be expended in conducting the diagnosis.

Because State funds must be used to identify viable candidate vehicles to be repaired, cost-effectiveness cannot be determined until after the project is complete. The model of evaluating each engine project (i.e., candidate vehicle for repair) individually and ensuring it meets the Carl Moyer Program cost-effectiveness limit is not an appropriate approach to follow. The stranded costs associated with diagnosing vehicles that are not ultimately repaired must be accounted for. Consequently, ARB staff is proposing that these costs as well as the costs to identify high emitting vehicles be distributed across the successfully repaired vehicles and that the voluntary repair program, in its entirety,

would need to meet the Carl Moyer Program cost-effectiveness limit. For VRV programs run in conjunction with VAVR programs, the districts may calculate the cost-effectiveness of the combined program.

Because a district may choose to run a VRV program over a number of years, ARB staff proposes that that cost-effectiveness analysis be done annually. That is, for each separate year of funding, the program cost-effectiveness is calculated and reported to ARB as part of the district's annual report.

This proposal reflects the unique nature of voluntary repair programs and should not be considered a precedent applicable to other source categories. Cost-effectiveness for all other source categories would continue to be evaluated on an engine by engine basis.

II. Proposed Project Criteria for VRV Programs

The proposed project criteria listed below provide air districts with the minimum qualifications for running VRV programs. The districts may choose to impose additional requirements to address local concerns.

A. Vehicle Eligibility

- Participation in the VRV program shall be entirely voluntary for vehicle owners.

- The program shall be complementary to BAR's Consumer Assistance Program. Only vehicles between their biennial Smog Checks or "off-cycle" from the Smog Check program are eligible for the VRV program. A vehicle must be more than 90 days from its next scheduled Smog Check to be eligible. All repairs must be completed at least 91 days in advance of the vehicle's next biennial Smog Check.

- The vehicle must be a gasoline-powered passenger car, light-duty truck, or medium-duty vehicle up to 8,500 pounds gross vehicle weight.

- Vehicles covered under their manufacturer's warranty period are not eligible. Warranty requirements are found in Title 13 California Code of Regulations, Division 3, Chapter 1, Article 6, section 2035 et seq. and Article 1, section 1961.

  – Manufacturer warranties generally cover vehicles for a period of 3 years or 50,000 miles whichever first occurs, with high-priced parts covered for a period of 7 years or 70,000 miles whichever first occurs.

  – For 2004 model year and newer vehicles certified to optional 150,000 mile emission standards, the high-priced part warranty is extended to 8 years or 100,000 miles whichever first occurs.

- The vehicle must have been registered in the district for at least 24 months prior to repair, and all Smog Checks must have been performed as required by the

Department of Motor Vehicles (DMV) in order for the vehicle to be considered registered.

- Vehicles registered to a non-profit organization, fleet, or a business are not eligible.

- The vehicle must be fully operational and shall be driven to the location of the repair.

- Vehicles whose emission control systems have been tampered with, as defined in Title 16 California Code of Regulations, Division 33, Chapter 1, Article 5.5, section 3340.41.5, are not eligible for participation in a VRV until such tampering has been completely corrected.

- Only vehicles identified as potential high emitting through a technology/approach such as RSD or an HEP database approved by the ARB and operated in accordance with the VAVR regulations found in Title 13 California Code of Regulations, Division 3, Chapter 13, Article 1, section 2601 et seq. are eligible for participation in a VRV program.

- Prior to being repaired, a vehicle must receive a pre-repair Smog Check acceleration simulation mode (ASM) test to establish its baseline emissions. To be eligible to participate, a vehicle's ASM test must exceed the pass/fail emission standard for the model year and vehicle class as defined in Title 16, Division 33, Chapter 1, Article 5.5, Section 3340.42 of the California Code of Regulations. (A table listing the emission standards can be found on BAR's web site at: http://www.smogcheck.ca.gov/ftp/pdfdocs/asm_ph43.pdf.)

  - Vehicles not testable under the ASM test (e.g., 4-wheel or all wheel drive vehicles) may be given a two speed idle (TSI) Smog Check test to determine eligibility.

  - If the vehicle's pre-repair emissions are below the pass/fail emission standards, the vehicle is not considered an high emitting vehicle and is not eligible for a VRV program.

  - The Smog Check test must be conducted by a BAR-licensed technician at a licensed Smog Check station and must be conducted in accordance with BAR regulations and procedures.

- A vehicle may only be repaired once in its lifetime through VRV program. .

- A district may establish additional qualification eligibility requirements such as consumer income eligibility restrictions, model year eligibility restrictions, or repair cost limits.

B. Repair Requirements

- Vehicles must only be diagnosed and repaired by Smog Check technicians licensed by BAR at Smog Check stations licensed by BAR.

- The Smog Check technicians and Smog Check stations must comply with all California laws and regulations governing automotive repair.

- The legal owner of the vehicle must provide written approval in advance authorizing the diagnosis and all repairs. The owner must be provided a final invoice detailing the cost of parts, labor, and tax for the repair in accordance with the Automotive Repair Act.

- Only emission-related repairs are fundable through a VRV program.

- Stations and technicians must follow a systematic diagnostic approach, in accordance with standard industry protocols, that obtains relevant data about the engine and emission control system on the vehicle, based on the type of emission-related Smog Check failure.

  - The systematic approach includes a diagnostic routine that provides sufficient data to diagnose and repair emission failures in a cost-effective and efficient manner. Data may include, but, are not limited to, compression readings, leak down percentages, intake manifold vacuum readings, scan tool data, condition of grounds, other electrical connections along with wiring, oxygen sensor testing, and other industry accepted factory testing procedures. Diagnostic and repair procedures specified by the vehicle manufacturer should take precedence over generic procedures.

  - The diagnosis must ensure the vehicle's engine is in good mechanical condition before performing repairs. This should include an inspection of basic engine operation (i.e., fuel control, individual cylinder contribution, cylinder seal, internal engine noises, oil burning, etc.) and a comprehensive visual inspection. All defects must be noted.

  - Diagnostic strategies must have the goal of maximum emission reductions for repair funds spent. Technicians must avoid diagnostic strategies and repairs that would result in short term emission reductions or minimal reductions.

- The technician must document all serviceable and defective emission related parts and systems found during the diagnosis and repair process and must provide the documentation to the district. The district must retain a copy. ARB recommends that districts provide a standardized diagnostic form to aid technicians in recording basic diagnostic information.

- An example of a standardized diagnostic form, taken from BAR's training course for licensed Smog Check technicians, is provided in Figure X-1 at the end of this chapter.

- It may not be necessary to fill out the diagnostic data form completely because all the tests listed may not be appropriate for every vehicle. However, care should be used to ensure that all relevant data are recorded to reflect a complete diagnosis of the emission-related failure.

- The diagnostic form should be considered a guide, not a list of the complete diagnosis required. ARB staff recognizes that each vehicles diagnosis is unique. Other tests may be required to completely diagnose the reason for the emission failures.

- If the technician discovers tampers during the pre-repair test or during the diagnosis, the technician must stop performing the test, diagnosis, or repair, and contact the district to inform them that the vehicle have been tampered with. Tampered vehicles are not eligible for participation into a VRV until such tampering has been completely corrected.

- If repairs involve replacing a vehicle's catalytic converter, the replacement must be compliant with the provisions of the ARB's on board diagnostics II (OBD II) regulation, that is the replacement must be an OBD II complaint catalyst.

- To receive emission credit under the Carl Moyer Program, the repair of the vehicle must bring the vehicle's emissions into compliance with the Smog Check emissions standards for the model year and vehicle class. Repairs that leave a vehicle's emissions greater than the ASM emissions standards are not creditable.

- The invoice for the repair must clearly detail each repair and associated cost, in accordance with all applicable automotive repair laws and regulations, before the invoice is paid. The invoice must include all repairs performed on the vehicle

- The district must designate a qualified staff person or third party unaffiliated with the Smog Check station to handle complaints or disagreements that may arise between the vehicle owner and the repair station. The contact information for that person must be made available to all vehicle owners who participate in the program.

  - The district should maintain a record of disputes and their resolution for use in evaluating and improving the program.

C. Evaporative Repairs

- Districts may, at their option, conduct evaporative testing on vehicles identified as potential exhaust high emitting vehicles and brought in for repairs.

- Low pressure fuel evaporative testing must be conducted using models that have been submitted to BAR for certification. Stations must follow testing and repair procedures prescribed in policy or regulations adopted by BAR.

- Evaporative testing must be conducted in accordance with the manufacturers standard operating procedures and the protocols for low pressure fuel evaporative testing developed by BAR.

- Only vehicles that fail the low pressure fuel evaporative test are eligible for evaporative repairs.

- Evaporative repairs must bring the vehicle's emissions into compliance with the low pressure fuel evaporative test to be creditable.

D. Particulate Matter Repairs

- If a viable method to measure PM emissions from vehicles is demonstrated, districts have the option measuring the PM emissions of vehicles identified as possible high emitters and quantify the emission reductions of repairing PM high emitting vehicles, subject to ARB approval.

- If a district intends to identify and quantify emission reductions from repairing PM high emitting vehicles, the district's VRV program plan must specify the analytical approach that would be used to measure and quantify PM emissions.

E. Calculating Emission Reductions

- Emission benefits are calculated from the difference between the pre and post-repair Smog Check ASM test where the post ASM test is a full ASM test, not a "fast pass" test.

  – Vehicles not testable under the ASM test (e.g., 4-wheel or all wheel drive vehicles) may be given a TSI Smog Check test to determine emissions.

  – The Smog Check test must be conducted by a BAR-licensed technician and must be conducted in accordance with BAR regulations and procedures.

- The pre and post repair Smog Check testing should be as close to the time of repair as possible.

- To calculate pre- and post-repair emission rates, the pollutant concentrations measured in the ASM test are converted to a federal test procedure (FTP) based gram per mile emission rate using the conversion equations developed by Eastern Research Group and Sierra Research and used in the ARB and BAR's *2004 Evaluation of the California Enhanced Inspection and Maintenance (Smog Check) Program*. The conversion equations are listed in Table X-1.

- The vehicle miles traveled (VMT) are assumed to be the average VMT of the vehicle's model year based on the ARB's motor vehicle emission model. The average VMT for each model year is listed in Table X-2.

- The life of the emission credit for exhaust and evaporative repairs is 1 year.

- The mass emission reduction is equal to the gram per mile emission reduction multiplied by the VMT multiplied by the one year credit life.

  Emission Reductions = $[ER_{pre\text{-}repair} - ER_{post\text{-}repair}]$* VMT * Life

  Where: $ER_{pre\text{-}repair}$ = Emission rate of vehicle prior to repair, based on pre-repair Smog Check converted to gram per mile rate using ASM-FTP conversion
  $ER_{post\text{-}repair}$ = Emission rate of vehicle after repair, based on post-repair Smog Check converted to gram per mile rate using ASM-FTP conversion
  VMT = Vehicle miles traveled of vehicle
  Life = Life of repair = 1 year

- The emission reduction from evaporative repairs is assumed to be equal to the average emission reductions estimated by ARB staff in its evaluation of the low pressure evaporative test, as summarized in *Environmental Impacts of Implementing A Low Pressure Evaporative Test in the California Smog Check Program*, released November 29, 2005. [http://www.arb.ca.gov/msprog/smogcheck/evap_report.pdf] These benefits on a gram per vehicle per day basis are:

	Emission Reduction
Hot Soak (gram per vehicle per day)	3.28
Diurnal Loss (gram per vehicle per day)	2.07
Running Loss (gram per vehicle per day)	12.66
Total Evaporative Benefit (gram per vehicle per day)	18.0
Total Evaporative Benefit (pounds per vehicle per year)	**14.5**

- Air districts retain the option of proposing modifications to the calculation methodology, where necessary, to reflect unique elements of their program. Districts must provide technical justifications to support any proposed modifications to the default methodology in their VVR program plan. The district must receive written approval from ARB to use a modified methodology.

  – If a district receives approval to use a modified calculation methodology, emission reductions from all vehicles repaired must be calculated in accordance with that approved methodology.

F. Calculating Cost-Effectiveness

- Cost-effectiveness must be calculated in accordance with the methodology described in Appendix C of *The Carl Moyer Program Guidelines – Approved Revision 2005*.

- The district must include the State funds expended on the program-related costs identify and repair high emitting vehicles in the cost-effectiveness calculations.

  – Program-related costs are the costs directly linked to conducting RSD measurements, Smog Check tests, diagnosing vehicles, and repairing vehicles.

  – Broad programmatic costs (e.g. the cost of RSD) which cannot be attributed to retiring a specific vehicle should be distributed proportionally across each vehicle retired. If the district is running a VRV program in conjunction with the VAVR program, these costs should be distributed across each vehicle repaired or retired.

  – All State funds used to pay for diagnosing and attempting to repair vehicles that are ultimately deemed unrepairable or are unsuccessful in lowering emissions below the Smog Check emission standards must also be included into the cost-effectiveness calculations. These costs should be distributed across each vehicle successfully repaired.

  – The program cost-effectiveness must calculated for each year of program funding and reported in a district's annual and final report for that year of funding.

- If the district has a cap on the amount it pays for repairs, vehicle owners may contribute their own funds to pay for repairs that exceed the district cap. Funds contributed by vehicle owners would not be included in the cost-effectiveness calculation.

- State funds used to pay for the administrative costs of running VAVR programs are not included in the cost-effectiveness calculations, but must be accounted for relative to the administrative limits associated with each funding source. Administrative costs include funds spent on outreach, contacting potential participants, data analysis, and development of data analysis tools such as databases.

G. Reporting and Record Keeping

- The district shall retain detailed records of each vehicle repaired and shall summarize the transactions in an annual report to the ARB. The report shall contain but not be limited to:

  1. District and district contact name and number

2. Make, model, and year of vehicle of each vehicle tested, diagnosed, and/or repaired
3. Vehicle VIN and license number
4. Name, address, and phone number of vehicle owner
5. Name, address, and telephone number of the business conducting the repair
6. Amount paid for each repair and nature of each repair
7. Date of repair
8. Data identifying vehicle as potential high emitting vehicle for VRV participation (RSD readings, etc.)
9. Pre and post ASM Test results
10. Emission reductions claimed
11. Verification that vehicle met registration requirement
12. Date next scheduled Smog Check

H. VRV Program Plan

- A district shall submit a VRV program plan to the ARB for approval prior to initiating the program. If the VRV program is being run in coordination with a VAVR program, one program plan can be submitted covering both elements if the district chooses.

- The district must receive written approval of the plan from the ARB's Executive Officer prior to implementing a VRV program.

- A district's VRV program plan must at a minimum include:

    1. The name, title, and telephone number of the district contact for the VRV program.
    2. An evaluation of environmental justice considerations including, but not limited to, outreach addressing community needs.
    3. An estimate of the number of vehicles that may be repaired and an estimate of the cost-effectiveness of the program along with all assumptions and calculations that were used to derive the estimate (recognizing that the ultimate cost-effectiveness will depend on the mix of vehicles actually repaired).
        - Any proposed modifications to the default emission reduction calculation methodology must be fully described.
    4. A description of the technology/method (RSD, high emitter profile, etc.) that will be used to identify potential high emitting vehicles for participation.
        - For RSD-based programs, the plan must include a detailed protocol describing the installation, calibration, and operation of RSD that will be used to identify high emitting vehicles along with the methodology for processing of the data collected.
    5. A copy of the letter that the district intends to send to vehicle owners soliciting their voluntary participation in the project.
    6. A copy of the contract with the business(es) that will be performing the vehicle testing and repairs.

7. A scope of work for the business(es) that will be performing the vehicle testing and repairs including the general diagnosis and repair protocols to ensure cost-effective and durable repairs.
8. A description of the methods that will be used and a timetable for monitoring and auditing vehicle repair operations.
9. The methodology for verifying that a vehicle is eligible for inclusion in the VRV program including confirmation of compliance with any Smog Check requirements.
10. A sample of the records that will be required of the business(es) that will be performing the vehicle repairs.
11. An evaluation of the potential for funding repairs that owners would have made anyway in absence of VRV program funding.
12. If a district intents to include an evaporative testing and repair element in its program, the plan must specify which test equipment it intends to use.
13. If a district intents to include a PM testing and repair element in its program, the plan must specify which test equipment and test protocol it intends to use.
14. A description of elements of the district VRV program that are more stringent than those listed in the guidance (if a district chooses to impose requirements beyond those required).
15. Any additional information necessary to explain or clarify how the district plan complies with the VRV guidance and the Carl Moyer Program.
16. The plan shall include itemized, estimated project costs including, but not limited to, the funds allocated to vehicle repair and the number of vehicles to be repaired; the funds allocated to vehicle retirement and the number of vehicles to be retired; and the costs allocated to RSD data collection, data analysis, outreach, and solicitation of vehicle owners.

- The project must follow the plan, and any substantive changes must be pre-approved by the EO.

Table X-1
ASM-FTP Correlation Equations[1]

Pre-1990 Model Year Correlation Equations

```
FTP_HC = 1.2648 * exp( - 4.67052
                + 0.46382 * hc_term
                + 0.09452 * co_term
                + 0.03577 * no_term
                + 0.57829 * wt_term
                - 0.06326 * my_term
                + 0.20932 * trk)

FTP_CO = 1.2281 * exp( - 2.65939
                + 0.08030 * hc_term
                + 0.32408 * co_term
                + 0.03324 * co_term**2
                + 0.05589 * no_term
                + 0.61969 * wt_term
                - 0.05339 * my_term
                + 0.31869 * trk)

FTP_NOX = 1.0810 * exp( - 5.73623
                + 0.06145 * hc_term
                - 0.02089 * co_term**2
                + 0.44703 * no_term
                + 0.04710 * no_term**2
                + 0.72928 * wt_term
                - 0.02559 * my_term
                - 0.00109 * my_term**2
                + 0.10580 * trk)
```

where:

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hc_term = ln( (ASM1_HC*ASM2_HC)^.5 ) - 3.72989
co_term = ln( (ASM1_CO*ASM2_CO)^.5 ) + 2.07246
no_term = ln( (ASM1_NO*ASM2_NO)^.5 ) - 5.83534

MY_Term = model_year - 1982.71

wt_term = ln( vehicle_weight in pounds)

TRK = 0 if vehicle is a passenger car and 1 if vehicle is a light-duty truck
```

[1] Conversion equations developed by Eastern Research Group and Sierra Research and used in the ARB and BAR's *2004 Evaluation of the California Enhanced Inspection and Maintenance (Smog Check) Program*.

1990 and Newer Model Year Correlation Equations

FTP_HC = 1.1754 * exp(- 6.32723
+ 0.24549 * hc_term
+ 0.09376 * hc_term**2
+ 0.06653 * no_term
+ 0.01206 * no_term**2
+ 0.56581 * wt_term
- 0.10438 * my_term
- 0.00564 * my_term**2
+ 0.24477 * trk) ;

FTP_CO = 1.2055 * exp(0.90704
+ 0.04418 * hc_term**2
+ 0.17796 * co_term
+ 0.08789 * no_term
+ 0.01483 * no_term**2
- 0.12753 * my_term
- 0.00681 * my_term**2
+ 0.37580 * trk) ;

FTP_NOX = 1.1056 * exp(- 6.51660
+ 0.25586 * no_term
+ 0.04326 * no_term**2
+ 0.65599 * wt_term
- 0.09092 * my_term
- 0.00998 * my_term**2
+ 0.24958 * trk)

where:

hc_term = ln (ASM1_HC*ASM2_HC)^.5) - 2.32393 ;
co_term = ln (ASM1_CO*ASM2_CO)^.5) + 3.45963 ;
no_term = ln (ASM1_NO*ASM2_NO)^.5) - 3.71310 ;

MY_Term = model_year - 1993.69;
wt_term = ln(vehicle_weight in pounds)

TRK = 0 if vehicle is a passenger car and 1 if vehicle is a light-duty truck

For cases in which the HC or NO ASM scores are zero, they are set to 1 ppm; for cases in which the CO ASM score is zero, it is set to 0.01%.

Definitions:

FTP_HC = Estimated hydrocarbon FTP emission rate in grams per mile
FTP_CO = Estimated CO FTP emission rate in grams per mile
FTP_NO = Estimated NOx FTP emission rate in grams per mile
ASM1_HC = Measured ASM 5015 mode hydrocarbon concentration in ppm
ASM2_HC = Measured ASM 2525 mode hydrocarbon concentration in ppm
ASM1_CO = Measured ASM 5015 mode CO concentration in percent
ASM2_CO = Measured ASM 2525 mode hydrocarbon concentration in percent
ASM1_NO = Measured ASM 5015 mode NOx concentration in ppm
ASM2_NO = Measured ASM 2525 mode NOx concentration in ppm

Table X-2
Average Vehicle Miles Traveled by Model Year for Calendar Year 2007

Model Year	Annual VMT*
1965 and older	5,173
1966	5,250
1967	5,350
1968	5,485
1969	5,635
1970	5,786
1971	5,910
1972	6,048
1973	6,132
1974	6,163
1975	6,312
1976	6,376
1977	6,475
1978	6,544
1979	6,636
1980	6,701
1981	6,794
1982	6,893
1983	6,998
1984	7,172
1985	7,306
1986	7,497
1987	7,600
1988	7,763
1989	7,943
1990	8,108
1991	8,317
1992	8,538
1993	8,787
1994	9,022
1995	9,252
1996	9,540
1997	9,834
1998	10,176
1999	10,546
2000	10,912
2001	11,328
2002	11,824
2003	12,411
2004	13,150
2005	13,983

*Average vehicle miles traveled calculated using EMFAC Working Draft 2B (June 2006). Numbers are subject to change pending final version of emission inventory model.

Figure X-1
Sample Diagnostic Data Form[1]

DIAGNOSTIC DATA FORM

The following chart is designed to assist the CAP station technician in the diagnosis and repair of failing CAP vehicles. Each vehicle and its emission failure(s) are unique and may require further tests than those listed below. Not all vehicles may require these tests.

Factory test procedures take precedence over any generic test.

WRITE YES (Y), NO (N) OR READING/EXPLAINATION. DO NOT CHECK

CAP ID#	Year / Make / Model	Vehicle License #	Technician #	Date
			Work order #	

Confirm basic engine condition:

Engine condition: any smoking, knocking, head gasket leaks or any other degraded engine condition(s)? _____

(*As needed*) compression test, cylinder balance test, leak down test results (whichever test was appropriate)

#1 _____ #2 _____ #3 _____ #4 _____ #5 _____ #6 _____ #7 _____ #8 _____

Base timing _____ Total timing advance _____ Coolant Temp _____ Vacuum readings _____

Ignition system: overall condition, are there any misfires? (HC failures) What is the specific component of the ignition system that needs to be replaced / repaired? List below

_____

Fuel pressure within specs? Y/N _____ results_____

Air Injection System (if applicable) Is AIS functioning correctly? Y/N_____ if no, why _____

EGR system (if applicable) Is system functioning correctly? Y/N _____ Is valve getting vacuum? Y/N _____

Does engine stumble/die when valve is manually raised? Y/N _____ Is EGR valve defective? Y/N _____

Is system restricted? Y/N:_____ Is system plugged? Y/N _____ Other:_____

Are there any Factory Technical Service Bulletins (TSBs), recalls/warranties related to the emission failure? _____

Are there any Diagnostic Trouble Code(s) stored? If yes, are they emission related? If yes, record code(s) _____

If vehicle is OBDI did you clear the codes and did they return? If vehicle is OBDII what is recorded in "Freeze Frame Data"?

Is vehicle failing for monitors? _____

Oxygen Sensor: Low Voltage: _____mV High Voltage: _____mV Rise time: _____mS

NOTE: min/max/rate of change measured while artificially manipulating air/fuel mixture full rich & full lean.

Average voltage: _____ Is O2 sensor functioning correctly? _____

Is vehicle in fuel control? Y/N_____ If no is O2 biased? Rich Y/N _____ Lean Y/N _____

Will computer respond to an artificial O2 signal? Y/N, if no, why?

_____

What are fuel trim numbers under test conditions? _____

Cross-reference the failed emission(s) with the related failed test.

Final Diagnosis / What component(s) or system(s) need to be repaired or replaced and why

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CATALYTIC CONVERTER DIAGNOSTIC ROUTINE

Factory diagnostic/testing procedures take precedence over generic tests.

Cat tests are valid or useful to the extent the vehicle is in fuel control. CAT tests require certain conditions be created by upstream systems in order to be valid. Fuel control is not just a varying O2S and/or fuel metering device. Fuel control is defined as the vehicle's ability to control fuel in response to the O2S input signal keeping the air/fuel ratio at 14.7 to 1 (stoichiometric). CAT replacement is generally the last repair approved.

Do not request a CAT with other repairs associated with its efficiency.

DO NOT REQUEST A CAT ON A VEHICLE THAT IS NOT IN FUEL CONTROL.

RECORD ON THE WORK ORDER "THE VEHICLE IS IN FUEL CONTROL".

O2 snap test	CO2 cranking test	Pre CAT / Post CAT (intrusive test)	Factory specific temperature test
O2% ____ %	HC: _____ ppm	Pre CAT: _____ Post CAT: _____	temp in _____ temp out _____
	CO2: _____	CAT efficiency: _____%	

Two CAT tests are more conclusive than one. A generic temperature test alone is not acceptable. Temperature tests are best used to confirm another test. An intrusive test is an optional test to confirm the effectiveness of the reduction portion of the catalyst.

[1] Sample diagnostic form from BAR's training course to licensed Smog Check technicians. Not all fields may be relevant for district VRV program. Districts may design their own forms if they choose.