

**Attachment 1: Potential Certification Flexibility for Low-NOx Heavy-Duty Engines**

Tier	For a Low-NOx Engine Family Opting into ITR, All Existing Certification Requirements Would Apply PLUS the Following Potential Provisions
Tier 1	<ol style="list-style-type: none"> <li>1. Assigned deterioration factors (DFs) may be used to help determine compliance with applicable emission standards.</li> <li>2. Not required to meet in-use monitoring performance ratio (IUMPR) requirements.</li> <li>3. Must demonstrate readiness of major monitors.</li> <li>4. OBD System Demonstration                             <ul style="list-style-type: none"> <li>• One engine family per MY is exempt from counting as an additional engine family for the purposes of triggering an additional OBD demonstration data set.</li> <li>• May request use of OBD testing procedures that are not 40 CFR, Part 1065 compliant.</li> </ul> </li> <li>5. Production Vehicle/Engine Evaluation Testing                             <ul style="list-style-type: none"> <li>• May test just one unique production vehicle per engine family for verification of standardized requirements testing (instead of ten).</li> <li>• May request approval for testing of a minimum of ten percent of vehicles per monitoring performance group (instead of 15 vehicles per monitoring performance group).</li> <li>• All production vehicle evaluation (PVE) test results are due one year from the start of production (instead of three months for verification of standardized requirements and six months for verification of monitoring requirements).</li> </ul> </li> <li>6. Up to five deficiencies related to NOx monitoring technology excluded from calculation of fines.</li> <li>7. For major monitors required to indicate a malfunction before emissions exceed a certain threshold, recall threshold is 3x the applicable monitor malfunction criteria (rather than 2x).</li> </ol>
Tier 2	<ol style="list-style-type: none"> <li>1. Production Engine Evaluation Testing                             <ul style="list-style-type: none"> <li>• May test just five unique production vehicles per engine family (instead of ten) for verification of standardized requirements testing.</li> <li>• May request approval for testing of a minimum of ten percent (instead of 15 percent) of vehicles per monitoring performance group.</li> <li>• All production vehicle evaluation (PVE) test results are due one year from the start of production (instead of three months for verification of standardization requirements and six months for verification of monitoring requirements).</li> </ul> </li> <li>2. One engine family per MY is exempt from counting as an additional engine family for the purposes of triggering an additional OBD demonstration data set.</li> <li>3. Up to three deficiencies related to NOx monitoring technology excluded from calculation of fines.</li> <li>4. For major monitors required to indicate a malfunction before emissions exceed a certain threshold, recall threshold is 3x the applicable monitor malfunction criteria for NOx (rather than 2x).</li> </ol>
Multiple Low NOx Engine Option	<p>A manufacturer with multiple eligible low-NOx engine families that have not participated in ITR in any prior MY may request the following instead of the Tier 1 and Tier 2 flexibility identified above.</p> <ol style="list-style-type: none"> <li>1. One ITR “early compliance” low NOx engine family meets full certification and OBD requirements in the current and all future model years.</li> <li>2. A second ITR “enhanced flexibility” low NOx engine family is exempt from OBD emission threshold monitoring requirements for the current MY, and must be fully OBD compliant in all future MYs.</li> </ol> <p><u>Potential Eligibility Requirements</u>                      For the current and subsequent three MYs, both the early compliance and enhanced flexibility low NOx engine family must not participate in NOx averaging, banking or trading programs and be surplus to all applicable rules, regulations, and other air quality mandates.</p>

Staff is evaluating potentially simplifying the proposed ITR by specifically defining eligible model years for low-NOx ITR engines to help accelerate deployment prior to the 2023 federal health-based eight-hour ozone standard attainment date and implementation of a potential mandatory low-NOx heavy-duty engine emission standard in 2023-2027 (as described in ARB’s Mobile Source Strategy Discussion Draft (October 2015)).

**Attachment 2: Potential ITR Certification Flexibility for Hybrid Heavy-Duty Engines**

Tier	<p align="center"><b>For a Heavy-Duty Hybrid Engine Family Opting into ITR, All Existing Certification Requirements Would Apply PLUS the Following Potential Provisions</b></p>
	<p><u>Emission Testing:</u> The hybrid vehicle in which the hybrid engine family receiving ITR flexibility is installed must demonstrate no significant increase in key criteria pollutants relative to its appropriate non-hybrid counterpart pursuant to this regulation’s emission test procedures to be eligible for ITR flexibility. <i>Staff welcomes stakeholder comment regarding the appropriate timing of this emission testing requirement. Requiring emission testing prior to Tier 1 could potentially better align with incentive funding requirements.</i></p>
Tier 1	<ol style="list-style-type: none"> <li>1. Assigned DFs may be used to help determine compliance with applicable emission standards.</li> <li>2. EMD, with NOx after-treatment monitoring, instead of heavy-duty OBD.</li> </ol>
Tier 2	<ol style="list-style-type: none"> <li>1. Assigned DFs may be used to help determine compliance with applicable emission standards.</li> <li>2. <i>Should Tier 2 require use of a standardized data communication protocol, diagnostic link connector, malfunction indicator lamp, or data available in accordance with J1979 or J1939 specifications?</i></li> <li>3. OBD System Demonstration                         <ul style="list-style-type: none"> <li>• One engine family model year is exempt from counting as an additional engine family for the purposes of triggering an additional OBD demonstration data set.</li> <li>• A hybrid engine family that has been previously certified to meet full heavy-duty OBD or OBD II requirements is exempt from OBD system demonstration requirements. However, any modifications made to such engine since that OBD or OBD II compliance shall nullify this exemption.</li> <li>• PHEVs must demonstrate the OBD system can be set to “complete” since the fault memory was last cleared for all of the required monitoring categories.</li> </ul> </li> <li>4. Production Vehicle/Engine Evaluation Testing                         <ul style="list-style-type: none"> <li>• May test just five unique production vehicles per engine family (instead of ten) for verification of standardized requirements testing.</li> <li>• May request approval for testing of a minimum of ten percent (instead of 15 percent) of vehicles per monitoring performance group.</li> <li>• All production vehicle evaluation (PVE) test results are due one year from the start of production (instead of three months for verification of standardization requirements and six months for verification of monitoring requirements).</li> </ul> </li> <li>5. Up to two deficiencies related to implementation of the hybrid technology excluded from calculation of fines.</li> </ol>

Staff is evaluating potentially simplifying the proposed ITR by specifically defining eligible hybrid engine eligibility timelines geared to help accelerate deployment of the next generation of robust hybrid and zero-emission truck and bus technologies.

### Attachment 3: Potential ITR Technology Diversity Element

#### Potential Eligibility Criteria

The ITR Technology Diversity Element would provide OBD and certification flexibility for other new advanced engine or heavy-duty vehicle technology that meets these four criteria:

1. represents a significant advancement in on-road heavy-duty engine hardware or architecture (i.e., aftertreatment and engine software changes would be excluded);
2. achieves a NO<sub>x</sub> or CO<sub>2</sub> emission reduction;
3. has not previously been certified and deployed in California; and
4. presents a potential OBD or certification compliance challenge.

#### Two Potential Categories

##### 1) Represents Significant Advancement in Heavy-Duty Engine Architecture

- Potential Technologies Include:
  - Camless engine
  - Opposed piston engine
  - Free piston engine
- *Should ITR include new engine technologies that are less advanced and may provide more modest emission benefits, such as Rankine Waste Heat Recovery?*
- *Should ITR include new alternative fuel engine technologies, such as DME engines, that provide a CO<sub>2</sub> benefit relative to diesel and natural gas when using a low carbon intensity fuel? If so, how can we ensure use of low-carbon intensity fuel?*

##### 2) Heavy-Duty Zero-Emission Vehicle Enabling Technology

This technology utilizes a certified off-road or gen set engine or an engine from a certified light- or medium-duty vehicle as a range extender in a hybrid heavy-duty vehicle that achieves 35+ miles All-Electric Range (AER). Such an engine would have to be an electronic engine, be the cleanest in its class, operate at steady state only, and, if diesel, be equipped with a diesel particulate filter. A heavy-duty hybrid with 35+ miles AER that utilizes such an engine would have to certify utilizing ARB's Hybrid Heavy-Duty Vehicle Test Procedures (December 2013).

- *Data Collection.* Telematics and engine parameter data would be provided to ARB annually to inform annual ITR eligibility and certification, potential ITR amendments, and other potential zero-emission commercial vehicle technology deployment strategies.
- *Potential Issues:*
  - *OBD.* Engines originally used in light-duty vehicles might be able to ramp up to HD OBD compliance, but near-term HD OBD may be more difficult for off-road or gen set engines.
  - *Durability.* Should ITR require these engines eventually meet 435,000 mile heavy-heavy-duty durability, or perhaps set aspirational OBD and durability goals, require in-use durability testing, and commit to a future feasibility assessment?

*This document is only intended to encourage stakeholder feedback, is incomplete, and should not be construed as a formal regulatory proposal.*