

Workshop for 2020 OBD Regulations Update

Emissions Certification and Compliance Division

California Air Resources Board

February 27, 2020

El Monte, CA

OBD Regulatory Update

- Affected Regulations:
 - OBD II Regulations: California Code of Regulations (CCR) sections 1968.2 and 1968.5
 - HD OBD Regulations: CCR sections 1971.1 and 1971.5

OBD Regulatory Update

- Projected Schedule (subject to change)
 - Public Workshop – El Monte, CA
 - February 27, 2020 (today)
 - Finalization of OBD Regulatory Proposal
 - Projected date: Late Spring 2020
 - 45-Day Notice Package
 - Finalization of package (to begin internal review process): early June 2020
 - Publication date: Late October 2020
 - Includes notice, staff report, and proposed regulatory language
 - Board Hearing: December 10-11, 2020

OBD Regulatory Update

- CARB Proposal (or Workshop Agenda)
 - Unified Diagnostic Services (UDS) (OBD II/J1979 HD OBD)
 - Particulate Matter (PM) Filter Monitor In-Use Performance Monitor Ratio (IUMPR) Requirement (OBD II and HD OBD)
 - Other Proposed Amendments (OBD II)
 - Cold Start Emission Reduction Strategy (CSERS) Monitoring Requirements (OBD II and HD OBD)

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Unified Diagnostic Services (UDS) for OBD

➤ Background:

- Industry concerned about limited number of remaining undefined 2-byte diagnostic trouble codes (DTC) and the need for additional DTCs for hybrid vehicles.
 - Indicating 2-byte DTCs will run out soon.
- Industry proposed to CARB the implementation of UDS services
 - Provides 3-byte DTCs, significantly increasing number of DTCs that can be defined.
 - Has features for data access that improve usefulness of the generic scan tool (GST) to repair vehicles and provide needed information on in-use monitoring performance.
 - Combined GST and service information would enable technicians to execute all monitors in a more timely manner in inspection and maintenance (I/M) scenarios.

Unified Diagnostic Services (UDS) for OBD

► Background (cont.):

- SAE J1979-2: the proposed standard that documents select ISO 14229-1 (UDS) services that can be used for OBD communication on Controller Area Network (CAN) data links.
 - These proposed UDS services for OBD will be referred to as “OBD/UDS” within this presentation.
 - OBD/UDS includes the porting of classic J1979 Modes \$01 to \$0A as well as additional features such as DTC-specific readiness, test results and IUMPR to OBD.

OBD/UDS Amendments – Freeze Frame

- Current Requirement:
 - Only one freeze frame required (1968.2(g)(4.3.4)).
 - Freeze frame for misfire and fuel system malfunctions have priority.
- Proposal: Add more freeze frame information to provide additional data for a repair technician to diagnose and repair an emission-related malfunction.
 - Require freeze frame for at least 5 DTCs, each with 2 frames per DTC (one for the 1st fault occurrence and the other for the most recent fault occurrence).
 - Eliminate freeze frame priority requirements.
 - 1st freeze frame - save all Parameter Identifiers (PIDs) required in 1968.2(g)(4.2.1)(A) on 1st fault occurrence.
 - 2nd freeze frame - update at least once per driving cycle anytime a fault occurs, and record all PIDs required in 1968.2(g)(4.2.1)(A).

OBD/UDS Amendments - Readiness

Readiness Group Categories

- Current Requirement: Readiness groups defined in 1968.2(g)(4.1)

Spark Ignition Readiness Groups	Compression Ignition Readiness Groups
Misfire	Misfire
Fuel system	Fuel system
Comprehensive component	Comprehensive component
Catalyst	Non-Methane Hydrocarbon (NMHC) catalyst
Heated catalyst	Oxides of Nitrogen (NOx) after treatment
Evaporative system	Boost pressure system
Secondary air system	Exhaust gas sensor
Oxygen sensor	Particulate Matter (PM) Filter
Oxygen sensor heater	Exhaust Gas Recirculation (EGR) and/or Variable Valve Timing, Lift, and/or Control (VVT) system
Exhaust Gas Recirculation (EGR) and/or Variable Valve Timing, Lift, and/or Control (VVT) system	

OBD/UDS Amendments - Readiness

- Proposal: Expand readiness group list to provide more comprehensive coverage of monitors in readiness.
 - Include all monitors subject to the requirements of 1968.2(d)(3.1) & (3.2) (i.e., IUMPR requirements).
 - Include all misfire and fuel system monitors.

OBD/UDS Amendments - Readiness

Proposed Readiness Groups

CCR Section 1968.2	Readiness Group
(e)(1)	Catalyst Monitoring
(e)(2)	Heated Catalyst Monitoring
(e)(3), (f)(3)	Misfire Monitoring
(e)(4)	Evaporative System Monitoring
(e)(5)	Secondary Air System Monitoring
(e)(6), (f)(4)	Fuel System Monitoring
(e)(7), (f)(5)	Exhaust Gas Sensor Monitoring
(e)(8), (f)(6)	Exhaust Gas Recirculation (EGR) System Monitoring
(e)(9), (f)(10)	Positive / Crankcase Ventilation (PCV) System Monitoring
(e)(10), (f)(11)	Engine Cooling System Monitoring
(e)(11), (f)(12)	Cold Start Emission Reduction Strategy Monitoring

OBD/UDS Amendments - Readiness

Proposed Readiness Groups (cont.)

CCR Section 1968.2	Readiness Group
(e)(13), (f)(15)	Variable Valve Timing, Lift, and/or Control (VVT) System Monitoring
(e)(14)	Direct Ozone Reduction (DOR) System Monitoring
(e)(15), (f)(15)	Comprehensive Component Monitoring
(e)(16), (f)(16)	Other Emission Control or Source System Monitoring
(f)(1)	Non-Methane Hydrocarbon (NMHC) Converting Catalyst Monitoring
(f)(2)	Oxides of Nitrogen (NOx) Converting Catalyst Monitoring
(f)(7)	Boost Pressure Control System Monitoring
(f)(8)	NOx Adsorber Monitoring
(f)(9)	Particulate Matter (PM) Filter Monitoring

OBD/UDS Amendments - Readiness

Readiness Completion Requirements

- Current Requirement:
 - 1968.2(g)(4.1) - Diesel/gasoline misfire and comprehensive component monitors (CCM) required to always indicate complete.
 - 1968.2(g)(4.1.8) – Fuel system monitors (except for the cylinder imbalance monitor) not included in readiness status determination.
- Proposal: Enhance readiness groups to benefit I/M programs by better indicating the emission system and component readiness status of the vehicle.
 - Misfire: Readiness set to complete after 4,000 fueled engine revolutions.
 - Fuel System: Readiness set to complete when both 4,000 fueled engine revolutions occur and all fuel system monitors subject to IUMPR requirements complete.
 - Comprehensive Components: Readiness set to complete when all CCM monitors subject to IUMPR requirements complete.

OBD/UDS Amendments - Readiness

DTC-Specific Information in Readiness

- ▶ Issue: I/M programs using readiness groups' completion status as PASS/FAIL criteria during emissions inspection.
 - ▶ When readiness groups are incomplete, difficult to determine which monitor(s) within the group are preventing completion.
 - ▶ Difficult to determine what driving conditions are required to set completion when a manufacturer-specific drive cycle is unsuccessful.
- ▶ Proposal: List all DTCs in a readiness group along with additional information for each DTC such as DTC-specific readiness and other DTC-specific info (i.e., pending status, confirmed status, complete this drive cycle).
 - ▶ When a readiness group is selected with a GST, a list of all DTCs associated with the readiness group is shown.
 - ▶ Can be used as a tool to help technicians set readiness to complete using enable criteria provided in service literature for the incomplete monitor(s).

OBD/UDS Amendments – Readiness

Miscellaneous

- Proposal: For individual electronic components used in major monitors (e.g., EGR valves/actuators), include component monitors in the major monitor readiness group.
 - Subject to test results and IUMPR requirements.
- Proposal: Use both bit 4 (TestNotCompletedSinceLastClear) and bit 2 (PendingDTC) of the DTC status-byte to determine which DTCs are preventing readiness group completion.
 - DTC specific readiness originally planned for bit 4, but UDS definition for readiness group completion (pending failures result in readiness completion) does not match OBD definition (pending failures do not result in readiness completion).

OBD/UDS Amendments - DTC

➤ DTC Status Bits

DTC Status Bits		Supported	Remarks
0	TestFailed	OBD II	
1	TestFailedThisOperationCycle	OBD II	Used for trigger condition for freeze frame (latest occurrence)
2	PendingDTC	OBD II	
3	ConfirmedDTC	OBD II	
4	TestNotCompletedSinceLastClear	OBD II	DTC based readiness since last clear
5	TestFailedSinceLastClear	Optional for OEM	Not required for OBD II
6	TestNotCompletedThisOperationCycle	OBD II	DTC based readiness this operation cycle
7	WarningIndicatorRequested	Optional for OEM	Not required for OBD II

OBD/UDS Amendments – Test Results

- ▶ Current Requirement: Required to report test results for monitors listed in 1968.2(g)(4.5).
- ▶ Issue: Manufacturer-defined Test Identifiers (TIDs) are used to identify each test performed by an OBD monitor.
 - ▶ Difficult for vehicle repair technicians and CARB OBD staff to correlate TIDs to specific DTCs/monitors without detailed reference material often missing in service literature.
 - ▶ Monitor test results intended to help the vehicle repair technician identify systems that may be close to failing and to verify an emissions repair.
- ▶ Proposal: Report test results by DTC from all monitors subject to the IUMPR requirements except for CCM.
 - ▶ DTC-specific test results also required for all misfire and fuel system monitors, even though they are not subject to IUMPR requirements.
 - ▶ This new service will aid in the identification of monitor test results.

OBD/UDS Amendments – Test Results

- Proposal (cont.):
 - Allow only one set of test results/TID per DTC
 - Issue: How to account for monitors with multiple pass/fail criteria and components with multiple monitors that are represented by one DTC?
 - Example: Purge flow diagnostics that can pass based upon fuel trim, engine speed, or manifold pressure changes.
 - Issue with misfire monitor addressed in next slide.
 - Industry to present ideas.

OBD/UDS Amendments – Test Results

- Current: For misfire monitor, test results stored in 2 separate TIDs.
 - Misfire monitor test results include the most recent test result and the Exponentially-Weighted Moving Average test result.
- Proposal: For misfire monitor, make available one of the TIDs via the DTC-specific test results service and the remaining TID(s) via the UDS data stream service.
 - DTC-specific test results service allow only one set of test results/TID per DTC. UDS data stream service allows more than one set of test results/TIDs per DTC for misfire monitor only.

OBD/UDS Amendments - IUMPR

- Current Requirement: Only specific subset of monitors listed under 1968.2(d)(3.2.2) required to track and report IUMPR data.
- Proposal: Report DTC-specific IUMPR for all monitors that are subject to the IUMPR requirements.
 - Will improve identification of vehicles that are not meeting minimum IUMPR requirements at the fleet level.

OBD/UDS Amendments – Unresolved Issues

- ▶ Industry request: Use SAE J1939 DTCs instead of SAE J2012 DTCs for OBD/UDS for serviceability reasons.
 - ▶ CARB wants to understand the pros and cons.
- ▶ Industry request: To have a 10-second response delay when the scan-tool requests a large amount of data from an OBD module after a key on, or a code clear event.
 - ▶ CARB wants to understand the real technical limitations and impacts to communications to a scan tool.

OBD/UDS Amendments – SAE Standards

- Proposal will incorporate by reference relevant SAE standards to accompany the proposed UDS-related amendments (list subject to change):
 - Updated version of SAE J2012 “Diagnostic Trouble Code Definitions”
 - Updated version of SAE J1699-3 “Vehicle OBD II Compliance Test Cases”
 - New standards SAE J1979-2

OBD/UDS Amendments

- Proposal: To require implementation of UDS services on all LD and MD OBD II vehicles.
 - Option to start as early as 2022MY.
 - Excludes UDS IUMPR amendments.
 - Must be able to verify standardization requirements (in case SAE J1699 not yet updated to accommodate UDS).
 - 2026+MY: Must meet all UDS amendments, including IUMPR (except as provided below for hybrids).
 - Hybrid vehicles: 30/60/100% 2026-2028MY phase-in of IUMPR requirements for hybrid components.
 - For IUMPR issues, may be granted deficiencies, but no fines for 2026-2028MY.

OBD/UDS Amendments

- ▶ Proposal (cont.): For HD engines using the ISO 15765-4 protocol:
 - ▶ Engines meet same implementation schedule as OBD II in previous slide, with following exception:
 - ▶ Implement UDS in accordance with SAE J1979-2, but not allowed to implement all the extra features included with UDS (i.e., only required to implement the modes and information currently available in SAE J1979).

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PM Filter Monitor IUMPR Requirement

- Current Requirement: Minimum IUMPR for PM Filter Filtering Performance Monitor:
 - 0.100 for 2016-2018MY MD Engine-Dyno Certified Vehicles, 2019-2021MY LD and MD Chassis-Dyno Certified Vehicles, 2013-2023MY HD Engines.
 - 0.336 for 2019+MY MD Engine-Dyno Certified Vehicles and 2022+MY LD and MD Chassis-Dyno Certified Vehicles.
 - 0.300 for 2024+MY HD Engines.
- Issue: Manufacturers have indicated issues meeting the 0.336/0.300 ratio.
 - Manufacturers indicated monitors cannot meet this requirement using current PM sensor technology.
- Proposal: No proposal at moment – CARB staff currently reviewing manufacturer data to determine appropriate action.

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Diesel Feedgas Generation Monitoring Requirements

- ▶ Current Requirement: Monitor NMHC catalysts and catalyzed PM filters for feedgas generation performance.
 - ▶ Test-Out Criteria – not required to monitor if all faults do not cause emissions to
 - ▶ (1) increase by >15% to >30% of the NO_x or NMOG+NO_x standard (% based on the emission standards the vehicle is certified to), AND
 - ▶ (2) exceed NO_x (or NMOG+NO_x) standards.
- ▶ Issue: Lack of feasible monitoring strategies.
- ▶ Proposal: Increase test-out criterion (1) for all vehicles to >30% of standards.

Scan Tool Function for Evaporative Emissions System Repair

- ▶ Background: OBD II system required to monitor a vehicle's evaporative system (EVAP) for leaks as small as one caused by a 0.020" diameter orifice.
- ▶ Issue: OBD II system not capable of determining the location of the leak.
 - ▶ Off-board diagnostics techniques often the only reliable methods of determining the location of leaks (e.g., off-board EVAP testers use smoke to identify leak location).
 - ▶ Off-board techniques require the vehicle's EVAP to be sealed (close off the air inlet vent solenoid, purge solenoid, etc.), which has proven difficult even with an OEM scan tool.
- ▶ Proposal: Require a standardized function that will enable the GST to seal the EVAP system in preparation for an off-board leak test.

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CSERS Monitoring Requirements

- Background:
 - Primary intent has been to monitor catalyst heating and reduced cold engine out emissions.
 - CARB has been requested to review the CSERS requirements to better ensure consistent interpretation and implementation.
 - Suggest CSERS requirements need more clarity to avoid confusion.
 - Suggest a metric to better determine what is subject to CSERS monitoring.
- Issue: How to determine what strategies or elements/components need to be monitored per the CSERS monitoring requirements?
- Seeking Feedback on Proposal concepts:
 - Possible list of components/elements that must be considered for monitoring.
 - Possible performance criteria based on comparison of FTP Bag 1 and Bag 3.
 - Proposal needs to ensure catalyst heating is monitored per CSERS, other emission controls, or both.

CSERS Monitoring Requirements

- Possible list of CSERS components/elements required for monitoring

Gasoline	Diesel
Fuel Pressure	EGR Flow
Idle Control	EGR Cooler Bypass Control
Ignition Timing Performance	Closed-Loop Boost Control
Variable Valve Timing	Open-Loop Variable Geometry Turbo
Split/Multiple Injections (Duration & Timing)	Swirl Valve Position
Intake Air Runner Control	Fuel Rail Pressure
Exhaust Temperature Too Low	Pilot Injection Quantity/Timing
Electrical Wastegate Position	Main Injection Quantity/Timing
Swirl Control Valve	Post Injection Quantity/Timing
Transmission Shift Patterns	Transmission Shift Patterns
Air/Fuel Ratio Control	Exhaust Throttle
Torque Reserve	Intake Throttle

Challenges in Identifying CSERS

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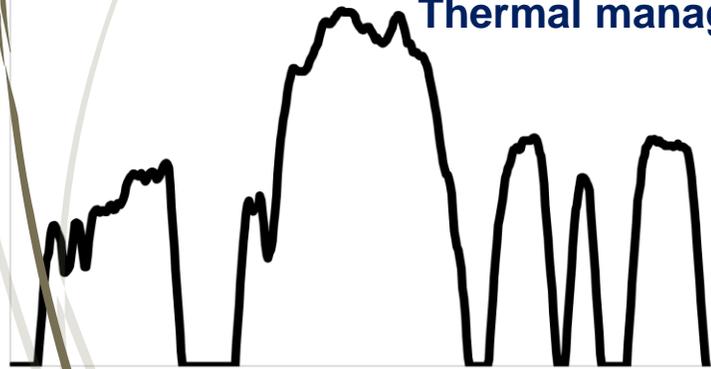
- Thermal management strategy active longer in FTP75 Bag 1 cold start compared to the two FTP75 Bag 3 hot start scenarios.
- Different behavior during cold start versus hot re-start. Extended activation specific to cold start.
- What difference should result in CSERS monitoring?

FTP75 Bag 1 cold start

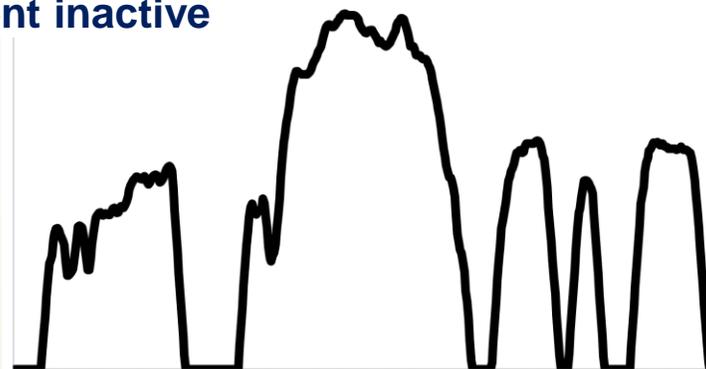
Thermal management active



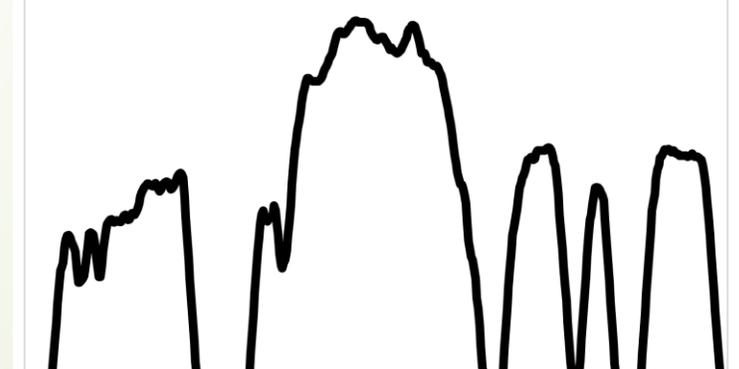
Thermal management inactive



FTP75 Bag 3 hot start

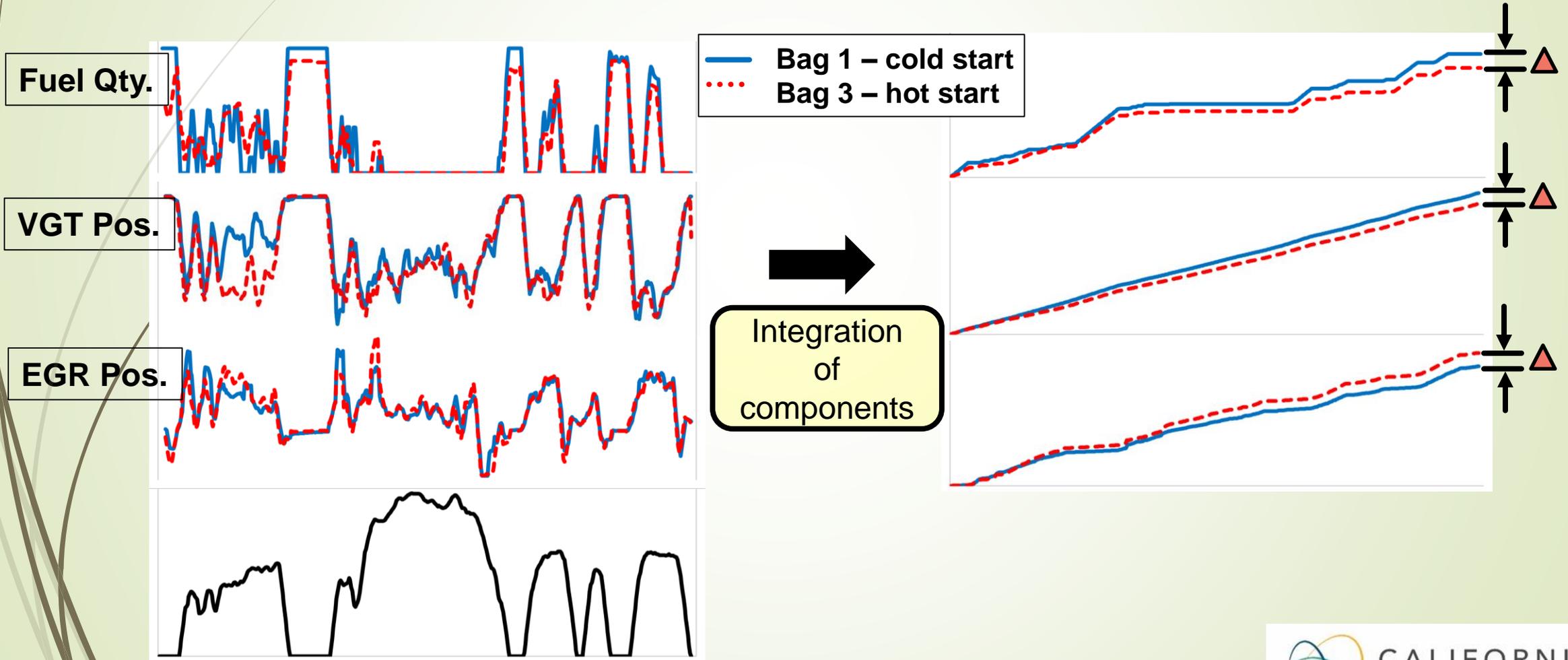


FTP75 Bag 3 hot start



Cold Start versus Hot Start Comparison

► What difference should result in CSERS monitoring?



CSERS Monitoring Requirements

- ▶ Monitoring catalyst heating has always been a focus of the CSERS requirements.
- ▶ Proposal would need to ensure catalyst heating is monitored.
 - ▶ If manufacturer does catalyst heating and it does not meet criteria to be monitored per CSERS, monitoring would be required per Other Emission Control or Source System Monitoring

Contact Information

- Official CARB documents available from
 - <https://ww2.arb.ca.gov/>
- Direct link to OBD webpage
 - <https://ww2.arb.ca.gov/our-work/programs/obd>

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