Project Title: Updating Heavy-Duty Equipment Emissions Prototype, Phase 2

WHAT IS THE NEED?

Gaseous and particle emissions from construction engines are an important fraction of the total air pollutants, and are gaining increasing regulatory attention. Quantification and analysis of pollutant emissions is necessary to accurately inventory the contribution of the construction equipment, of the type used by Caltrans, to atmospheric loadings, particularly for those projects in non-attainment or maintenance areas. Non-attainment area refers to an area considered to have air quality worse than the National Ambient Air Quality Standards, it must have and implement a plan to meet the standard, or risk losing some forms of federal financial assistance. An area may be a non-attainment area for one pollutant and an attainment area for others.

Prior to the development of the Phase 1 Off-Road Equipment Prototype, no emissions prototype was mutually accepted by Caltrans and regulatory agencies, which could be used for the estimation of construction emissions or the development of appropriate regulations. This was partly due to a lack of emissions data from construction equipment under in-use operating conditions.

As years have passed since the development of the initial prototype, newer emissions standards have been established by the Environmental Protection Agency (EPA), known as “Tier 4”. These standards represent the highest level of clean air regulations to date. Therefore, it is necessary to update the prototype to accurately analyze emissions from newer equipment types, which will show the continuous reduction of harmful air pollutants from the Department's construction practices.

WHAT ARE WE DOING?

The project will measure the emissions of up to 10 pieces of Tier 4 final off-road construction equipment, and update the Off-Road Equipment Prototype to include the analysis of construction equipment emissions, given the most recently adopted and stringent air emissions standards.
Prototype, to include estimating emissions from Tier 4 final equipment, as a function of fuel use for idle and working modes. Additionally, the researchers will estimate cold start emissions, hot start emissions, and diesel particulate filter regeneration emissions if possible, to determine if these emissions should be included in the prototype.

WHAT IS OUR GOAL?

Our goal is to add accurate emission estimates for Tier 4 final equipment to the Off-Road Equipment Prototype, as the number of these engines in the off-road fleet will be steadily increasing in coming years.

WHAT IS THE BENEFIT?

All construction projects require an Environmental Impact Report (EIR), which is reviewed by regulatory agencies and interested parties. These reports must include all the expected benefits and drawbacks to the land, air, water, and people within and near the construction site. When there is a lack of up-to-date scientific data to support the conclusions in the EIR, regulators or interested parties can severely delay or completely block the construction by requiring a complete reassessment of the EIR. Any significant delays in the construction project and approval process increases construction cost.

Many projects have been delayed for several years, as regulators or interested parties claim that the negative impact on air quality, and/or immediate health problems of people near to the construction site exceed any other benefits, brought by the emissions of Nitrogen Oxides (NOx) and Particulate Matter (PM). Currently, California Air Resources Board (CARB) and EPA inventory models for off-road construction equipment, overestimate the emissions because data for in-use off-road construction equipment was not available when the models were constructed. This research will provide the data to extend the Off-Road Equipment Prototype to Tier 4 final engines, thus providing accurate estimates of emissions for the majority of in-use construction equipment. Once the data and prototype are accepted by the regulatory agencies, they will lead to changes in regulations and inventory models based on sound science, and enhance the environmental process associated with implementing new construction projects.

WHAT IS THE PROGRESS TO DATE?

Between January 31, 2018 and December 12, 2018 emission testing of ten pieces of construction equipment was completed. The emission measurements involved 2 consecutive days of testing as the equipment was operated over various cycles on either a Quinn Caterpillar or an RDO Equipment test lot. The units tested include 3 excavators (2015, 204 hp, CAT 335F; 2016, 318 hp, CAT 336F; and a 2017,172 hp, Hitachi 210GLC), 3 Wheel Loaders (2015, 188 hp, CAT 930M; 2017, 365 hp, John Deere 744KII; and a 2014, 397 hp, John Deere 824KII), 2 backhoe/loaders (2015, 115 hp, CAT 430F2 and a 2017, 126 hp, John Deere310SL), and 2 Crawler dozers (2014, 397 hp, John Deere 1050K and a 2015, 357 hp, CAT D8T). The emissions data has been analyzed and is currently being quality reviewed. All of the units were certified to Tier 4 emission standards and were equipped with a Diesel Oxidation Catalyst / Diesel Particulate Filter (in one canister) followed by a Selective Oxidation Catalyst in a separate canister.

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