ENVIRONMENTAL PROTECTION AGENCY

[FRL-9615-9]

Control of Emissions from New Nonroad Compression-Ignition Engines: Approval of New Scheduled Maintenance for Selective Catalytic Reduction Technologies

AGENCY: Environmental Protection Agency (EPA)

ACTION: Notice

SUMMARY: This notice announces that EPA has granted manufacturers new emission-related scheduled maintenance and maintenance intervals for the replenishment of the nitrogen-containing reducing agent for selective catalytic reduction (SCR) technologies used with nonroad compression-ignition (NRCI) engines for 2011 and later model years. Replenishment of reducing agent for SCR technologies is considered critical emission-related maintenance.

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SUPPLEMENTARY INFORMATION:

I. Background

EPA adopted new emission standards for NRCI engines on June 29, 2004.[1] We expect that many manufacturers will use SCR systems to meet the final Tier IV NOx reduction requirements for their diesel engines. SCR systems use a nitrogen-containing reducing agent that usually contains urea and is known as diesel exhaust fluid (DEF). The DEF is injected into the exhaust gas upstream of a catalyst and requires periodic replenishment (maintenance) by refilling the DEF tank.

[1] 69 FR 38958 (June 29, 2004).

NRCI engine manufacturers are required to provide written instructions for properly maintaining and using the engine, including the emission control system, to purchasers of new engines. These maintenance instructions, including the hours associated with the maintenance intervals, also apply to the engine during its service accumulation for emission testing purposes.

Maintenance performed on NRCI engines is classified as critical emission-related maintenance if it includes any adjustment, cleaning, repair, or replacement of critical emission-related components. As set forth at 40 C.F.R. §§ 1039.125(a)(1), 1039.125(a)(2), and 1039.125(a)(3), a manufacturer may schedule critical emission-related maintenance on these type of components if certain conditions are met, including a demonstration that the maintenance is reasonably likely to be done at the recommended intervals, and depending upon the size of the engine and the type of emission-related component, an EPA-prescribed minimum hour maintenance interval. For example, a manufacturer of engines below 130 kW may not schedule maintenance more frequently than 3,000 hours for catalytic converters and if the engines are at or above 130 kW then a manufacturer may not schedule the catalytic converter maintenance more frequently than 4,500 hours.

In addition, should a manufacturer desire a new or shorter scheduled maintenance interval (that it wishes to recommend to purchasers and perform during service accumulation on emission-data engines) not found under §§ 1039.125(a)(2) and 1039.125(a)(3), and instead utilize §1039.125(a)(5), then the manufacturer must submit a request to EPA for approval. A request for a shorter maintenance interval includes new scheduled maintenance on emission-related components that were not in widespread use with NRCI engines before 2011. Requests from manufacturers for new scheduled maintenance intervals must include: (1) a description of the proposed maintenance step (2) the recommended maximum feasible interval for this

maintenance (3) the rationale with supporting evidence to support the need for the maintenance at the recommended interval and (4) a demonstration that the maintenance will be done at the recommended interval on in-use engines.

In considering requests for new scheduled maintenance EPA will evaluate the information provided to EPA and any other available information to establish alternate specifications for maintenance intervals as deemed appropriate.

EPA believes the existing allowable scheduled maintenance hour intervals applicable to catalytic converters are generally applicable to SCR systems which contain a catalyst, but that SCR systems are a new type of technology and that DEF refills are a new type of maintenance uniquely associated with SCR systems. Therefore, the 3,000 hour (engines below 130 kW) and 4,500 hour (engines at or above 130 kW) intervals are generally applicable to SCR systems, but are not controlling in determining the appropriate DEF refill interval. As noted, the SCR systems are a new type of technology designed to meet the newest emission standards and the DEF refill intervals represent a new type of scheduled maintenance; therefore, EPA believes that manufacturers may request from EPA the ability to perform the new scheduled maintenance of DEF refills.

II. Current Requests

EPA has received information from the Engine Manufacturers Association,[2] as well as AGCO, Caterpillar, and IVECO supporting their requests for new recommended scheduled maintenance intervals for their SCR systems.

[2] The EMA members participating in nonroad diesel engine activities include: Caterpillar Inc., Cummins Inc., Deere & Company, Daimler Trucks North America LLC, Deutz Corporation, Fiat Powertrain Technologies S.p.A., Hino Motors, Ltd., Isuzu Manufacturing services of America, Inc., Komatsu Ltd., Kubota Engine America Corporation, MTU Detroit Diesel Corporation, AB Volvo, and Yanmar America Corporation.

Several of the requests noted that the DEF is essential for the proper functioning of the SCR system, and thereby constitutes a "critical" maintenance component.[3]

The requests primarily seek EPA's approval of a DEF tank that provides a range of operation that is equal to the engine or equipment's fuel capacity – this is known as a 1:1 ratio – for 2011 and later model year nonroad engines.[4] In determining the recommended DEF refill intervals, several of the requestors applied "good engineering judgment" as described in the March 27, 2007 SCR certification guidance for on-highway engines.[5] Some noted that since SCR systems may consume DEF at a rate of approximately 2% to 4% of the rate of diesel fuel consumption (consumption rates could be even higher as one requestor noted), it would be technically infeasible to equip a nonroad engine or piece of equipment with a DEF tank large enough to operate for the standard 3,000- or 4,500-hour maintenance interval without DEF refill. For example, considering a representative range of construction and agricultural equipment, to meet the 3,000 to 4,500 hour maintenance requirements:

- A skid steer loader with a 50 kilowatt (kW) engine, that normally carries a maximum of 25 gallons of fuel, would require a DEF capacity of approximately 150 gallons, weighing over 1,400 pounds and requiring more than 20 cubic feet (ft^3) of space.

[3] 40 CFR 1039.801 defines a critical emission-related component to include, in part, any component whose primary purpose is to reduce emissions.

[4] Several of the requests also seek a 2:1 DEF refill ratio if there is no DEF level indicator. However, because EPA has already made clear that such DEF level indicator is otherwise necessary (see footnote 8) the Agency is not evaluating the 2:1 ratio request at this time. Separately, a couple of the requests seek a DEF tank size that is capable of sustaining a minimum of 120 hours of operation for engines used in part-time and full-time stationary applications when the engine is provided with a very large, and possibly unlimited fuel supply. One of those requests has been withdrawn. The other does not provide sufficient evidence to support why the recommended interval is the appropriate maintenance interval for these particular applications. Thus, the Agency is not taking action to approve the requests at this time, but may act in the future if more detailed information on this issue is provided to EPA.

[5] *See* CISD-07-07, p. 2.

- A bulldozer with a 150 kW engine, that normally carries a maximum of 110 gallons of fuel, would require a DEF capacity of approximately 900 gallons, weighing over 8,000 pounds and requiring more than 120 ft^3 of space.
- A combine harvester with a 250 kW engine, that normally carries a maximum of 250 gallons of fuel, would require a DEF capacity of approximately 900 gallons, weighing over 8,000 pounds – almost half as much as the combine's grain tank capacity – and requiring more than 120 ft^3 of space.
- A large off-highway mining truck with a 900 kW engine, that normally carries a maximum of 500 gallons of fuel, would require a DEF capacity of approximately 5,500 gallons, weighing over 50,000 pounds and requiring more than 735 ft^3 of space.

Several of the requests suggested that in order to apply good engineering judgment EPA must strike the proper balance between the dictates of operating nonroad equipment (which requires DEF tanks of small enough weight and size so as not to hinder the engine's or equipment's function while also not causing too frequent stops or downtime) and what the requestors suggest is EPA's need to ensure emission compliance in use. The requestors suggest that mobile nonroad engines and equipment are directly analogous to "vocational" on-highway vehicles, in that they typically are refueled on a daily basis from a central location and so are well-suited to the refilling of their DEF tanks on the same daily basis.[6]

The requestors also suggest that their recommended DEF refill intervals are the maximum intervals since longer intervals would require larger and heavier tanks, which may jeopardize the engine or equipment's mission or functionality. One of the requestors noted, by way of example, that its average engines used in modern agriculture and construction machines would consume as

[6] In EPA's November 9, 2009 approval of new scheduled maintenance for SCR-equipped on-highway engines and vehicles, the Agency found that for vocational vehicles the DEF refill interval should equal the range of the vehicle operation that is no less than the vehicle's fuel capacity (i.e. a 1:1 ratio). 74 FR 57671.

much as 1,000 to 2,200 gallons of DEF in order to meet the 4,500 hour regulated interval. Such tanks (weighing 9,000/20,000 pounds) would be essentially impossible to install given the limitations in available space and visibility for operators on machines, with impacts on safety, along with massive increases of machine weight which would pose serious problems in operability in agricultural lands along with worsening machine fuel consumption resulting in higher CO_2 emissions. Such constraints include the need to work and pass in very narrow openings in orchards, safety and visibility concerns, and the operability of other components on the equipment (including clearance between the DEF tank on tires). This requestor also asks EPA to consider the shelf-life of DEF at normal ambient temperatures as 18 months, much less than the 3 to 5 year period which roughly corresponds to the interval of 4,500 hours.

A separate request noted the important relationship between DEF and fuel volume, packaging and serviceability concerns, along with tilt capability and weight concerns in support of its recommended 1:1 DEF refill ratio. A 1:1 ratio develops the correct machine operating habit to fill the DEF at each fuel fill interval, and from a vehicle design standpoint many of its applications are taking away fuel tank volume to create space for the DEF tank and provide instances where the DEF tank is nestled in the fuel tank area. In terms of serviceability, the optimal placement of the DEF tank is close to the fuel tank so both can be refueled conveniently at the same time. As the filler neck on the fuel tank is already accessible from ground level, placing the DEF tank nearby ensures that it is also accessible. Providing such accessibility increases the limitations on the design and placement of the DEF tank. Tanks sized for a 1:1 ratio are much more likely to fit within the allowable space on a piece of equipment than a larger tank. Examples were provided by the requestor noting where 2:1 tanks would not fit. This requestor also noted that a 2:1 DEF tank would add 65 to 220 pounds to machines and would

negatively affect the ability to carry payload, which is one of the primary functions of the majority of construction machines. Lastly, construction machines must operate in a variety of conditions and operate often on steep slopes. Equipment with 1:1 DEF tanks of the correct design creates a lower risk of losing DEF fluid suction pickup when operating on extreme tilt as compared to larger tanks.

In order to fulfill the obligation to demonstrate that the maintenance will be done at the recommended interval on in-use engines, requestors noted that manufacturers will deploy warnings and inducements should the DEF level become too low. In addition to these initial inducements, should the operator ignore them, then the requestors noted that manufacturers will employ "severe inducement" intended to disable the functionality of the engine or equipment.[7]

Furthermore, EPA notes that several current SCR systems include the final inducement of either having the engine shut down or idle only (with no power) when no DEF is present in the DEF tank (or the system is no longer able to dose with DEF), and such SCR systems meet EPA's expectations of what is required for nonroad SCR systems.[8] As an example, one manufacturer noted that "To provide the necessary assurance that the DEF tank will be refilled, each vehicle will be equipped with a constant viewable DEF level indicator included in the vehicle dashboard display….the operator display system includes a visible warning signal that indicates when the level of DEF in the tank is low and will need refilling. As a final inducement, the system also includes programmed engine derates that limit engine performance once the DEF level drops below certain levels, thereby limiting vehicle performance." EMA, in its request, noted that should operators fail to notice audible or visible warning signals indicating low DEF, then the manufacturers may also use a reduction in engine power or equipment utility to provide more

[7] EMA suggests that a severe inducement would reduce the engine to 60% of the rated speed and 50% rated torque.
[8] EPA held a public webinar on July 26, 2011. Copies of the presentation used at this webinar can be found at: www.epa.gov/otaq/cert/documents/nrci-scr-web-conf.2011-07-25.pdf.

dramatic notice that the DEF tank needs refilling. This "severe inducement" is intended to disable the functionality of the engine or equipment, and to substantially limit the likelihood that the engine or equipment could perform any useful work, but is not intended to prohibit the engine or equipment's mobility or ability to idle. EMA also notes that it expects EPA to provide guidance on an appropriate final inducement once the SCR system runs out of DEF.

III. Discussion

EPA believes that SCR systems are a new technology and are properly considered a critical emission-related component since their primary purpose is to control emissions. In addition, the replenishment of DEF as part of maintaining the SCR system's functionality is considered to be critical emission-related maintenance under 1039.125(a).

EPA believes it appropriate to evaluate the DEF refill rates by taking into consideration the space and weight constraints typically involved with the range of NRCI engines using SCR systems, including safety and impacts of weight and dosing rates on greenhouse gas emissions and fuel efficiency. EPA believes it must also take into consideration the likelihood that the maintenance of DEF refills will be performed by the owner or operator.[9]

In our 2009 *Federal Register* notice regarding heavy-duty on-highway engines and vehicles using SCR systems, we concluded that the requested intervals were appropriate because we determined that manufacturer-recommended DEF refill intervals approximated the maximum feasible maintenance intervals associated with reasonable DEF tank sizes. We also concluded that the maintenance intervals recommended ensure that the functions and operational efficiency of such vehicles are not overly compromised.[10] EPA knows of no SCR technology for NRCI engines that is yet capable of attaining longer operation (generally beyond one tank full of diesel)

[9] 40 CFR 1039.125(a)(5).
[10] 74 FR 57561 (November 9, 2009).

without a DEF refill. As noted by the requests, there are significant space and weight constraints associated with increasing the DEF tank size in order to accommodate a 2:1 refill ratio. EPA believes it appropriate to take into consideration the need for locating the DEF tank in close proximity to the fuel tank and the remainder of the SCR system, as well as the increased likelihood that the DEF tank will be refilled if it becomes standard operating practice to refill the DEF tank at the same time as the fuel tank. EPA believes that such nonroad equipment is similar to centrally-fueled heavy-duty on-highway vehicles and that there is a sufficient basis and a reasonable expectation that DEF tank refills will occur on a timely basis.

EPA notes that the regulations allow any manufacturer to petition EPA under the "paragraph (a)(5) process" for a new maintenance interval for a particular engine family or application than that approved for the industry if the manufacturer can show that a certain interval is the appropriate maintenance interval for the particular engine configuration being certified.

EPA also notes that all critical emission-related maintenance must have a reasonable likelihood of being done at the recommended intervals on in-use engines. Paragraph 1039.125(a)(1) sets forth several methods by which such demonstration can be made, including data showing that if a lack of maintenance increases emissions, it also unacceptably degrades the engine's performance. In the context of SCR systems and the potential of an empty DEF tank and an inoperable SCR system, EPA notes that equipment under such operating conditions are expected to shut down or idle only. Engine manufacturers employing such final inducements meet the requirements of (a)(1) and furthermore meet the requirement under (a)(5) for DEF refill intervals based on a 1:1 ratio.

For the reasons set forth above, EPA approves a new scheduled maintenance interval for DEF refill that shall be no less than the equipment's fuel capacity (i.e., a 1:1 ratio of DEF refill to fuel refill) for 2011 and later model year nonroad engines.

IV. Procedures for Objections

Anyone may request a hearing on this determination. The request must be in writing and include a description of your objection and any supporting data. The request must be made by [INSERT DATE 30 DAYS FROM FR PUBLICATION] .

If, after review of any objection and supporting data, we find that the request raises a substantial factual issue, we will hold a hearing in accordance with 40 CFR Part 1068 Subpart G.

Dated: December 23, 2011.

Gina McCarthy
Assistant Administrator
Office of Air and Radiation

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