Marine Diesel Engine Emission Standards NPRM

Briefing for National Association of Clean Air Agencies, MSF Committee

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Background – Engine Standards

- EPA Tier 4 standards apply to marine diesel commercial engines >600 kilowatts (kW); most companies are using Selective Catalytic Reduction (SCR) as a control technology
  - Standards adopted in 2008
  - Tier 4 standards phased in from 2014 through 2017,
  - Smallest engines (600-1,400 kilowatts, kW) began in 2017
- Engine manufacturers thus far have not built Tier 4 engines that are designed specifically for high-speed marine vessels
- Boat builders cannot currently build some planing boats because no suitable certified Tier 4 engines are available in the 600-1,400 kW range
  - Especially Savannah Bar Pilots pilot boat & Maine lobster boats
  - Some fast ferries and similar vessels with high power density engines are avoiding Tier 4 by using multiple 500-600 kW engines
  - Affects up to 25 engines per year

Pilot Boats

- Savanah Bar Pilots (user) and Vigor Kvichak (ship builder) are requesting relief, now, to build a pilot boat for the Port of Savannah
  - No suitable Tier 4 engine is currently available
  - Lengthening vessel would subject it to speed limit in whale strike avoidance areas
- Boat builders will need a couple years to redesign vessels to accommodate greater size and weight of anticipated Tier 4 engines with SCR aftertreatment
- EPA projects that model year 2022 is the appropriate time frame for building compliant Tier 4 vessels, with engines available in 2019 and two years of lead-time for new vessel design/sea trials
- Hovercraft are a special case--one new vessel every 2-5 years for the U.S. market
  - Unconventional design, weight sensitive, widely varying sizes
  - In the NPRM, EPA is requesting comment on need for relief for these vessels

Lobster Boats (slide 1 of 2)

- Changes in lobstering since EPA 2008 rule -- bigger boats and greater travel
  - Most new lobster boats are 40-50’ long
  - Most new vessels need 750-900 kW from light-weight engines to meet performance specifications and safety needs
- No suitable Tier 4 engine is currently available
- European standards in 2021 will increase the demand for SCR technology on engines with high power density
- Absent relief, lobster boat builders will likely continue to build boats that are under-powered with 500-600 kW Tier 3 engines

Lobster Boats, cont.

- Even with suitable engines, there are significant vessel redesign issues for lobster boats, including—
  - SCR aftertreatment, along with urea-based diesel emissions fluid (DEF) and related components, adds substantial size and weight
  - Fiberglass vessel design and limited space constrain engine positioning
  - Vessels are sensitive to weight, and weight distribution, to operate properly
  - SCR adds substantial heat to compact engine room
  - Water-cooled exhaust causes concerns about saltwater damaging catalyst and sensors
  - Boats idle for hours at a time, which raises concerns for catalyst durability

Proposed Relief

- EPA proposed two phases of vessel relief from 600-1,400kW Tier 4 engine standards
  - Phase 1: Near-term relief that would apply to all affected vessels (e.g., pilot boats and lobster boats)
  - Phase 2: Longer-term relief for more challenging vessel applications (e.g., lobster boats)
- We also proposed adjustments to EPA regulatory engine certification requirements to provide an incentive to produce Tier 4 engines for these applications (that is, to reduce the certification burden)
  - Low sales volumes deter needed development cost investment in these engines
  - High power density engines have shorter operating lives

Phase 1 Vessel Relief: now through Model Year 2021

- Affected vessels would be able to use EPA Tier 3 certified engines through the end of 2021
  - Relief would apply for pilot boats and lobster boats
- Affected vessel would be defined as:
  - High-speed vessel ≤ 65 feet in length
  - High power density engine(s) in the 600 to 1,400 kW range
  - No more than 2,800 kW total propulsion power (1 or 2 engines)

Phase 2 Relief for Model Year 2022 and later

- Phase 2: Longer term relief for more challenging vessel applications
  - EPA projects that smaller affected vessels with fiberglass and other nonmetal hulls (e.g., lobster boats) would need relief until 2024, even if engines become available during Phase 1
  - It is not clear that engine manufacturers will certify 600-1000 kW engines to Tier 4, even with streamlined certification and the upcoming 2021 European SCR-based standards
- EPA also proposed to add a waiver process to allow for continued use of Tier 3 engines for qualifying vessels for 2024 and beyond
  - Requesting comment on an alternative to simply allow more time before Tier 4 standards apply, until model year 2028

Phase 1 and 2 Applicability

Criteria	Phase 1	Phase 2
Engine power density	> 35 kW/liter	> 40 kW/liter
Engine power rating	≤ 1400 kW	≤ 1000 kW
Total vessel propulsion power	≤ 2800	≤ 1000 kW
Vessel speed to length ratio	> 3.0 knots/$\sqrt{ft}$	> 3.0 knots/$\sqrt{ft}$
Vessel length	≤ 65 ft	≤ 50 ft
Vessel hull construction	any	non-metal
Vessel USCG classification	uninspected	uninspected

Engine Certification Adjustments

- Would apply to high power density marine engines
- Proposed reduced durability testing by temporarily allowing assigned emissions deterioration factors for Tier 4
- Proposed shorter useful life for Tier 4 engines with high power density (aligned with faster aging with high output)
  - Align useful life for high-output engines with the existing useful life for recreational diesel engines, which are also high power density
  - Reduce useful life from 10,000 hours to 5,000 hours
- Requesting comment on a different test procedure engine operation duty cycle that better represents in-use operation with high-output engines
  - The same cycle used today for recreational marine diesel engines
  - Adds an engine idle mode and includes more low-power operation

Estimated Impacts

- Emission Inventory Impacts
  - Estimated using 2008 rule methods, data
  - 2019: 108 tons NOx and 2.3 tons PM10[1] forgone
  - 2022: 37 tons NOx and 1 ton PM10[1] forgone
  - Estimated stream of inventory impacts (2019-35): 5,098 tons NOx and 107 tons PM10[1] forgone

- Estimated Benefits Impacts
  - Estimated using reduced form modeling tool
  - Benefit impacts do not exceed high-end estimate of $4 million forgone in any year
  - Estimated stream of benefit impacts (2019-2035; $2015): $13 million to $41 million forgone

- Estimated Cost Impacts
  - Estimated using 2008 rule methods, data
    - Less expensive Tier 3 engines (5 years) + operating savings (13 years)
    - Modeled 2 ways: behavioral approach and full-cost pass-through approach
  - Estimated stream of cost impacts (2019-35; $2018): $5.8 million (full-cost pass-through), $5.4 million (behavioral approach) savings

[1]Consistent with 2008 rule, the inventory analysis is for PM10. In the 2008 rule, PM2.5 inventory was estimated at 97% of PM10 emissions

Global Marine Fuel

- IMO's global marine fuel standard goes from 3.50 to 0.50 percent sulfur in January 2020
  - Fuel suppliers would likely meet demand with a mix of distillate and lower-cost residual fuel
- As written, EPAs regulation in 40 CFR part 80 does not allow fuel suppliers to make or sell distillate fuel that exceeds the standards for ULSD (15 ppm) or ECA marine fuel (1000 ppm)
  - Without the proposed amendment, fuel suppliers could not cost-effectively supply distillate fuel for the IMO global marine fuel standard
- Proposed amendment would allow an exemption with a set of basic conditions for distillate global marine fuel, such as:
  - Exempt fuel could not be commingled with non-exempt fuel
  - Exempt fuel could not have more than 0.50 % sulfur (i.e. the exempt fuel needs to be intended for use as global marine fuel)
  - Suppliers would need to designate the fuel as "global marine fuel" and maintain product transfer documents identifying the fuel as such

For More Information

- Notice of Proposed Rulemaking and associated documents are available at:
  - https://www.epa.gov/regulations-emissions-vehicles-and-engines/amendments-related-marine-diesel-engine-emission
- Comment period is open through October 21, 2019
  - Docket ID No. EPA–HQ– OAR–2018–0638, at https://www.regulations.gov