Comments (T.H. DeFries, August 3, 2015) on

"Speciation Profiles and Toxic Emission Factors for Nonroad Engines"
EPA-420-R-14-028
draft, March 2015

1A. In many places the report uses emission data from onroad engine measurements when nonroad emissions measurements are not available. It makes sense to me that the emissions between onroad and nonroad engines would be the same, but maybe I am just naïve. I would like to see a discussion (up front somewhere) of why the emissions of nonroad and onroad engines might be expected to be different. Is it a consequence of different emission standards, different emission controls (as a result of standard differences), and a difference in how the vehicles are used, or what?

1B. In several (many) places in the report an analysis of emission factors for the sought after nonroad vehicle, fuel type, and emissions type cannot be performed because the needed data does not exist. In each instance a substitute dataset is analyzed. For example, the dioxin and furan emission factors for nonroad CNG exhaust are based on an analysis of onroad gasoline exhaust dioxin and furan data. The reasons why these substitutions might be reasonable are not given – other than the substitute data exists. To me the lack of discussion makes the substitution highly questionable. The argument that "MOVES needs something" doesn't really cut it for me. There are those who would argue that zero is a better guess than a completely incorrect emission factor value.

So, what can be done about this? Let me suggest there be a separate discussion of the believed formation mechanisn or source for each emission category. Ideally, there would be research to reference that identifies the sources. This discussion could be in the Introduction, perhaps in Subsection 1.1, which already has a presentation of each emission category. For example, one category of emissions are the PAHs. Are PAHs in the exhaust derived from PAHs in the fuel, from fuel combustion, from PAHs in the engine oil, from combustion of engine oil, or what? If the predominant source is known, it could provide a reason for choosing the substitute dataset used to determine the PAH emission factors. If none of the sources are known, then the reader at least knows that we tried to find a reasonable substitute based on some sort of logic.

2. The second paragraph of the Intro says that factors are updated using from test program data of gasoline and diesel. Are there no test programs on CNG and LPG?

3. The section heading for 1.1 in the text and in the TOC differ.

4. Section 1.2, second paragraph: benzo(g,h,i)perylene.

5. Section 1.2, fourth paragraph, second line: "chemical mechanism species" is a term I don't recognize.

6. Section 1.3, second paragraph: Why is it "important to note"? Do you expect that emission factors would vary greatly by the factors mentioned? I guess that without any data you don't know, but maybe you could mention that for other emission factors where data does exist as a

function of the factors mentioned, the emission factors vary greatly. By inference the nonroad emission factors are also likely to vary greatly. We just don't know by how much.

7. Section 2.1, first paragraph: I don't understand why the section starts out with "In the absence of data" when it seems that data does exist and it is used for the analysis.

8. Section 2.1, first paragraph: The "single" test program apparently actually measured emissions of nonroad vehicles. Many of the sections that follow mention that nonroad data was not available so onroad data was used for the analysis. So, I think it is important to make clear for Section 2.1 that nonroad data was actually used.

9. Section 2.1, second paragraph: I am a novice when it comes to the definitions and differences among VOC, NMOG, NMHC, THC, and TOG. Then, Equation 2 throws ethane and acetone into the mix, and I am lost. I know this was explained in Section 1.2, but I need a graphic or something to make clear the differences. As it is, when I get to the two paragraphs above Table 5, I just say to myself, "if you say so…" Maybe "those in the know" don't need anything more, and it's OK as is for them.

10. Section 2.2, first paragraph: Is $OC_{2.5}$ the correct term, or is it a typo and should be $PM_{2.5}$? If it's correct, it is out of the blue for me.

11. I thought that I had understood what was going on, but when I got to Section 3.1 I began to get confused. I guess maybe this confusion may have begun in my mind with the introduction of the terms "VOC profiles" and "VOC emission profile," which are first mentioned in Section 3.1. I presume these terms mean a set of VOC fractions. But I then realized that I was not really certain what all of this work was trying to get. I think (but I'm not sure) that it's two things:

1) emission rates for THC, NMHC, NMOG, TOG, VOC, etc., and

2) the fraction of each by species that make up the VOCs.

So, for example, for Item 1, Table 5 says that for 2-stroke, E0 the VOC emission rate is 35586 mg/mi. And for Item 2, Table 6 gives the fractions of the 35586 mg/mi that it attributed to 1,3-butadiene (0.00214), etc. Multiplying, that would mean that the 1,3-butadiene emission rate is 76 mg/mi (=35586*0.00214). Is that what the report is trying to figure? That is what is stated at the beginning of the second paragraph of Section 2.1 "In the MOVES model, individual VOC fractions are multiplied by total VOC emissions to obtain emission factors."

It seems that the toxic fractions (as in Table 6) apply only to VOCs. So, then why are THC, NMHC, NMOG, TOG, and CH4 shown in Table 5? So, it's not clear to me the distinction between 1) how MOVES will do a calculation and 2) how the literature data is being used to come up with emissions numbers to put into MOVES.

I think this could be solved by adding another subsection to the Introduction. It would tell what MOVES needs to do the calculations, that is, what this report is trying to figure out. Section 1.1 starts out by listing the species, but doesn't complete the idea by telling how calculations are done in MOVES. Section 1.2 talks about the operational definitions of THC, NMOG, etc., what previous MOVES versions lacked, … Section 1.3 talks about what literature was used to

calculate the numbers in this report. But what is missing is what quantities we are trying to calculate.

The idea would be that for each type of fuel/emission (gasoline exhaust, diesel exhaust, CNG exhaust, LPG exhaust, evaporative emissions, and crankcase running exhaust emissions) we want to calculate X, Y, Z for use in MOVES. Basically the section needs to say: "MOVES needs the following information: X, Y, Z. So, we're going to estimate these quantities from literature studies." This could be perhaps most clearly portrayed using a table with blank cells. Please tell me in the Introduction. I think that this new subsection could go between Speciation and Methods, and it might be called something like Emission Factors to be Determined. Then, in the later sections, if the report used the same tabular layout, but now with the numbers for the fuel type, the clarity would be much better.

Somewhere around where you tell what you are going to calculate, you could include Equations 1, 2, 3, 4. It looks to me like they may apply to more fuels than just gasoline exhaust, so putting them early in the report and explaining them may be more appropriate for the Introduction.

12. Section 3.1, fourth paragraph: Why are you talking about MY 2007 all of a sudden?

13. Section 3.1, fifth paragraph, fourth line: Better to say "diesel #2 C:H molar ratio of". At first I thought it was a weight ratio.

14. Section 3.4, second paragraph: What's a congener?

15. Table 14: Is it possible to tell what the detection limits are so that we know what the emission factors with ND are less than? I don't mind that in MOVES NDs will be set to zero, but I think that you should tell in this document what the ND values are.

16. Section 4.1, first paragraph: What does "conservative" mean? "Conservative" from the environmentalist's point of view or from the engine manufacturer's point of view? Does it mean that the real emissions, which we have no data for, are expected to be less or more than the emissions that the existing data provides? Let me say that "conservative" is always a poor term for use in a technical report.

17. Section 4.1, first paragraph: It strikes me that a transit bus is quite different from a nonroad vehicle. Can you say anything that might make us think that the CNG transit bus is a reasonable surrogate for a CNG nonroad engine? Are even the overall (i.e., non-speciated) emissions similar?

18. Section 4.2, first paragraph, first sentence: Does "in a manner similar" mean using Equations 3 and 4? If that's it, say so. My suggestion, as I have stated earlier, is that the technique may best be covered in a new subsection in the Introduction. Then, here, you could just refer to the Introduction.

19. Table 17: Is it possible to tell what the detection limits are so that we know what the emission factors with ND are less than? I don't mind that in MOVES NDs will be set to zero, but I think that you should tell in this document what the ND values are.

20. Table 18. To follow along with Equation 5, shouldn't the title for Column 2 be Onroad CNG Emission Factor (g/mi) and the title for Column 3 be Nonroad CNG Emission Factor (g/gal)? I think that would make the table clearer. So, I am assuming that Column 3 has the values that we need for nonroad vehicles, and Column 2 just shows the onroad values that they are derived from.

21. Section 4.4: Boy, this is a stretch! CNG dioxins and furans from onroad gasoline engines! All we can do is convert the units using Equation 5? Can you mention ANY reason that these guesses are at all reasonable (see comment 1B)?

22. Table 19. To follow along with Equation 5, shouldn't the title for Column 2 be Onroad CNG Emission Rate TEQ (g/mi) and the title for Column 3 be Nonroad CNG Emission Factor TEQ (g/gal)? I think that would make the table clearer. So, I am assuming that Column 3 has the values that we need for nonroad vehicles, and Column 2 just shows the onroad values that they are derived from.

23. Section 6.1.1: In the case of evaporative emissions using toxic fraction data from onroad vehicles makes complete sense because the mechanism of evaporation is independent of the type of vehicle.

24. Section 6.1.1: An alternate source of toxic fraction information is Sam Reddy's ReddyEvap model. This model uses physical chemistry and compound properties to calculate gasoline vapor compositions for different liquid gasoline compositions. The model also calculates vapor composition for different conditions such as Reid vapor pressure, ethanol content, fuel tank fill level, atmospheric pressure, and tank temperature.

25. Section 6.1.2: I seem to recall (I could be remembering incorrectly) that ReddyEvap also calculates the increased permeation of gasoline hydrocarbon compounds when ethanol is present in the gasoline – a synergistic effect. The data in Table 23 don't seem to show this effect.