EPA420-R-00-022

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
ANN ARBOR, MI 48105

OFFICE OF
AIR AND RADIATION

MEMORANDUM

DATE: November 17, 2000

SUBJECT: Summary and Analysis of Comments for Notice of Proposed Finding: Control of Emissions from New Nonroad Spark-Ignition Engines Rated above 19 Kilowatts and New Land-Based Recreational Spark-Ignition Engines

FROM: John Mueller, Mechanical Engineer
Assessment and Standards Division

THRU: Glenn Passavant, Nonroad Center Director
Assessment and Standards Division

TO: Docket A-98-01

We published a Notice of Proposed Finding in the Federal Register on February 8, 1999 regarding emissions from new land-based nonrecreational nonroad spark-ignition engines rated above 19 kilowatts and new land-based recreational spark-ignition engines.[a] In that notice we requested comments from all interested parties on all aspects of the notice and its supporting documentation. We received comments from 12 entities including industry groups, government agencies, private citizens, and environmental groups. The purpose of this memorandum is to summarize, analyze and respond to the comments we received.

List of Commenters

The following entities provided written comments on the Notice of Proposed Finding.

American Motorcyclist Association (AMA)
Bluewater Network
California Motorcycle Dealers Association (CMDA)
Industrial Truck Association (ITA)
International Snowmobile Manufacturers Association (ISMA)
Steven K. Lyda
Motorcycle Industry Council and the Specialty Vehicle Institute of America (MIC/SVIA)

[a] 64 FR 6008, February 8, 1999.

Orbital Combustion Process - For A Cleaner Tomorrow (OCP-FACT)
Magaly Rosas
Southwest Research Institute (SwRI)
State of Wyoming, Office of Federal Land Policy
United States Department of the Interior (DOI)

Summary and Analysis of Comments

This summary and analysis of comments is divided into several general subject areas. The first section deals with general issues concerning the proposed finding and the conclusions we reached in the proposal. The second section deals with comments pertaining to the seasonal and geographic nature of recreational vehicle usage and emissions. The third section deals with the potential impact of future standards and the technologies that may be employed to meet any future standards. The fourth and fifth sections deal separately with the emissions modeling used to support the conclusions in the proposed finding for recreational and nonrecreational vehicles and engines.

1. Finding - General

Summary of Comments:

California Motorcycle Dealers Association (CMDA) commented that we based our finding on emissions inventories which were derived using erroneous information. CMDA is concerned that this will lead to unwarranted regulations.

The Motorcycle Industry Council, the Specialty Vehicle Institute of America (MIC/SVIA) and S. Lyda all suggested that our emissions inventories were substantially overstated. They, along with the International Snowmobile Manufacturers Association (ISMA), suggested that we need to refine our modeling further before we can make a finding of contribution.

S. Lyda commented that section 213(a)(3) of the Clean Air Act allows us to exercise judgement in determining whether a class or category of new nonroad engines and new nonroad vehicles contribute to air pollution described in section 213(a)(2). He stated that this discretion allows us to decide when carbon monoxide (CO) or ozone precursor emissions from a class or category of new nonroad vehicles or engines are insignificant enough that regulating them would be a waste of time.

M. Rosas and the U.S. Department of Interior (DOI) expressed general support for the finding. DOI expressed concern about the impact of snowmobile use in national parks, especially Yellowstone National Park (YNP). DOI submitted a variety of information, including estimates of snowmobile use in YNP and its impacts on air quality and an investigation of snowmobile driver exposure to CO while traveling in the wake of another snowmobile. DOI also informed us of several studies they have underway in this area.

The American Motorcyclist Association (AMA) and S. Lyda opposed including recreational vehicles and industrial equipment in the same finding. AMA stated that off-road motorcycles and ATVs are generally discretionary purchases that are used in rural areas, in contrast to industrial equipment which is more of a mandatory purchase and tends to be used more in urban areas. AMA

stated that, while it supports reasonable emission controls for off-road motorcycles and ATVs, this is not the proper place to initiate such controls. AMA did not, however, recommend an alternative. S. Lyda commented that recreational engines are subject to much higher transient load conditions and have higher power to weight ratios than industrial equipment. These factors, he added, would make it much harder to reduce emissions from recreational engines than from industrial engines.

Both AMA and S. Lyda commented that the off-road motorcycle and ATV industry is moving away from 2-stroke engines in favor of 4-stroke engines. They suggested that this alone serves to reduce emissions from off-road motorcycles and ATVs.

Bluewater Network commented that snowmobiles are one of the largest sources of unchecked pollution nationwide, and urged us to consider regulating their emissions as soon as possible. Bluewater pointed out that snowmobiles emit very high levels of PM compared to other vehicle types, and there are numerous PM nonattainment areas in which snowmobiles are a significant contributor to respiratory problems, asthma and premature mortality. Bluewater also cited studies showing high CO and PM levels in parts of Yellowstone National Park and high CO exposures to riders in trailing snowmobiles, pointing out that it is common for snowmobiles to travel in groups, exposing riders to high CO levels for extended periods of time.

U.S. DOI commented that our finding should go beyond considering nonattainment areas and address snowmobile emissions in the context of regional haze regulations and other regulations that protect air quality in Class I areas across the United States. DOI pointed out that reducing snowmobile emissions would contribute to air quality improvements and haze reductions in some Wilderness areas near national parks.

Response to Comments:

As a result of the information provided by the commenters and additional information we have uncovered since the proposal, we have been able to improve the accuracy of our emissions modeling estimates for recreational vehicles. As discussed later in this memorandum, we have revised our emission inventory estimates through a more rigorous evaluation of the information we had at the time of the proposed finding and have evaluated further information that was submitted to us in response to that proposal as well as additional information we collected. The details of the revised recreational modeling estimates (including all of the information we considered and our conclusions regarding how to use that information) are contained in a separate memorandum to the docket.[b] We believe that these revised emissions inventory estimates are justified considering all of the information currently available. While we have confidence in the accuracy of these new estimates, we intend to continue pursuing additional data and further refine our recreational vehicle emissions inventories in the future.

The result of the improvements to our modeling is that our total estimates for recreational and nonrecreational applications have changed. Our estimates of hydrocarbons (HC), carbon monoxide (CO) and particulate matter (PM) have decreased by 44 percent, 20 percent, and 63

[b] "Emission Modeling for Recreational Vehicles," EPA memorandum from Linc Wehrly to docket A-98-01, November 14, 2000.

percent, respectively, while our estimate of total oxides of nitrogen (NOx) has increased by 32 percent. Our estimates of snowmobile emissions inventories were reduced by 76 percent for HC, 77 percent for CO, 45 percent for NOx and 66 percent for PM, as compared to those in the proposed finding. In contrast, off-road motorcycle and ATV emissions inventories of HC and NOx increased by 83 percent and five percent, respectively, while their inventories of CO and PM were reduced by two percent and 63 percent, respectively. The net result of these changes is that total recreational vehicle emissions inventories decreased by 48 percent, 30 percent, and 65 percent for HC, CO and PM, respectively, while NOx inventories remain essentially unchanged compared to those in the proposed finding. For Large SI, our new estimates represent reductions of five percent for HC and 48 percent for PM, and increases of 11 percent for CO and 35 percent for NOx. While these new inventories represent a change from those in the proposed finding, these changes do not fundamentally change the conclusions we reached in that proposal, namely that, in our judgement, nonroad spark-ignition (SI) engines rated above 19 kilowatts (kW), as well as land-based recreational nonroad spark-ignition engines, cause or contribute to air quality nonattainment in more than one ozone or carbon monoxide (CO) nonattainment area, and that particulate matter (PM) emissions from these engines cause or contribute to air pollution that may reasonably be anticipated to endanger public health or welfare.

We disagree with AMA and S. Lyda's comments that it is inappropriate to consider all large SI nonroad engines and vehicles together when determining emissions contribution. The legislative history of the Act indicates that we should not subdivide categories of nonroad engines into small subcategories.[c] This is because Congress did not want us to subdivide source categories into such small divisions that each subcategory by itself would have minimal contribution, despite the fact that nonroad engines as a whole contribute significantly to pollution. This is likely the reason why the final version of the Act does not require a finding of "significant contribution," but merely "contribution," for individual categories of nonroad engines. In general, we chose to group engines and equipment together based on common characteristics such as combustion cycle, fuel, usage patterns, power rating, and equipment type. By dividing nonroad engines and equipment into separate categories based on these characteristics we are able to devise the most appropriate regulatory programs for each category which take into account the specific characteristics of the engines and equipment, as well as the unique traits and needs of the affected vehicle and equipment manufacturing industries and the end users of the vehicles and equipment. In addition, it avoids the danger recognized in the legislative history of dividing nonroad engines into small categories.

Large SI nonroad engines, both recreational and nonrecreational, do have similar emissions characteristics, though there are also significant differences in usage and design. We will take these differences into account in designing the regulatory requirements for these engines, as indicated in the accompanying Advance Notice of Proposed Rulemaking. However, we believe that the emissions characteristics of all large SI nonroad engines are sufficiently similar that they can be reviewed as one category in making this finding.

However, even if we were to agree with the commenters that we should review recreational vehicles separately from nonrecreational equipment, our result would be the same. As indicated in the tables presented in the preamble, large SI nonrecreational equipment are modeled to contribute

[c] Senate Report 101-228, pp. 104-105.

306,000 tons of NOx, 125,000 tons of HC, 2,294,000 tons of CO and 1.6 tons of PM to this year's national inventories. Similarly, recreational SI contributed 587,000 tons of HC, 4,231,000 tons of CO and 5.6 tons of PM to national inventories. Review of the local inventories show similar results. Table 3 in the preamble shows substantial emission totals both for recreational and nonrecreational engines in all emission categories. Off-road motorcycles and ATVs alone account for a considerable amount of emissions, as do snowmobiles. It is clear from these totals that even if, as suggested, we reviewed recreational vehicles separately, they would still contribute to emission contributions in more than one ozone or CO nonattainment area and would contribute to PM pollution that may reasonably be anticipated to endanger public health or welfare, and the Administrator has explicitly, using the authority of section 213(a)(3) and (4), made that finding in this action.

Regarding comments that the off-road motorcycle and ATV industries are moving away from 2-stroke engines in favor of 4-stroke engines, the current populations already include significant numbers of 4-stroke engines, and we believe that further shifts away from 2-stroke engines would not change the finding that these engines contribute to air pollution. It is true that 4-stroke engines tend to have lower HC and PM emissions than 2-strokes. However, off-road motorcycles and ATVs would not stop emitting HC, in particular, or even PM, if these engines all became 4-stroke. Moreover, CO emissions tend to be similar, and 4-strokes generally have higher NOx emissions than 2-strokes. In any case, speculation about the possible future populations of these engines does not detract from the fact that these engines currently contribute to air pollution. In addition, there is no evidence that 2-stroke engines are going to be eliminated voluntarily from the market, especially for off-road motorcycles. Currently, 4-stroke engines account for more than 70 percent of the total off-road motorcycle/ATV population. Seventeen percent of the current ATV population is currently 2-stroke. The off-road motorcycle population is currently 67 percent 2-stroke. While the manufacturers have indicated to us that they intend to offer more 4-stroke models in the future, it remains to be seen whether these additional offerings will be at the expense of 2-stroke sales, or whether 4-strokes will maintain their current share of the market, but with more different models available. We also believe it is notable that none of the manufacturers submitted comments suggesting that the populations would move toward a higher fraction of 4-strokes. The commenters may in fact have shown that emission standards may be useful to provide further encouragement for manufacturers to develop more 4-stroke engines for these vehicles.

We agree with the comments of M. Rosas and have finalized the proposed finding. We also agree with DOI and Bluewater Network that emissions of snowmobiles appear to be responsible for elevated levels of CO and decreased visibility in Yellowstone National Park. While this area is not a CO nonattainment area, it does appear that increased levels of CO, sometimes above the national ambient air quality standard (NAAQS), have been measured, adding to our belief that snowmobile emissions in areas of concentrated snowmobile use can dramatically increase pollution levels in those areas. DOI also notes that 27 other units of the National Park system allow snowmobiles and that these concerns also apply in these areas as well. Bluewater also notes that snowmobiles contribute to PM levels in several nonattainment areas, which appears to be consistent with our modeling results, which show snowmobiles contributing to PM levels in PM nonattainment areas such as Denver County, CO and Spokane County, WA. Although we recognize that recreational vehicles do contribute to PM emissions, we have not yet decided on the appropriateness of PM standards for these vehicles.

2. Seasonal and Geographic Nature of Emissions

Summary of Comments:

ISMA stated that snowmobile use is limited to cold weather and therefore doesn't contribute to ozone nonattainment. AMA pointed out that snowmobiles account for 75 percent of recreational vehicle emissions and considering that they are generally only used when it snows, their contribution to the recreational category is irrelevant in the scheme of national emission reductions, especially for ozone. CMDA stated that snowmobiles are used in climatic conditions and altitudes where there are no ozone violations. Finally, MIC/SVIA stated that our modeling does not distinguish between cold weather (i.e., non-ozone causing) and warm weather emissions. MIC/SVIA added that snowmobiles dominate the recreational HC emissions inventory but do not contribute to ozone and should be removed when considering an ozone strategy.

Several commenters provided comment on the geographic nature of recreational vehicle emissions. ISMA simply stated that snowmobiles are not used in or around nonattainment areas and don't contribute to nonattainment. ISMA provided trail maps to further this argument. AMA stated that, while off-road motorcycle and ATV owners may live in nonattainment areas, the majority of off-road motorcycle and ATV use is in rural areas. AMA mentioned examples of areas of high use of off-road motorcycles and ATVs. The vast majority of these areas, according to AMA, are attainment areas. Thus, AMA commented, unlike industrial equipment, off-road motorcycles and ATVs have little impact on emissions in nonattainment areas. MIC/SVIA stated that recreational emissions occur predominantly in rural and attainment areas, and therefore it is not appropriate to compare them to nationwide on-highway emissions.

Response to Comments:

Regarding the contribution of snowmobile emissions to ozone, snowmobiles are not a separate category of nonroad engines and will be regulated as part of a broader category. Whether we view snowmobiles as part of the full large SI category, or even if we view them as part of the recreational vehicles category, they clearly are part of a category of engines that contributes to ozone concentrations in more than one nonattainment area. No commenter stated that snowmobiles should have been placed in its own separate category of nonroad engines, nor would that be appropriate, given the similarities in usage and design between snowmobiles and, at the very least, off-road motorcycles and ATVs. Moreover, even reviewing snowmobile emissions themselves, they emit substantial amounts of HC in several nonattainment areas, which would certainly increase ozone levels in those areas.[d] Further, the evidence in the docket also shows that snowmobile emissions contribute to concentrations of CO in several CO nonattainment areas. Given the statutory language regarding the categories of new nonroad engines subject to regulation, categories "which, in the Administrator's judgment cause or contribute to [ozone or carbon monoxide concentrations in more than one area that has failed to attain the national ambient air quality standards for ozone or carbon monoxide]," snowmobiles are part of such a category, and in fact would be such a category were it

[d] "Additional Detail on Revised Recreational Vehicle Emissions Inventories," EPA memorandum from John Mueller to docket A-98-01, November 15, 2000, and the inventories provided for the 1991 Nonroad Study (Docket No. A-91-24, Document No. II-B-4).

looked at separately.

We recognize that snowmobiles' contribution to ozone concentrations is less important if it occurs solely during portions of the year when exceedences of the ozone NAAQS are unlikely to occur. We will bear this issue in mind as we move forward with emission regulations for these vehicles. In the Advance Notice of Proposed Rulemaking (ANPRM) accompanying this Final Finding, we specifically request comment on whether we should distinguish snowmobiles from other recreational vehicles in regulating ozone precursors.

Regarding the comments of AMA and MIC/SVIA that snowmobile emissions dominate the HC emissions inventory, our revised estimates indicate that off-road motorcycles and ATVs are actually a larger source of HC and other pollutants than snowmobiles and, in any case, clearly contribute to both national and local inventories.

Regarding the assertion that emissions from recreational vehicles occur most often in rural areas, this assertion is not relevant for our finding. The test under the statute is whether a category of engines contributes to ozone or CO contributions in more than one nonattainment area, not whether it contributes even more pollution in rural areas. Moreover, though there is a strong correlation between nonattainment areas and urban areas, particularly for ozone, there are many counties that are part of nonattainment areas that may be considered rural or suburban in character - in fact, there is not much correlation between PM nonattainment areas and urban areas. In any case, the evidence, including the particular site information provided by AMA, shows that recreational vehicles are used in numerous nonattainment areas around the country and in fact contribute sizable emissions in such areas. Our local modeling information, with geographical distribution of recreational vehicles based on the presence of areas to ride them in (such as recreational vehicle parks), indicates considerable usage of these vehicles in nonattainment areas[e]. The inventories provided for the 1991 Nonroad Study (Docket No. A-91-24, Document No. II-B-4) contain numerous examples of nonattainment areas with populations of recreational vehicles.

3. Future Standards and Technology

Summary of Comments:

We received a variety of comments on recreational vehicles concerning the availability of emissions control technology, concerns about the use of particular technologies, and potential impacts of future standards on the affected industries.

Supporters of Orbital Combustion Process-For A Cleaner Tomorrow (OCP-FACT) commented that the Orbital Combustion Process technology is available and that we should consider its capabilities as we develop new emission standards. OCP-FACT submitted a variety of information which details the operation and capabilities of the OCP technologies and listed several

[e] Further details of the growth and geographical allocation methodologies are covered in the paper, "Geographic Allocation and Growth in EPA's NONROAD Emission Inventory Model," by Gary Dolce, Greg Janssen, and Richard Wilcox, presented at the 1998 Air and Waste Management Association Conference.

companies which have announced plans to introduce engines with the OCP fuel system. DOI suggested that we base our standards on emerging, rather than existing technology. DOI noted that the Society of Automotive Engineers has sponsored a "Clean Snowmobile Challenge" intended to allow student engineers the opportunity to develop cleaner and quieter snowmobiles.

Both AMA and S. Lyda suggested that there are safety concerns with some technology likely to be used on off-road motorcycles and ATVs. S. Lyda commented that any technology that increased weight the of a motorcycle would impact its handling. He added that emission standards which require complex fuel management technology may leave riders stranded, whereas current carburetors can easily be fixed on the trail. Both AMA and S. Lyda commented that catalysts would increase the risk of burns and fires. S. Lyda also commented that we must consider the cost and availability of technology before promulgating standards. He claimed that some technologies may be too costly or complex to mass produce. AMA suggested that the use of alternative fuels (such as gasohol) and lubricants in the existing fleet should be aggressively explored before requiring engine-based technologies.

CMDA commented that any unwarranted regulations would hurt motorcycle and ATV dealers. AMA stated that any regulations should not hurt the recreational industry, which provides jobs and stress relieving benefits for many citizens.

The Industrial Truck Association (ITA) provided detailed comments regarding possible EPA approaches for regulating Large SI engines. ITA states that it favors harmonization with California and opposes federal standards that are more stringent than California's. ITA also opposes use of any test cycles beyond the California steady-state cycle. ITA also provided comments regarding lead time, fuel specifications and evaporative emissions.

Response to Comments:

Comments on applicable technologies and safety and cost concerns with those technologies are not relevant to this finding. Nor are comments related to the specifics of possible approaches by EPA in regulating these engines. The purpose of the finding is to determine whether emissions from the vehicles and engines being considered contribute to air pollution, as required under sections 213(a)(3) and (4) of the Act. Such a finding provides authority for us to set appropriate emissions standards for these vehicles and engines. All of these comments, however, are very relevant to the development of such emissions regulations. Thus, we will consider the availability of technology as well as its cost, safety and other factors, including appropriate fuel requirements, as we develop a proposed regulatory scheme for these vehicles and engines. There will be further opportunities for public input as we go through the process of developing the regulations.

We do not agree with CMDA that any regulations we put into place would hurt the recreational industry. Without knowing the levels of the standards and the nature of the compliance program it is impossible to predict the impact of regulations on an industry. We do share AMA's opinion that any regulations we put into place for the vehicles and engines covered by the final finding not unnecessarily impact the affected industries. As we work to propose regulations for these vehicles and engines we will take into account the nature of the affected industries and will attempt to structure a regulatory program that minimizes the impact on those industries. During the rulemaking process we invite any interested parties to submit comments on the potential impact of

those proposed regulations on the affected industries.

4. Emissions Modeling - Recreational

Summary of Comments:

We received a variety of comments on our recreational vehicle emissions modeling. In general, the commenters stated that we overestimated recreational vehicle emissions through incorrect or inappropriate inputs to our emissions model. CMDA stated that erroneous load factors, usage and inventories will be used to determine whether the vehicles and engines under consideration should be regulated. AMA commented that our modeling does not account for emissions reductions expected from regulations in the state of California.

MIC/SVIA commented that our HC emission factor for off-road motorcycles and ATVs is high for engines operated at high loads. ISMA provided new industry average snowmobile emission factors for HC and CO based on recent testing by the snowmobile manufacturers.

ISMA commented that our snowmobile load factor is too high. ISMA cited recent testing and analysis done by Southwest Research Institute in support of a snowmobile emission factor of 0.337, significantly lower than our estimate of 0.81. S. Lyda commented that, based on an informal survey he conducted at off-road motorcycle races, the off-road motorcycle load factor is 0.28. He stated that this load factor may be on the high side given that it was based on a survey of motorcycle racers, and the majority of trail riders do not ride as hard as racers, but that it was more realistic than our load factor of 0.72. MIC/SVIA commented that the on-highway load factor is less that 0.10 based on an analysis of the federal test procedure for on-highway motorcycles. MIC/SVIA argued that, even if off-road motorcycles were operated at twice the load of on-highway motorcycles, the off-road motorcycle load factor would still be less than 0.20.

MIC/SVIA stated that we did not provide information on what average rated horsepower (hp) was assumed in the analysis, but that 35 hp appears close to our estimate. ISMA also stated that average hp was not provided in the proposal.

ISMA commented that our snowmobile usage estimates are too high. ISMA cited some state studies which showed snowmobile usage to be no more than 50 hours per year, rather than the 121 hour estimate in the proposed finding. MIC/SVIA commented that its own survey data suggested that off-road motorcycle usage is 84 percent lower than our estimate. Finally, S. Lyda commented that, based on an informal survey he conducted at off-road motorcycle races, off-road motorcycle usage is about 84 hours per year. He also stated that our usage rates are overstated because many riders have more than one motorcycle or ATV, and our modeling did not account for this.

ISMA agreed with our snowmobile population estimates, but stated that the industry will not maintain double-digit growth rates in the future.

S. Lyda claimed that the combined errors of our model inputs result in off-road motorcycle/ATV inventories that are eight times higher than reality. MIC/SVIA claimed that once the modeling problems they discussed are corrected, recreational vehicles would be estimated to

contribute less than one half percent to mobile source HC emissions, about 1.2 percent of our original estimate.

Response to Comments:

We have undertaken a very thorough review of all of the data, information and judgements that went into our emissions modeling. We have considered all of the information submitted by the commenters and have gathered additional information for consideration as well. As discussed earlier in this document, we have significantly revised our emissions estimates as a result of this review. We have documented all of the information we considered as well as our rationale for choosing the inputs we did in a separate memorandum.[f] Although our updated modeling took into account information beyond that submitted by the commenters, the following responses deal specifically with the comments we received.

CMDA provided no details regarding their claims of erroneous information. However, we have revised certain of these factors based on other information received during the rulemaking process.

It is true that our emissions model does not take into account the emissions control program in California. However, the impacts of this are minimal. First, California does not have any emission regulations in place for snowmobiles. Second, California allows the sale of non-compliant off-road motorcycles and ATVs, which are allowed to operate in specific geographic areas during certain times of the year. As a result, a sizable percentage of off-road motorcycles and ATVs in California do not meet any emission standards. Third, a reduction in modeled emissions to take into account California's regulations would not have an appreciable effect on the total emissions forecast and would not affect the clear evidence that these engines contribute to air pollution. Finally, our finding is based on the contribution to ozone and CO in nonattainment areas, as well as the contribution to total PM inventories, both nationwide and in specific areas. Numerous areas that we considered in making this finding are outside of California. Thus, although our modeling may marginally overstate the national emissions inventories from recreational vehicles because it does not account for California's emissions regulations, this issue in no way compromises the validity of our conclusion regarding the finding itself.

Regarding the HC emission factor for off-road motorcycles and ATVs, although MIC/SVIA questioned our emission factor, they did not provide any rationale as to why they believed it was too high. Nor did they provide any additional data or analysis from which a new emission factor could be derived. We used data on actual off-road motorcycles and ATVs provided by a manufacturer to develop our off-road motorcycle/ATV emission factors.

Regarding the emission factors for snowmobiles, ISMA did not provide the actual analysis it used to derive its industry average emission factors. Lacking such supporting information we do not believe that it is appropriate to adopt ISMA's recommended emission factors. However, we performed our own analysis of data from a variety of sources, including tests of individual

[f] "Emission Modeling for Recreational Vehicles," EPA memorandum from Linc Wehrly to docket A-98-01, November 14, 2000.

snowmobiles provided by ISMA as well as from several test programs performed by Southwest Research Institute (SwRI). The majority of the snowmobile engines tested were new or nearly new and represented recent model year snowmobiles (1990 and later), although a few of the tests were on older snowmobiles. Our analysis of this data yielded snowmobile emission factors of 111 grams per horsepower hour (g/hp-hr) for HC, 296 g/hp-hr for CO, 0.86 g/hp-hr for NOx, and 2.7 g/hp-hr for PM. Our HC emission factor is slightly higher than ISMA's recommendation of 104 g/hp-hr, while our CO emission factor is lower than ISMA's recommendation of 331 g/hp-hr. These differences are not substantial, and we have confidence that our snowmobile emission factors are reasonable given the data available to us.

Regarding the snowmobile load factor, we agree with ISMA that the snowmobile load factor we used in the proposed finding is too high. Further, we believe that the SwRI testing program cited by ISMA provided a fairly robust examination of snowmobile operation through the actual in-use testing of snowmobiles. Thus, we have adopted the load factor developed by SwRI for our modeling of snowmobile emissions.

We agree with S. Lyda and MIC/SVIA that the proposed off-road motorcycle/ATV load factor is unrealistically high, considering the power to weight ratio of these vehicles. In the absence of specific measured load factor data for off-road motorcycles and ATVs we have used the snowmobile load factor of 0.34 for both off-road motorcycles and ATVs. The snowmobile load factor was developed using instrumented vehicles under actual driving conditions, and we believe that snowmobile and off-road motorcycle/ATV operations are similar enough that using a load factor that has its basis in actual testing is the most appropriate approach given the information available to us. This is a significant reduction of the load factor compared to what we proposed, and we believe this is the most reasonable value given the data available to us. This load factor is close to and generally supported by the estimate provided by S. Lyda per his informal survey of several off-road motorcycle racers. We acknowledge Mr. Lyda's significant individual effort in gathering and providing this information. We have chosen to use this specific load factor for off-road motorcycles and ATVs due to its basis on actual measured load during engine operation. We do not believe that on-highway and off-road motorcycle riding are similar enough to draw any reasonable conclusions about the load factor of one from the load factor of another.

In our emissions modeling for recreational vehicles we use horsepower (hp) ranges for 4-stroke motorcycles and ATVs, as well as snowmobiles. However, because our 2-stroke emission factors for off-road motorcycles and ATVs are in terms of grams per mile, we have no need for hp information in modeling these groups. In modeling, rather than use a single average hp to represent an entire group of vehicles, we break to total hp range into separate bands, each with its own population. This allows us to more accurately model future in the makeup of the vehicle population. However, to answer MIC/SVIA's and ISMA's questions about average hp, we calculated, based in the inputs to our emissions model, the population-weighted average hp of 4-stroke motorcycles to be 10.5, 4-stroke ATVs to be 21.2, and snowmobiles to be 48.3. It is difficult to assess how these numbers relate to the 35 hp number that MIC/SVIA provided because, for reasons previously discussed, we do not have average hp estimates for 2-stroke motorcycles or 2-stroke ATVs.

We agree with ISMA that our annual operating hours for snowmobiles were too high. While we have reduced our snowmobile operating hours estimate, we do not agree with ISMA that it should be less than 50 hours per year. Using information from studies done on the economic impact

of snowmobile operation for eight different states, as well as consumer satisfaction survey results from the snowmobile industry, and survey results from Bluewater Network and Power Systems Research we have developed an estimate of 57 hours per year for typical snowmobile operation.

Regarding the estimated annual hours of usage for off-road motorcycles and ATVs, new information we considered suggested that off-road motorcycle and ATV use differ dramatically, and that it is not appropriate to use a single annual usage rate for both. For off-road motorcycles we considered data from two sources. The first source is a survey done by MIC. This survey was done using two different methods which resulted in two very different estimates of annual usage, with one estimate being almost six times higher than the other. Because the results of the two methods are so dramatically different, we have concerns about the results of the MIC survey. The second source of information we considered for off-road motorcycle usage was a study of recreational fuel usage done by Oak Ridge National Laboratory (ORNL). Using the information on fuel usage in this study, along with fuel economy information from California and SwRI, we derived an annual usage rate of 120 hours per year for off-road motorcycles. While this value is not nearly as low as MIC suggested it should be, it is somewhat lower than the value we used in the proposed finding.

For ATV usage we relied on a study done by the Consumer Product Safety Commission (CPSC). This study was fairly robust, and from it we derived the value of 350 hours per year for ATVs. Contrary to what S. Lyda claimed about the number of motorcycles a given rider owns, the CPSC study suggested that a given ATV is used by more than one rider. Thus, the annual ATV hours of usage developed from the CPSC report represents usage per ATV. A given rider tends to ride about 100 hours per year less than this per-ATV estimate.

Regarding ISMA's comment concerning snowmobile population growth, we based our future population estimates on extrapolations from historical snowmobile population estimates. We agree with ISMA that large snowmobile population increases are not likely to continue. We estimated that total snowmobile population will increase less than eight percent between 2000 and 2010, with similar growth projected beyond that[g].

Our current estimates of recreational vehicle emissions are reasonable when considering all the information available to us. While our estimates of recreational vehicle emissions did go down from the proposal, as discussed earlier in this memorandum, they did not go down nearly as much as S. Lyda and MIC/SVIA suggested they might or should.

5. Emissions Modeling - Nonrecreational

Summary of Comments:

The Industrial Truck Association (ITA) noted several concerns with the details of the emission modeling published with the proposed finding. ITA noted that the Nonroad Model predicts about a 10 percent growth in population between 2000 and 2010, but that NOx emissions increase by 27 percent over this period, CO emissions increase by 18 percent, and HC emissions decrease by 24 percent. These figures appeared to be inconsistent and anomolous.

[g] See footnote e

ITA shared forklift shipment statistics to suggest an improved estimate of 390,907 forklifts operating in the U.S. (compared with our estimate of 442,00). ITA's figure was based on an average forklift life of 8 years. ITA recommended an estimate of 1250 hours annually, rather than 1500 hours, to characterize forklift usage rates. ITA noted that average rated horsepower should be between 45 and 55 for forklifts powered by spark-ignition engines. These figures could not be compared to the Nonroad Model, because the analogous figures were not published with the proposed finding.

Southwest Research Institute (SwRI) also found various aspects of our emission modeling worthy of note. SwRI suggested deleting leaf blower/vacuum from the population listing for Large SI engines, expecting that all these engines would be have rated power below 19 kW. SwRI commented that our estimate of the population of airport ground-service equipment was too low, based on their earlier published estimates of these vehicles in California. SwRI reported that they had been generally unable to find gasoline-fueled generators rated above 19 kW, either from the in-use population or from new models from various manufacturers.

Analysis of Comments:

The apparent discrepancy in population and emission changes between 2000 and 2010 is caused by the model's use of fuel-specific growth rates, in conjunction with a mistake we made in the calculation of volatile organic compounds (VOC) in the proposal.[h] We inadvertently used VOC emission rates for natural gas engines to represent LPG engines in the proposal. The effect of this was that per-engine HC emissions from LPG engines were dramatically underestimated. Also, the model projects a faster growth in sales for LPG-fueled engines than for gasoline-fueled engines. In fact, we projected that gasoline equipment populations will actually decrease in the future due to decreasing sales in favor of LPG equipment. Since the proposed emission factors for LPG engines are higher for NOx emissions, lower for CO emissions, and dramatically lower for HC emissions relative to gasoline engines, the long-term emissions picture shows a NOx emissions increasing faster than the population growth, CO increasing at a rate less than population growth, and HC emissions actually decreasing over time. Having corrected the problem with the LPG emission factor for VOC, our final inventory estimates for Large SI equipment increase over time for all pollutants, as would be expected. However, the different growth rates for LPG and gasoline engines, as previously discussed, mean that the growth rate in the inventories is different for the different pollutants, and does not directly track engine population.

To arrive at the estimate of 442,000 forklifts operating with SI engines, we relied on an industry report that showed not just population estimates, but additional information about how the population is distributed among different industry sectors (retail, wholesale, manufacturing,

[h] Hydrocarbon (HC) and volatile organic compounds (VOC) tend to correlate fairly well and are often used interchangeably. However, in the case of natural gas vehicles, VOC emissions tend to be very low compared to HC emissions due to the fact that a large percentage of natural gas vehicle HC emissions are methane, a compound with very low ozone-forming potential compared to most other HC compounds in vehicle exhaust.

construction, utilities, and services) and among companies with different fleet sizes.[i] These figures fit together to provide a detailed picture of forklift operations in the U.S. consistent with the original population estimate. In contrast, ITA provides no basis for its estimate of an 8-year average lifetime for forklifts. The industry report on forklifts described above estimates a 17-year life. As a result, we believe that the original estimate may be too low, but is nevertheless a very defensible estimate.

We have updated our estimates of annual operating rates for forklifts using the industry report referenced above. The new estimate increases to 1800 hours. Again, the report characterized the information separately for different industry sectors in compiling a single, average estimate. This detailed approach provides a compelling argument for its conclusion. ITA provided no information supporting its lower estimate of forklift operating rates.

The Nonroad Model computes an emission contribution from each engine model, rather than relying on a calculation based on average values (for load factor, average horsepower, hours per year, etc.). Based on the population figures for each engine model, the weighted average power level for forklifts with spark-ignition engines is 69 hp. This figure is 25 percent higher than ITA's upper estimate. While these figures are quite close, they could nevertheless be reconciled by comparing population counts of individual engine and forklift models.

Some leaf blower/vacuums use a 65-horsepower air-cooled engine. These units are used for clearing leaves and small branches from large municipal parks. We therefore did not change these figures in the model.

We agree that the estimated population of airport ground-service equipment is too low. We have been actively pursuing an improved estimate for this figure, but have not been able to fully resolve the issue. In the absence of better information, however, we have chosen to leave our airport ground service equipment population estimate unchanged.

We recognize that there are few gasoline-fueled generators. We have therefore adjusted the model to change the population of generators thought to be operating on gasoline to be LPG-fueled.

---

[i] "The Role of Propane in the Fork Lift/Industrial Truck Market: A Study of its Status, Threats, and Opportunities," by Robert Myers for the National Propane Gas Association, December 1996.