

**Preliminary Comments from Members of the Chartered SAB on the SAB
Draft Report *SAB Review (12/3/12) of Exposure Estimation Methodologies for
Broiler Animal Feeding Operations and for Lagoons and Basins at Swine and
Dairy Animal Feeding Operations***

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Comments from lead reviewers

Comments from Dr. Pedro Alvarez

1. Were the charge questions adequately addressed?

Yes, the charge questions were directly and thoroughly addressed.

2. Are there any technical errors or omissions in the report or issues that are not adequately dealt with in the draft report?

I did not detect any technical errors in this review report, which was carefully prepared. There are no blatant omissions either. However, the report could be more useful if it provided some technical guidance to the EPA as a follow up to two of the recommendations. Specifically: (a) I agree that the statistical regression approach used to set EEMs was based on a relatively dataset of static variables, and that these EEMs should not be broadly extrapolated. I also agree that a more reliable approach would be to develop process-based models of varying levels of complexity to provide options to AFOs with different levels of data availability; however, such models need to be properly calibrated and validated. The SAB review would be more useful if it provided guidelines about the minimum number of sites, and goodness-of-fit criteria needed to calibrate these models. Furthermore (b) in the interim, the SAB correctly recommends expanding the dataset used in their statistical approach. This recommendation would be more useful if it provided guidelines on how to determine the minimum number of data (and source variability and geographical distribution) that need to be considered to have the necessary statistical power to develop the EEMs.

3. Is the draft report clear and logical?

Yes, the report is clearly written and logical. The committee did an excellent job/

4. Are the conclusions drawn or recommendations provided supported by the body of the draft report?

Yes, the conclusions and recommendations are based on thoroughly documented sound principles and practical considerations. In addition to the logical recommendations discussed in point (2) above, the recommendation to not combine the swine and dairy datasets to estimate NH₃ emissions is also sound, because of differences in nitrogen content and manure composition from these sources that affect the rate and extent of pertinent microbial processes. I also agree with the recommendations that static predictor variables (e.g., animal type, total live mass) should not be used in lieu of dynamic data on lagoon conditions (e.g., pH and temperature, wind speed, which are more influential variables) to NH₃ estimate emissions, and that zero values should be considered in the statistical analysis whenever the measurements are considered valid. Overall, the committee's offers valuable suggestions that will increase the credibility and usefulness of this effort to develop EEMs.

Comments from Dr. Joel Ducoste

Responses to six charge questions were provided in the SAB review report. Below are comments on the responses provided in the draft report. As part of the review, I discuss items that could have been included in the report that were not originally addressed. Overall, the draft report is logical and the conclusions/recommendations provided are generally supported by the body of the draft report.

Question 1: EPA's Approach for developing the EEMs

Statistical Approach

The report outlines adequately that the EPA should not apply the current version of the statistical and modeling tools beyond the farms included in the data set. It further states that these models should include variables that are mechanistically based. The report states that a large number of farms that adequately represents a broad range of conditions found on farms across the US should be used to develop these models. However, no method or reference was stated to determine the number, location, and types of farms that would be deemed sufficient for proper validation of the model. The report adequately expresses the concerns associated with improper measurement sampling during warmer periods but does not provide a way to avoid this problem. It does note that more data analysis be performed to assess the impact of weather on emissions.

Finally, the report suggests that the EPA create a modeling approach that relies on default parameters to allow for broader usage by several farms. However, the report does not discuss the involvement of a parameter sensitivity analysis. Sensitivity analysis is crucial for model discrimination, optimization, and parameter estimation. Sensitivity analysis can be useful not only for understanding model behavior, but also for identifying the physical, chemical, and biological processes that may be most important. Obtaining accurate empirical estimates of the parameters that captures the most important mechanistic processes may then improve the accuracy of the proposed models. Again, some more references for the use of sensitivity analysis in model development would be helpful in the final report.

Process based modeling Approach

The report discusses the need to develop process based models for air emissions from AFOs. These models would better represent the fundamental processes that drive the composition and quantity of the emissions produced. The report cites the NRC report, which presents a very simple flow chart schematic of a process based emissions model. Yet no specifics was provided to determine what sub-models will be included (i.e., sub models related to the physical, chemical, and biological processes, transport processes, etc.), procedure for model validation, appropriate data to help validate sub-models. As mentioned in the report, these process based models can be very complex and require significant amount of data to validate important sub-models. Uncertainty and sensitivity analyses will also be needed to assess sub-model discrimination and parameter estimation. The report stated the advantages for using process models. However, the report should also describe the disadvantages (i.e., significant number of fitting constants, computational requirement of the uncertainty analysis, etc.).

Question 2: EPA's decision to combine the swine and dairy dataset to better incorporate seasonal meteorological effects as well as combining data from lagoon and basin operated facilities

The response provided by the SAB on this question was adequate. The problems with combining the data was properly discussed.

Question 3: EPA's decision to use static predictor variables as surrogates for data on lagoon/basin conditions. In addition, does the SAB recommend that EPA consider specific alternative approaches for statistically analyzing the data that would allow for the site specific lagoon liquid characteristics to be used as predictor variables

The response provided by the SAB on this question in the report was adequate

Question 4: Does the SAB recommend that EPA consider alternative approaches for developing the draft NH₃ EEM that balances the competing needs for a large dataset (to reflect seasonal meteorological conditions) versus incorporating additional site specific factors that directly affect lagoon emissions. If so, what specific alternatives approaches would be appropriate to consider?

Much of the response provided for this section was about model setup instead of providing alternatives. In developing the response to this question, the report states that the RPM and bLS emissions estimates were very close in several of the datasets collected in the NAEMS study. However, the NAEMS study may not be sufficient to draw that similarity conclusion. In this section of the report, an effort was made to develop emission units that reflect the source. However, if mechanistic based variables are utilized in the model or if a process-based model is developed to generate the EEM data, then consistent units across design setups should be used. It will help with ensuring mass balance in the modeling results.

Question 5: EPA's approach for handling negative or zero emissions

The response provided by the SAB on this question was adequate. References to support decision would be helpful for detailed explanations not provided in the report. The following are suggestions for references to include in the report.

Analytical Methods Committee, 2001, Measurement of near zero concentration: recording and reporting results that fall close to or below the detection limit, *Analyst*, 126(2), 256-259

Currie, L.A., 1999, Detection and Quantification Limits: Origin and Historical Overview, *Analytica Chimica Acta*, pp 127-134

Janiga, I., Mocak, J., Garaj, I., 2008, Comparison of Minimum Detectable Concentration with the IUPAC Detection Limit, *MEASUREMENT SCIENCE REVIEW*, Volume 8, Section 1, No. 5, pp 108-110

Rocke, D.M., Durbin, B., Wilson, M., Kahn, H.D., 2003, Modeling Uncertatinty in the Measurement of Low Level Analytes in Environmental Analysis, Ecotoxicology and Environmental Safety, 56, pp 78-92

Wilson, M.D., Rocke, D.M., Durbin, B., Kahn, H.D., 2004, Detection Limits and Goodness of Fit Measures for the Two-component Model of Chemical Analytical Error, Analytica Chimica Acta, 509, pp 197-208

Question 6: SAB recommendations on alternative approaches for handling negative and zero data other than the approaches used by the EPA

Much of the response to this question was addressed in the response provided in Question 5.

Question 7: EPA's approach used to develop the draft broiler VOC EEM

The response provided by the SAB on this question in the report was adequate.

Quality Review summary:

1) Were the charge questions to the committee adequately addressed?

Please see comments above that describes issues with particular charge questions

2) Are there any technical errors or omissions or issues that are not adequately dealt with in the draft report?

Please see response to Charge questions 1, 4, and 5 above.

3) Is the draft report clear and logical?

Yes, overall.

4) Are the conclusions drawn or recommendations provided supported by the body of the draft report?

Yes, overall

Comments from Dr. Taylor Eighmy

Overall Comments:

1. General Thoughts:

The SAB Animal Feeding Operations (AFO) Air Emissions Review Panel (the “Panel”) has assembled a very thorough review of EPA’s Broiler and Lagoon draft documents for developing emissions-estimating methodologies (EEMs) for use with select AFOs. These EEMs were requirements imposed from a 2005 voluntary air compliance consent agreement between the EPA and 14,000 AFOs.

The report reflects a great deal of work by the panel, careful consideration of public and committee member comments on the two EPA draft documents and proposed EEMs, incorporation of additional information from the agency, and thoughtful deliberation in the generation of the review from its draft to final form.

The 2005 consent agreement affords the SAB the opportunity to recommend delay in the EEM implementation if the available data used are not adequate to support the EEMs. Given the importance of EEMs in regulating and managing AFOs, the recommendations by the panel for EPA to go back and develop process-based models and to significantly expand the NAEMS data used are very appropriate.

2. Mapping the Report to the Letter to the Administrator and to the Executive Summary:

I found the 2.5 page summary letter to the administrator sufficiently balanced between brevity and detail. The contents and the structure of the letter map well to the full report. The content and structure of the executive summary also map well to the full report.

3. Report Organization:

The report is well organized and clear to follow and aligns well with the seven charge questions.

Response to the Four Specific Questions:

1. Were the original charge questions to the Panel adequately addressed?

I believe that all seven charge questions were adequately addressed. Comments on the draft broiler and lagoon reports were also provided.

2. Are there any technical errors or omissions in the report or issues that are inadequately dealt with?

From my perspective, no.

3. Is the report clear and logical?

I found the report to be very clear and logical.

4. Are the conclusions drawn or recommendations provided supported by the body of the report?

Yes, very much so.

Comments from Dr. Daniel Stram

1. Were the charge questions adequately addressed?

Issue 1. Statistical methodology used to develop the draft EEMs

Question 1: Please comment on the statistical approach used by the EPA for developing the draft EEMs for broiler confinement houses and swine and dairy lagoons/basins. In addition, please comment on using this approach for developing draft EEMs for egg-layers, swine and dairy confinement houses.

The review calls for EPA to (1) adopt a process-based approach for the development of EEMs; (2) to base the modeling of pollutant output on more than just the small number of sites available from the NAEMS; and (3) recommends the "EPA not to apply the current versions of the models for estimating emissions beyond those covered in the data set."

I feel that more direct comment on the statistical methods used should be given by the SAB review, specifically given the evident success in modeling NH₃ and several other pollutants for the three sites considered in the broiler report. I think it is important to separate the question of whether the existing data was well analyzed from the question of the generalizability of the results. For example a key EPA finding of the broiler report (from my quick scan of the report) was that there didn't seem to be a need for a random effect term for site in the models for the pollutants considered; it is not clear however if the right kind of random effects were really considered, since I think the EPA model for broiler emissions only allowed for a random intercept term. The random intercept term seems rather artificial since the emissions are largely grounded at zero when there are no birds or buildup on site. EPA probably should also investigate whether slope terms are different by site (with a random interaction between site and bird size for example), if the slope terms varied by site this would quite important since it would mean you would have to have different equations to model the three different sites considered. A finding of a need for random slope terms for these three would certainly raise questions about the generalizability of the results to other sites not measured.

There are other considerations regarding generalizability that go beyond the statistical analysis of the three sites. For example, why did these specific sites end up being selected to be part of the NAEMS or Tyson study? I would (naively perhaps) assume that they were selected because they were *thought* to be representative of a large portion of the industry. Thus even if some variability between the three sites is detected, the question about generalizability rests on the broader issue of how the specific sites were chosen and how much of the industry each one is *thought* to represent. Issues of generalizability rarely can be treated solely as a statistical problem, decisions have to be made in light of imperfect data.

I have concerns about the recommendation that EPA try to base EEMs on process-based models quantifying the flows of materials from one process on a farm to the next as a primary prediction method with empirical data used only for calibration of the process-based models. First of all this is very vague but also It appears that there already is a method (multiple regression based) that has explained very substantial portion of the variance (high R²) of some of the pollutants at individual farms; moreover the high R² achieved is pretty clearly not a function of over-fitting (i.e. the cross validation R² could have not been so high if the models were over-fit).

In the data shown in the broiler report some very basic variables such as bird inventory and average bird mass appear highly predictive of output of the pollutants and can be made even more predictive by including some additional ambient or confinement variables. It would seem much more reasonable to suggest that some additional validation (perhaps short-term) of the (evidently highly predictive) EEMs at additional locations be undertaken at some well-chosen sites rather than recommend dropping the statistical approach totally in favor of extensive physical modeling (i.e. process-based methods *using what input data?*). While the NAEMS study is dependent on the representativeness of the operations chosen to study, overall having some data (especially if it is judged to be properly analyzed) is far better than having none, and while the generalizability of the slope coefficients relating bird inventory and size to pollutant levels at other farms (that raise other breeds to different sizes using different feed for example) may involve uncertainties, there seems little doubt that bird inventory and size will be driving variables in any case.

The SAB report also recommends a process-based approach to developing models for egg layers; I think this recommendation underestimates the value of the regression approach and its likely applicability, given the success with broilers at capturing a large fraction of variability using easily understood and collected variables.

Question 2: Please comment on the agency's decision to combine the swine and dairy dataset to ensure that all seasonal meteorological conditions are represented. In addition, the agency also seeks the SAB's comments on whether the agency should combine lagoon and basin data.

The issues surrounding the swine and dairy report seem to be quite complicated and the SAB report argues quite compellingly that swine and dairy animals are different from each other and that lagoons and basins are different. Again however I think it would be useful to try to split the question of whether the data available is properly analyzed (to provide predictor equations for the specific sites considered) from the question of the generalizability of the results to all possible operations, if this is possible.

Question 3: Please comment on the agency's decision to use SPVs as surrogates for data on lagoon/basin conditions. Given the uncertainties in that approach, does the SAB recommend that the EPA consider specific alternative approaches for statistically analyzing the data that would allow for the site-specific lagoon liquid characteristics to be used as predictor variables?

I am sympathetic to the SABs concerns comments that " To the extent that a given SPV is not clearly, unambiguously and fundamentally related to the emission rate through a well-established emissions mechanism – the resulting EEM cannot be reasonably extrapolated to other AFOs." Again however I think that some discussion of the success (or not) of the predictors in describing the data shown should be provided. Here only NH₃ was analyzed, and the (cross validated) R² were quite high (~60 percent) although lower than the broiler report. Moreover it appeared that site differences could be explained on the basis of such seemingly relevant variables as animal type, farm capacity, and lagoon surface area. Farm capacity and lagoon surface area both seem (to this reviewer) to be rather unambiguously and fundamentally related to emissions, I suspect that any prediction model would use both these variables or time-dependent versions of these variables. Of course they may be modified by other variables (e.g. lagoon chemistry: pH, nitrogen content) to be applicable as broadly as possible.

Question 4: Does the SAB recommend that EPA consider alternative approaches for developing the draft NH₃ EEM that balances the competing needs for a large dataset (to reflect seasonal meteorological conditions) versus incorporating additional site-specific factors that directly affect lagoon emissions. If so, what specific alternative approaches would be appropriate to consider?

I don't have any comments on the response to this question. The responses seem helpful and appropriate.

Question 5: Please comment on the EPA's approach for handling negative or zero emission measurements

The response to this question seems to be quite comprehensive and helpful. Eliminating negative values is indeed not always the most reasonable method.

Question 6: In the interest of maximizing the number of available data values for development of the draft H₂S EEMs for swine and dairy lagoons/basins, does SAB recommend any alternative approaches for handling negative and zero data other than the approach used by the agency.

No comments here either.

Question 7: Please comment on the approach EPA used to develop the draft broiler VOC EEM.

Again I am not happy with the implication that regression modeling (page 31 lines 22-26) of measured data using such basic input variables as bird number and size would not play an important role in the development of a VOC EEM. The SAB review recommends that VOC EEM not be pursued *at this time*. This recommendation is based on only having data from Kentucky as well as concerns about sampling technique. It appears (page 31 lines 1-4) that the SAB review committee could still be convinced that the EPA VOC collection methods may have yielded good data in Kentucky. If that is the case then should the EPA proceed with a VOC EEM? The phrase *at this time* is ambiguous on this point.

2. Are there any technical errors or omissions in the report or issues that are not adequately dealt with in the draft report?

My overall concern is the many places in the text where regression modeling is assumed to be at best second tier to process-based modeling. All the variables used can be regarded as surrogates for underlying unobserved variables (e.g. bird mass and number a surrogate for total nitrogen in bird droppings). Is it realistic to assume that much better data can be readily obtained in order to meet the goals of the voluntary consent agreement? Issues of generalizability are important but can be at least partly removed from the quality of the data analysis. The analysis by the EPA seems at least superficially to provide decent predictions in many instances. There is an underlying presumption that it is impossible to generalize the results of the regression analyses because of the small number of sites examined. However if in the design of the project the sites were specifically chosen to be representative of broad groupings of AFO operations (which I assume perhaps naively to be true) then the generalizability should still be just as valid (if not completely certain) now.

3. Is the draft report clear and logical?

Overall the report is written quite clearly.

4. Are the conclusions drawn or recommendations provided supported by the body of the draft report?
see comment # 2.

Comments from other SAB Members

Comments from Dr. Ingrid Burke

1) *Were the charge questions to the committee adequately addressed?*

Yes; each of the questions was clearly addressed in the full report, and the executive summary. The justification for the responses was less well addressed, and could have been much more so, in the Executive Summary and in the Letter to the Administrator.

2) *Are there any technical errors or omissions or issues that are not adequately dealt with in the draft report?*

Yes. It seems to me that more clarity, less redundancy, and a bit more explanation are all needed. I think that the problem with redundancy was substantial, and that it will be possible to reduce the overall length of the report to some degree.

3) *Is the draft report clear and logical?*

See above, but here are some examples:

Page 2, in the Letter, first full paragraph. The report describes the location of the broiler sites very specifically, then does not do so for swine and dairy lagoon sites. The two sentences need to be parallel. To support the statements below, that is, that the limited individual site data are not sufficient to be extrapolated using statistical models across the whole country, I don't think the site locations need to be there. But if we do it for broilers, we need to do it for dairies, swine breeding, etc.

I think that the idea that statistical models are not as valuable as process-based, or mechanistic models, is repeated far too many times, without really enough pithy explanation to get it clearly any of the times it is brought up. Somewhere (e.g in the overview or in the Charge 1 part, in all three sections of the report), I recommend we take this approach:

- 1) EPA used data from a limited number (n) of sites
- 2) EPA is proposing using statistical models that combine the broiler, swine, etc data
 - a. The models use x, y, and z as predictor variables, at THIS temporal scale and THIS spatial scale
 - b. And a, b, and c as output variables, at THIS temporal scale and THIS spatial scale
- 3) Statistical models are inherently flawed because they are restricted to the domain of the predictor variables, and because the domain of the measurements does not cover the domain of the rest of the U.S. adequately
- 4) We recommend process models, which can be applied (and tested, and adapted) outside the domain of the current data.
- 5) We recommend not combining the swine and broiler and dairy models, again, because the domain of input variables is so different (I realize that the AFO Panel thought hard about this, but I am not so convinced of this, particularly if a process model is used...).

These ideas show up all over the document, but not this clearly, ever (it's really hard to find a place where even the simplest description of the statistical models exists). I recommend doing it once, under Charge 1 in the Summary and the full report, and in one paragraph in the Letter.

- 4) Are the conclusions drawn or recommendations provided supported by the body of the draft report?

Yes, though again, I question whether the two conclusions a) that process models are needed, and b) that the type of operations cannot be combined, are compatible.

A few typographical or syntactical suggestions (I only did markups on the Executive Summary).

Page 1 Exec Summary: I dislike the syntax, used twice in this paragraph: "The EPA..requested the Science Advisory Board to review". I'm not sure it's correct, anyway. I recommend, in both cases (line 5 and line 13): " The EPA requested THAT the SAB review"...

Page 3, Executive Summary: line 11. "between" should be replaced with "among", I think. Line 8-9, that same paragraph, there is something missing in "may not control emissions all farms across the nation".

Page 4, ES: line 10. Literature that should be included IS included...(not "are")

Page 4, ES, line 25: data ARE, not "is".

Same page, lines 28-41, redundant of much above.

Page 5, ES, line 25. I don't think it's "erroneous" to combine the data. It's an oversimplification, or something, but it's not an error if it's done intentionally and transparently.

Page 7, ES, lines 21-22. None of these units is correct for fluxes (mass/unit area/unit time). The document apparently says mass/time should be mass/area or even mass/animal weight. Help. This is perpetuated in the full report.

Comments from Dr. Terry Daniel

General comments

This is a very thorough and rather critical review of the EPA's attempt to develop (empirical/statistical) models for assessing atmospheric emissions from animal feeding operations nationwide. At the same time, the review panel was careful and specific in recommending revisions and additions to the EPA modeling effort. The implications are that greater efforts over a longer time will be needed to achieve a credible model for assessing the targeted pollutants from AFOs. It seems likely that this will mean that current practices (and associated levels of air pollution) will prevail until more convincing assessments are achieved. It is clear from the review that the current EPA effort does not rise to the standards applied by the panel. What is less clear is whether the time and effort needed to develop models that do meet those standards are worth the costs of foregone pollution abatement.

Specific Quality Review questions

1. *Were the original charge questions to the SAB panel adequately addressed?*

Yes

2. *Are there any technical errors or omissions in the report or issues that are not adequately dealt with in the Committee's report?*

Not than a non-expert in the field would recognize. The panel appears to have been very thorough and expert in their analysis.

3. *Is the Committee's report clear and logical?*

Yes, the report is very well written and technically sophisticated and seems to target the key areas where the EPA assessment models can and should be improved.

4. *Are the conclusions drawn or recommendations provided supported by the body of the Committee's report?*

Yes, the recommendations are well supported by the body of the review. There are some suggestions that the EPA process might be improved and extended by additional data and by changes in analyses applied to the data already collected. It is less clear whether such improvements of the current studies would be sufficient to support some useful near-term assessments of atmospheric emissions from some AFOs (beyond the few actually studied) while the process models and other longer term improvements are being achieved.

Comments from Dr. George Daston

I found this report to be well written, with the conclusions well supported by the information contained in the review. The panel is to be commended for its specific and pragmatic advice.

We were asked to address four specific questions as part of the quality review.

1. whether the original charge questions to SAB Standing or Ad Hoc Committees were adequately addressed;
2. whether there are any technical errors or omissions in the report or issues that are inadequately dealt with in the Committee's report;
3. whether the Committee's report is clear and logical; and
4. whether the conclusions drawn or recommendations provided are supported by the body of the Committee's report.

Question 1: The charge questions posed to the review panel were all adequately addressed in a very transparent way.

Question 2: I found no technical errors in the report. One of the major criticisms of EPA's methodologies is that their models and conclusions are based on data from an inadequate number of broiler and swine and dairy feeding operations. I think it would be helpful to provide EPA with more specifics on how much data are enough to build a valid suite of models. By that, I don't mean that the SAB should be providing them with a bright-line, but it would be help to provide some guidance as to criteria that are most important in deriving representative samples of data. For example, is it sufficient to evaluate at least a percentage (1-2%?) of all the animal feed operations in an unbiased way, or is it better to select the sample to represent farms of different sizes, or that have different climate or hydrology, etc.?

Question 3: I found the report to be clearly and logically presented.

Question 4: I found the conclusions of the report to be well documented and supported.

Comments from Dr. Otto Doering

I believe that the charge questions to the committee were adequately addressed.

I did not find technical errors or omissions or issues that are not adequately dealt with in the draft report.

The draft report is clear and logical.

The conclusions drawn or recommendations provided are supported by the body of the draft report.

Additional Comments:

The Animal Feeding Operations Emission Review Panel has done an excellent job on a most important subject. Animal feeding operations represent a major challenge in terms of emissions. The correct estimation of these emissions is critical to developing cost effective methods for mitigation or control.

I strongly support the conclusion of the panel that EPA should not apply (extrapolate from) the current versions of the models for estimating emissions beyond the cases in the current data set.

I strongly support the conclusion of the panel that the swine and dairy data sets should not be combined given the important differences between the two.

I strongly support the recommendation that a process based modeling approach be developed. It is critically important to be able to follow the process from feed to housing to storage to application or other end utilization. These materials change over time depending upon conditions and system design. Being able to quantify air species of interest, like NH₃, is terribly important. The development of a process model should not be viewed as an impossibly large undertaking. The suggestion of the panel is to start with more simple process models and develop complexity as the data allows, while being able to use the NAEMS data to validate the process model as it is being developed. This suggestion (which follows a recommendation from the National Research Council) should be followed.

Comments from Dr. Michael Dourson

I believe so, but I have several general, and probably hopelessly naïve, questions for the panel to consider. Specifically,

I was surprised by the lack of reference to the typical contaminants of concern at these and similar operations. Is this not the focus of the modeling work? If so, what are these contaminants? My guess is that they would include ammonia, hydrogen sulfide, methane and particulate matter.

If these or other contaminants are the focus of the work, why were the American Conference of Governmental Industrial Hygienist (ACGIH) Threshold Limit Values (TLVs), or Short Term Exposure Limits (STELs) or the National Institute of Occupational Safety and Health (NIOSH) or Occupational Safety and Health Administration Permissible Exposure Limits (PELs) not considered in the report? I imagine that if the AFOs were regulated under NIOSH and OSHA that residential areas would be less impacted. Alternatively, one might consider the use of Acute Exposure Guideline Levels (AEGs) for residents, although these values are often for singular or infrequent exposures.

- Ammonia ACGIH STEL = 35 ppm
- Hydrogen sulfide ACGIH STEL = 15 ppm
- Methane ACGIH TWA = 1000 ppm
- Particulate matter (not otherwise specified) ACGIH = 10 mg/m³ as inhalable particles

Are there any technical errors or omissions in the report or issues that are not adequately dealt with in the draft report?

I am not able to answer this question.

Is the draft report clear and logical?

The draft was very clear. I enjoyed reading and learning about a new area of science.

Are the conclusions drawn or recommendations provided supported by the body of the draft report?

I am not able to answer this question.

Comments from Dr. David Dzombak

I commend the panel on a thorough evaluation that is clearly responsive to the charge, and for a well written and well organized report. The clarity of the report and the specific advice offered will be valuable to the EPA in reconsidering and further developing the emissions-estimating methodologies for animal feeding operations. The specific advice in Section 4 on how the reports can be improved is supplemental to the charge question responses and will be helpful to the EPA.

1. Were the original charge questions adequately addressed?

Yes, the original charge questions are addressed adequately.

2. Are there any technical errors or omissions in the report or issues that are not adequately dealt with in the Panel's report?

I found no technical errors or omissions.

3. Is the Panel's draft report clear and logical?

The draft report is well written and very well organized. It responds to the charge questions systematically and clearly. I offer some minor suggestions to improve consistency of formatting and clarity.

- (a) The Letter to the Administrator is well written and nicely summarizes the focus and key findings of the report. It is fairly concise at than three full pages in length. My only suggestion for improvement is that there is no explicit mention of what the charge was to the panel. It would not be appropriate or desirable to repeat the charge questions in the Letter, but a little more information about the specifics of the charge could be given in the opening paragraph, in summary form.
 - (b) In Section 3 of the body of the report, there is some inconsistent formatting that needs to be fixed. Some of the italicized, fourth sub-level, non-numbered headings have colons after them and some do not (e.g., see p.14). Some of the third sub-level headings are underlined and some are not (e.g., see pages 18, 23, 26, 29, 30). A "Background" subsection, however brief, should be provided for Section 3.6 to parallel all of the other parts of Section 3, and the Background and Response sub-sections should be numbered.
 - (c) In Section 4, the sub-section headings should be bold to parallel the format in Section 3.
 - (d) The heading for Appendices should be modified (or perhaps omitted) so that it is clear that this discussion belongs to Section 4.2.
4. Are the conclusions drawn or recommendations provided supported by the body of the Panel's report?

The conclusions and recommendations are adequately supported in the body of the report.

Comments from Dr. Robert Johnston

1) Were the charge questions to the committee adequately addressed?

Yes, the charge questions were adequately addressed.

2) Are there any technical errors or omissions or issues that are not adequately dealt with in the draft report?

To my knowledge, there are no technical errors or major omissions in the report, and I agree with the report's general recommendations. The report correctly highlights the multiple shortcomings of the Agency's current EEM approaches, including an inability to generalize from such a small sample, problems with the use of static predictor variables, and the inappropriateness of combining data from swine and dairy basins.

It seems clear that the empirical model developed by EPA is insufficient, and the report strongly recommends that the agency "develop process-based models of air emissions from AFOs of all types (e.g., broiler, dairy, egg layers, swine, etc.)." However, while noting the "potential drawbacks with developing and applying process-based models to assess emissions at AFO facilities," the report seems to accept as a foregone conclusion that process-based models are necessarily superior to empirical models. Is this universally true for EEMs, particularly given the paucity of available data? This conclusion warrants a more nuanced discussion. For example, will a process based model developed with a paucity of data necessarily outperform an empirical model? (The report correctly notes that process-based models are data intensive.) Should this be evaluated by the Agency? It seems as if the report focuses on an "ideal" process-based model, rather than a likely-imperfect model of the type that would be feasible with existing data. In this case, it seems a valid question whether a process-based model would necessarily outperform an empirical model.

Regardless of the above concern, I agree with the report that the current small-sample empirical model developed by EPA has limited application to farms across the US, and should not be used. Regardless of the value of empirical models in general, there is no justification for nationwide application of a model based on data from only three broiler facilities and nine swine and dairy facilities.

3) Is the draft report clear and logical?

Yes, the draft report is clear, logical and detailed.

4) Are the conclusions drawn or recommendations provided supported by the body of the draft report?

Yes, the recommendations provided are supported by the body of the draft report. However, as noted above, the report could provide a more nuanced discussion of the advantages/disadvantages of empirical versus process-based models, to provide more balanced support for its (strong) recommendation of the latter.

Comments from Dr. Bernd Kahn

This SAB review is well written; my responses to the four questions are, respectively, 1.yes, 2.no, 3.yes, and 4. yes. Major concerns are:

p.8, 1.43: This is labeled 'general comments' but appears to refer to p.32, 1.1, 'Specific Recommendations' \; if so, it should be re-titled accordingly. Are the recommendations in response to the questions and the recommendations given here integrated in the Letter?
 p.2, 1.1 of Letter; Executive Summary response to charge questions; Responses to charge questions; and p.33, 1.8: The advice makes clear that the data base is far too small to represent the half million sites under consideration. The recommended approaches that consider the variety of parameters of the processes and atmospheric conditions related to seasons and locations are very useful, but still leave open the question: what is the minimum number of test sites that would be acceptable? Is the number in the hundreds or thousands?
 p.3, 1.24 and elsewhere: When the review committee refers to 'egg-layers', 'broilers', and 'chickens', what distinction do they draw that applies to the emission-estimating purpose?

Typos, etc.:

p.1, 1.9: Insert " after 'Report'.
 p.2, 1.5-6: Use abbreviation 'AFO' instead of panel name.
 p.2, 1.18: Reference 6 is really reference 1; also, on p.4, 1.9, reference 7 is really 3, and on p. 11, 1.1, reference 9 is really 3.
 p.4, 1.20: Change 'is' to 'are'.
 p.11, 1.19: Refer to Appendix A in this paragraph.

Comments from Dr. Catherine Karr

- 1) Were the charge questions to the committee adequately addressed? YES
- 2) Are there any technical errors or omissions or issues that are not adequately dealt with in the draft report? NO
- 3) Is the draft report clear and logical? YES
- 4) Are the conclusions drawn or recommendations provided supported by the body of the draft report? YES

Comments from Dr. Nancy Kim

General comment

Although this is not my area of expertise, the panel's review of the two reports seems well carried out and its recommendations provide EPA with a path forward.

Comments on the draft report.

1. Were the charge questions to the committee adequately addressed?
Yes.
2. Are there any technical errors or omissions or issues that are not adequately dealt with in the draft report?
Not that I noticed.
3. Is the draft report clear and logical?
Yes, for the most part.

Letter to the Administrator

The letter to the Administrator could be edited to be more concise, to be clearer, and to emphasize the most important conclusions.

Suggestions for paragraph beginning on page 2, line 11.

- a. The two sentences beginning on line 13 and ending on line 15 seem unnecessary in light of the sentences before and after them. Regardless of how the beginning of this paragraph is edited, reducing the duplication of thought that occurs in the beginning of the paragraph would make it more direct for the letter to the Administrator.
- b. Moving the overall recommendation in this paragraph (occurs on line 19 – 21) to the beginning of the paragraph would highlight the conclusion for the Administrator and follow the structure followed in the next two paragraphs.
- c. The last two sentences in this paragraph seem like after thoughts. They may not be of sufficient importance to be included in the letter to the Administrator. If the panel thinks they need to be in the letter, could they be more concisely expressed in this paragraph or should they be in a separate paragraph? Perhaps moving the recommendation sentence to the beginning of the paragraph will help with this.

The last sentence of the paragraph beginning on page 2, line 27 seems to be disconnected from the major topic. Is it needed in the letter? Should it be a topic sentence in a separate paragraph?

The paragraph beginning on page 2, line 36 is long and contains a number of different points. The paragraph could also be more concise.

- a. One suggestion is that the two sentences that begin on page 3, line 3 address somewhat different points than the beginning of the paragraph. They could possibly

- be deleted. If they are sufficiently important to be included in the executive summary, they should probably be in a separate paragraph(s).
- b. Another approach would to eliminate some of the details. For example, the last sentence in the paragraph may not need to be in the executive summary.
4. Are the conclusions drawn or recommendations provided supported by the body of the draft report?
Yes.

Minor comments.

Letter to the Administrator

Page 1, line 29. The sentence beginning with, “As part of the agreement...” seems unnecessary

Executive Summary

1. Page 2, line 39. Need a period at end of sentence.
2. Page 3, line 8. Need an at after emissions and before all.
3. Page 4, line 25. Should be data are.
4. Page 8, line 17. The should not be capitalized.

Comments from Dr. Francine Laden

1) Were the charge questions to the committee adequately addressed?

Yes – the charge questions are adequately addressed.

2) Are there any technical errors or omissions or issues that are not adequately dealt with in the draft report?

The report is very thorough and appears to adequately deal with all important issues.

3) Is the draft report clear and logical?

Yes – the draft report is clear and logical

4) Are the conclusions drawn or recommendations provided supported by the body of the draft report?

The conclusions and recommendations are supported by the body of the draft report. The Executive Summary provides a useful and concise summary of the report.

Comments from Dr. Cecil Lue-Hing

General comments

The report is well organized, well written and easy to read.

Specific comments

Letter to the Administrator

The letter is well written and presents a good summary of the recommendations. The recommendations are firm and unambiguous.

The Executive Summary

The Executive Summary is well done, and provides a good summary of the major recommendations in the body of the report.

The Body of the Report

The report is well organized, and well written. All charge questions posed by the EPA to the Panel were appropriately addressed. The SAB provided very comprehensive recommendations for upgrading both the Broiler Report and the Lagoon Report.

Quality Review Questions

1 – Were the original charge questions to the committee adequately addressed?

Yes

2 – Are there any technical errors or omissions in the report or issues that are inadequately dealt with in the Panel's report?

None that I could identify.

3 – Is the Panel's draft report clear and logical? and

Yes

4 – Are the conclusions drawn or recommendations provided supported by the body of the Committee's report

Yes

Comments from Dr. Elizabeth Matsui

I reviewed the three SAB reports and assessed whether the charge questions were adequately addressed, whether there were any technical errors or omissions, whether the draft reports were clear and logical, and whether the conclusions/recommendations were supported by the body of the draft report.

Comments from Dr. James Mihelcic

1) Were the charge questions to the committee adequately addressed?

Yes

2) Are there any technical errors or omissions or issues that are not adequately dealt with in the draft report?

I did not see any. The report is very complete in terms of providing EPA with detailed scientific and technical issues to consider.

3) Is the draft report clear and logical?

The draft report is clear and logical.

4) Are the conclusions drawn or recommendations provided supported by the body of the draft report?

Yes

Editorial

On page 35 there are duplicative sentences.

(lines 19-23) The discussion of the U.S. dairy and swine industries should be rewritten. Additional details should be provided on the overall operations at the dairy and swine industry facilities, particularly the facility waste handling techniques and manure management systems.

&

(lines 42-43) The report should be rewritten to include additional details on the dairy and swine industry, in particular the waste handling techniques and manure characteristics.

Comments from Dr. Eileen Murphy

1. Were the original charge questions to SAB Standing or Ad Hoc Committees adequately addressed?

Yes. I thought the summaries of the grouped charge questions in the Executive Summary were well done.

2. Are there any technical errors or omissions in the report or issues that are not adequately dealt with in the Committee's report?

I do not have expertise in this area.

3. Is the Committee's report clear and logical?

Yes. It is well written and a non-expert can follow it.

4. Are the conclusions drawn or recommendations provided supported by the body of the Committee's report?

Yes.

Comments from Dr. Duncan Patten

1) Were the charge questions to the committee adequately addressed?

More than adequate

2) Are there any technical errors or omissions or issues that are not adequately dealt with in the draft report?

Not my area of expertise. However:

I wonder about the many recommendations to use "qualitative" analyses that, I assume, might be compared with "quantitative" measures or be used as the "only" approach.... or is the point to use only one or the other approach and not compare them? Or, will the qualitative analyses suggest what quantitative analyses might be done. If so, how does this allow development of a strategy that is applicable across the board as approaches might differ between case studies if some are qualitative and some quantitative?

3) Is the draft report clear and logical?

Quite well written with logical steps developing to recommendations.

4) Are the conclusions drawn or recommendations provided supported by the body of the draft report?

Based on the following statement from the letter: "The SAB recommends development of a conceptual framework as well as a focus on the drivers of compliance costs. Rather than simply focusing on the question of whether EPA generally overestimates or underestimates costs, the SAB recommends a focus on the drivers of costs so that insights can be gained for future analyses", there is sound thinking on the committee's part to support this recommendation.

The other basic conclusion or recommendation is for EPA to improve this type of comparative analysis by reducing the size of metrics and using more case studies but expansion of the case studies would be using qualitative analyses which, as I see it, might not be comparable to the quantitative studies.

These are nitpicking questions but one's that may need thinking.

Comments from Dr. Amanda Rodewald

1. Were the charge questions adequately addressed?

Yes

2. Are there any technical errors or omissions in the report or issues that are not adequately dealt with in the draft report?

No.

3. Is the draft report clear and logical?

Yes.

4. Are the conclusions drawn or recommendations provided supported by the body of the draft report?

Yes.

Comments from Dr. Jeanne VanBriesen

1. Were the charge questions to the committee adequately addressed?
 - a. Yes. The report is comprehensive in its response to the charge questions.
2. Are there any technical errors or omissions or issues that are not adequately dealt with in the draft report?
 - a. No. The report provides significant analysis of all aspects of the charge questions.
3. Is the draft report clear and logical?
 - a. Yes.
4. Are the conclusions drawn or recommendations provided supported by the body of the draft report?
 - a. Yes. In addition to the support provided in the body of the draft report, the report provides additional references for consideration.
 - b. The issue of the adequacy of the limited data for extrapolation to the full US is clearly articulated as a problem and leads to the recommendation that EPA not apply the current version of the models for estimating emission beyond those covered in the data set. It would be good to include some details of how other farms in the US are expected to be outside the range of data for the available data set to strengthen this conclusion. Addition of some context on the number of farms that the method would be applied to would highlight the significance of the challenge of extrapolation from the limited data (e.g., content discussed on pg 35, lines 5-9 would be a good addition to the executive summary for context, perhaps on pg 1 lines 33-39 or on pg 3 lines 6-7). Additional focus on the recommendation to EPA to quantify the representativeness of data used in the process would also be of value (e.g., as discussed on p. 15, lines 19-21 and p. 35 lines 33-36).

Comments from Dr. John Vena

Were the charge questions to the committee adequately addressed? Yes

Are there any technical errors or omissions or issues that are not adequately dealt with in the draft report? Not to my knowledge.

Is the draft report clear and logical? Yes

Are the conclusions drawn or recommendations provided supported by the body of the draft report?
Yes