Meeting Minutes

Air Toxics Science Advisory Committee
Meeting No. 8

July 15, 2015 (9 am to Noon, PDT)
Conference Room EQC-A, 10th Floor, DEQ HQ
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Portland, Oregon 97204

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DEQ is a leader in restoring, maintaining and enhancing the quality of Oregon's air, land and water.

List of Attendees

ATSAC members: Bill Lambert, Kent Norville, Dean Atkinson, Max Hueftle, and Bruce Hope. Dave Stone attended by phone. David Farrer was absent.
DEQ staff: Sue MacMillan, Sarah Armitage, Anthony Barnack, Phil Allen, Jeffrey Stocum

Sue MacMillan stated that she has had trouble keeping up with creating meeting minutes to post on the ATSAC website. Currently, she is working on minutes for the May and June ATSAC meetings, and a portion of the April meeting minutes still need to be corrected prior to posting on the website. She will prepare draft minutes and email to all committee members for review.

Bill Lambert brought up the need to discuss scheduling of the next meeting in August, since it is a busy month for many committee members. Committee poll should be conducted to see which committee members will be here in August, and which won't. He wanted the committee to be aware that the initial urgency of Ambient Benchmark Concentration (also referred to as ABC) review by the committee being completed by the end of 2015 has been relaxed, due to the DEQ deadlines for related rulemaking having been extended into early 2016.

Polycyclic aromatic hydrocarbons (PAHs)

Bruce Hope had been tasked with creating a proposal for the committee to consider in regard to the ABC for total PAHs, which is based on the toxicity of the index PAH, benzo(a)pyrene. He recommends following the previous policy regarding the ABC for total PAHs, which was to use benzo(a)pyrene as an index PAH, to which all other PAHs are compared in regard to relative toxicity/cancer potency. This approach is well- supported by USEPA's Integrated Risk Information System database and by European Union guidelines. He proposed retaining the current ABC of 0.0009 micrograms per cubic meter (hereafter referred to as ug/m^3), but using a slightly different set of related PAHs to undergird that benchmark. He proposed referring to a list of only 25 PAHs, rather than the list of 32 PAHs that was used in 2006 to undergird the current ABC for total PAHs.

The subject of age-adjusting the ABC using age-dependent adjustment factors (also referred to as ADAFs) was discussed. Use of ADAFs is typically used when the chemical in question is known to have mutagenic effects, and benzo(a)pyrene is a chemical that has mutagenic effects. Because the effects of a mutagenic chemical are assumed to impact children and adolescents to a greater degree than they do adults, the ADAFs help to adjust a risk-based protective concentration to account for this higher mutagenic potential in children and adolescents.

Age factor adjustment of benchmarks for mutagenic chemicals was discussed by the ATSAC about 10 years ago, but EPA had not developed the protocol well enough to be usable at that time, so the committee originally did not apply ADAFs to mutagenic chemicals that they reviewed. Since then, EPA has provided guidance for the use of ADAFs when calculating benchmarks for potential mutagens. However, only vinyl chloride and benzo(a)pyrene have been sufficiently characterized to allow credible use of ADAFs based on based on their mutagenicity.

Other PAHs are known mutagens but still have not been sufficiently characterized in a way that allows credible application of ADAFs, because the database for the mutagenic properties of PAHs is still small. It is thus probably not appropriate to apply ADAFs to the existing benchmark for total PAHs.

It is true that ADAFs are applied in human health risk assessments to chemicals other than vinyl chloride and benzo(a)pyrene. Nonetheless, it is likely only fully justifiable to apply ADAFs to vinyl chloride and benzo(a)pyrene, at this point in time. In light of these considerations, Bruce Hope recommends not applying ADAFs to any of the air quality benchmark values, in order to be consistent among benchmarks. However, the ATSAC recommends that DEQ continue to use ADAFs when conducting human health risk assessments of these compounds.

Based on recommendations made in EPA's *Toxicological Review of Benzo(a)pyrene* (September, 2014), IRIS is likely to adopt the new unit risk estimate of $6x10^{-4}$ per ug/m^3, which converts to a benchmark concentration of 0.002 ug/m^3. If we retain the standing ABC for total PAHs of 0.0009 ug/m^3 (or 0.001 ug/m^3, if rounded up), then Oregon would be different from EPA.

The committee asked for more-detailed documentation of its discussion and decision-making in notes to attend the future revision of the ABC tables, to be used when DEQ takes the revised ABCs to the Environmental Quality Commission, based on the rule-making process that will occur in the future. Expanded notes will help people understand how the ABCs were chosen, as will review of any related guidance.

Bruce Hope wanted to know if the committee agreed with the proposal to use a list of 25 PAHs, rather than the list of 32 used originally. He explained that the list of 25 that he is recommending is based on inclusion of PAHs that are actually present in air and related to combustion. The original list of 32 PAHs was the best guess 10 years ago, even though a portion of the list of 32 PAHs were related to soil and sediment impacts. Nineteen (19) of the proposed PAHs are recommended in Minnesota Department of Health guidance, and include airborne PAHs, as well as those deposited from air onto soil and then potentially resuspended in air. All of the 25 proposed PAHs have reasonably solid potency equivalency factors, as well, which will allow detected concentrations of PAHs to be converted, in order to allow comparison with the toxicity of benzo(a)pyrene, and to allow detected benzo(a)pyrene concentrations to be summed with PAH concentrations that are equivalent, in terms of relative toxicity, to benzo(a)pyrene. That summed concentration would then be compared to the ABC for total PAHs in order to make a judgment as to whether or not exceedances of the ABC have occurred. He presented a slide showing the entire list of 25 PAHs being proposed.

Max Hueftle noted that it looked like the PAH pyrene is missing from this list, and it is a PAH commonly monitored by EPA and others. He recommended checking the DEQ monitoring list (which contains 16 PAHs requested by EPA) against the proposed 25 PAHs, to see if any are missing. Anthony Barnack, DEQ air monitoring coordinator, will check to see if pyrene is a PAH required by EPA. It is likely that pyrene should be included, and if this proves to be true, then the proposed list will contain 26 PAHs, rather than 25.

The committee decided not to perform age-adjustment protocols on the benchmarks for chemicals being reviewed that have mutagenic effects.

Dean Atkinson pointed that the committee has not yet considered nitro-PAHs and oxygenated PAHs, and it would be good to have an extra protective factor for those. The committee may want to augment the proposed list of PAHs list with nitro-PAHs and oxygenated PAH in the future, if more information on their toxicities becomes available in the future.

Bill Lambert summarized the recommendation for the ABC for totals PAHs. The committee has reviewed the history behind the original list of 32 PAHs, and is choosing to revise that list to a total of 26 PAHs, included those required and requested by EPA and those of interest to DEQ, as described by Bruce Hope. In doing this, the committee has eliminated compounds which are not combustion-related or air-derived. The committee considered application of age adjustment factors to PAHs and decided that this approach is not appropriate, and we reached a consensus to retain the current ambient benchmark concentration for total PAHs of 0.0009 ug/m^3. In addition, it is agreed that all PAHs in the list, other than benzo(a)pyrene, will be adjusted using potency equivalency factors prior to being compared to the ABC. The committee voted unanimously to accept these protocols and to retain the current ABC for total PAHs.

The committee requested that DEQ run the full set of ATSAC-related old guidance documents through the Committee for review, for example, Internal Management Directives.

Diesel particulate matter (DPM)

Bill Lambert summarized committee discussions that had already taken place to date, including: the fact that the committee recognizes that there is a large amount of diesel activity in the state; we now have a good idea of ambient diesel concentrations in Oregon; that there have been significant economic and technical shifts as related to old-technology diesel engines versus new-technology diesel engines; there is an increased transportation of containers via truck and railway; and that Port closures have occurred which significantly increases the amount of heavy-duty vehicles on the road, which means higher use of diesel engines, both old- and new-technology. New-technology diesel engines greatly reduce diesel emissions, but there are still a lot of older diesel engines being used in Oregon, although we are unsure of the exact number. An older fleet is still in use, but long-haul truck fleets are cleaning up fast. Short-haul trucks still use dirty older engines, both along intermodal roadways and at hubs.

Diesel emissions are best understood in Oregon by looking at data for particulates with an aerodynamic diameter size of 2.5 microns or less (typically referred to as PM 2.5), because diesel concentrations are estimated as a portion of detected PM 2.5. This approach lacks specificity, but is practical to use. Related fate and dispersion models allow us to understand exposures of the population to PM 2.5 and to diesel emissions. Prevention activities are moving forward in terms of school bus engine replacements and fleet engine upgrades, but these changes are limited and have only occurred in pilot programs so far. Health benchmarks for diesel are policy-forcing. But DEQ still needs more funding to expand these programs, which so far has come mostly from federal programs, and not from the state. However, Oregon has competed effectively for federal grant monies. Much of the evidence that the committee is reviewing in regard to diesel emissions is based on the effects of emissions from older diesel engines. Diesel emissions contain ultrafine particles that make up a portion of PM 2.5, and these small-diameter particles are able to move deeply into the human respiratory tract, where the particles remain in place for a longer time, and so cannot easily be cleared from the lungs. Organic chemicals thought to provide a significant amount of the toxicity associated with particulate inhalation then come into contact with lung and other tissue, where they are able to become biologically active, and hence toxic.

Diesel particulates are known to be complex compounds of carbon, organic chemicals, and a number of other entities. There is no protocol at this time that allows the direct detection of diesel particulates. But one way to attempt to quantify the toxicity of diesel emissions is to use elemental carbon as a marker or surrogate for the exposure of lung tissue to diesel particulates. The committee acknowledged that there is no recognized, single marker for diesel exhaust. Given this situation, the committee has looked both at monitoring and modeling capabilities to be able to understand how population exposures interact with potential toxicity of diesel emissions, and understand where the committee should set potential benchmark concentrations.

In regard to available toxicity benchmark numbers for diesel emissions, some earlier guidance was withdrawn by both EPA and the World Health Organization, due to questions regarding the credibility of the data used to make benchmark estimates. Studies conducted primarily on rodents and epidemiology studies of human effects of diesel are of mixed quality, and difficult to interpret. Committee members have differing viewpoints regarding this information, which they will discuss.

Bruce Hope views the review of the diesel benchmark as a three-part problem: 1) issues with monitoring, 2) issues with modeling of exposure-based concentrations, and 3) sufficient understanding of the complex toxicity of this compound. Committee members may be coming from different perspectives, but are actually talking about the same problem. Lambert mentioned that it would be useful to talk about modeling issues related to assessment of diesel emissions, before returning to the toxicology discussion.

Kent Norville presented information on modeling of diesel particulate matter. He discussed air dispersion modeling, how diesel particulate matter is defined, and use of the EPA Motor Vehicle Emission Simulator model, typically referred to as MOVES. Kent Norville noted that MOVES could provide estimates of elemental carbon and organic carbon that could be used in conjunction with monitoring to identify diesel emissions. Please refer to Kent Norville's PowerPoint presentation for more detail.

Max Hueftle presented information on carbon measurement, including protocols for monitoring for and identifying elemental carbon (EC). Please refer to Max Hueftle's PowerPoint presentation for more detail.

A committee member asked about how diesel emissions would figure into EPA's National Air Toxics Assessment information, to be released later this fall, and which will be based on data from the 2011 Emissions Inventory. Interestingly, EPA does perform dispersion modeling of diesel particulate matter, but does not attempt to estimate cancer risk associated with those emissions.

Max Hueftle went on to say that black carbon (BC) is another compound that is collected by DEQ in air samples, although there is no available toxicological or epidemiological data for black carbon. Both elemental carbon and organic carbon are somewhat arbitrarily defined by their analytical testing methods. Organic carbon is not light-absorbing, and is volatilized using inert gas. Elemental carbon, on the other hand, is light-absorbing, and can be made to combust in a controlled oxidizing atmosphere.

New analysis methods for elemental and organic carbons are being developed by the Desert Research Institute. Also, there is a lot of data nationally available; in fact, samples collected via 47,000 filters are analyzed annually by EPA.

Anthony Barnack mentioned that DEQ does have some of its quartz filters analyzed, so there is some data on elemental carbon for some areas of the state. He thinks ratios could be developed for various areas based on historic collection data. DEQ could potentially apply a ratio factor to total PM2.5 in order to estimate elemental carbon amounts. There is also source-specific speciation, which could be apportioned in the Emissions Inventory to estimate amounts of elemental carbon or other chemicals. Speciation profiles are also used in source apportionment modeling.

Bruce Hope then presented information on the toxicology and composition of diesel emissions. Please refer to his PowerPoint slides for further detail. He said that the main question is: what components of diesel are actually toxic? Diesel particulate matter is a complex, and only partly-understood, mixture of pollutants. There are three basic components in diesel emissions, including carbon (largest component by mass), and ultrafine particles are part of the carbon component. In 2016, EPA is planning to assess ultrafine particulates, including PM 0.1, and is expected to come up with a proposed standard. It does appear so far that the carbon component is not the primary carcinogenic element in a diesel particle. However, particles do cause inflammation on their own, and if a human or animals subject is loaded with enough particles through inhalation, there can be an initial inflammatory response that eventually results in the appearance of cancer in the tissue.

Ultrafine particulates are an effective way of introducing metals and PAHs into the lungs of people. Water-soluble transition metals such as cadmium and chromium, which are also present in diesel particulates, also have powerful carcinogenic effects. Thus, it appears that carbon is serving as powerful internal delivery mechanism of these toxic components that are attached to it. Many researchers measure elemental carbon and total particulate mass, and then say that elemental carbon is equivalent to the total particulate mass. However, using total mass carbon in this case results in an overestimation of the actual cancer potential. A better way to try to estimate cancer risk would be to measure all three of the main components of diesel exhaust. Again, using particulate matter to estimate the cancer risk associated with diesel exhaust results in an overestimation.

Another significant problem is that little research has been conducted that will allow estimation of a credible benchmark value for diesel emissions. California's Office of Environmental Health Hazard Assessment calculated a unit risk estimate for diesel exhaust in 1998, and that number has been questioned for years by a number of technical agencies, including the International Agency for Research on Cancer, and some of the researchers whose data was used to calculate the California value. EPA and the World Health Organization both tried to produce a unit risk estimate, but gave up because they considered the available data to be inadequate. No other agency or researcher has been able to replicate the California value, which further detracts from its credibility. Although the California value has been adopted and used by Washington state and a metropolitan agency in Vancouver, B.C., it seems that the California value was accepted because there was no other estimate available for diesel emissions. Also, the California value is based on total particulate mass, which is most likely not the component in diesel exhaust that can cause cancer.

Bruce Hope discussed a slide used by the ATSAC in 2005/2006, which shows a graph, with air concentrations in units of ug/m^{3}on the y axis, and ranges of diesel benchmark values as horizontal bars for each study considered. These studies included: Dawson and Alexeeff, 2001; Stayner et al. 1998 (epidemiological data); Stayner et al. 1998 (animal toxicity data); Pepelko, 1993; World Health Organization, 1996: USEPA, 1998; and California Office of Health Hazard Assessment, 1998. He stated that the values shown in the Stayner bars have been substantiated, and that studies performed by Garshick (which form the basis of some of the studies shown in the graph) resulted in values that range between .001 ug/m^3 and 0.01 ug/m^3. Since 2006, the Pepelko, World Health Organization, and USEPA studies have been withdrawn, due to inadequate data. Nothing newer has become available since then.

Bruce Hope pointed out that the concentration of 0.1 ug/m^3 is the upper –bound value of a credible range of studies from the World Health Organization in 1996 (*Environmental Health Criteria 171* document), which were considered by the ATSAC in 2005 and 2006. He thinks that the standing ABC value of 0.1 ug/m^3 might still be the right value for our current review of the ABC for diesel particulate matter.

Dean Atkinson stated that the metals and PAHs associated with particulates are expected to have a multiplier effect on the overall toxicity. Bruce Hope mentioned that we are waiting for EPA to step up and weigh in on the toxicity of small particles.

Dean Atkinson said he would recommend choosing a value from the approximate middle of the range of studies we've just discussed, perhaps 0.01 ug/m^3.

Sue MacMillan displayed a short list of studies with related protective concentrations that were either stated in a study, or can be calculated from information in the study. These concentrations ranged from the current ABC value of 0.1 ug/m^3 for diesel particulate matter, to a concentration of 0.0003 ug/m^3, calculated from information provided in a Vermeulen et al., 2014 study.

Bruce Hope suggested that the ATSAC decision really comes down to retaining the existing ABC value of 0.1 ug/m^3, or moving to a more mid-range number as suggested by Atkinson. He has issues with the California value of 0.003 ug/m^3. This value, and how it was estimated, was challenged in a lawsuit which was eventually denied. He asked that if this value is credible, why haven't a larger number of agencies chosen to use it to make decisions about protection of human health? He thinks the California value overestimates actual risk from exposure to diesel particulates. The prior values recommended by USEPA and the World Health Organization (but now withdrawn), estimated the protective concentrations to be higher (less stringent) than the California value.

Dave Stone agreed with Bruce Hope, and pointed out that the study behind the California value does not include an exposure response, which detracts from the credibility of the California value. Kent Norville said that studies showed a weak dose response for diesel particulate matter in regard to both human and animal studies.

Bill Lambert said that studies conducted by Silverman, Steenland, and Garshick measured PM 2.5 on a routine basis and then analyzed a subset of filters to come up with the related amounts of elemental carbon. The best data is retrospective workplace data (epidemiological data) that allows us to discern effect, and this shows an excess risk. But it is difficult to apply the results of occupational studies to an environmental situation that includes women and children. Uncertainty about the point of departure of the toxic effects is what undermines USEPA and other efforts to make progress. He also asked that if ATSAC is providing solid ABCs for PAHs and metals (which are components of diesel particulate matter), does that give adequate protection for a population exposed to diesel particulate matter, without actually having a separate diesel particulate matter benchmark?

Dean Atkinson responded there have been toxic studies that show the parts do not equal the whole. Also, there is a multiplier factor for diesel particulate matter. He noted that metals delivered deep into the lungs through inhalation of ultrafine particles is worse in terms of toxic effects than metals inhaled normally. Bruce Hope said that particulates like diesel particulate matter, which are made up of carbon cores coated with other pollutants, are of greater concern, but maybe not as much concern as is indicated by the California value. He asked the committee whether they really want to make a guess as to how much worse these pollutants are, when we have very little study or other data with which to determine actual toxic effects?

Dean Atkinson responded by pointing out that the ATSAC has already changed the nickel benchmark in order to provide two different nickel benchmarks based on common physical characteristics of two subgroups of nickel. Maybe we could do this for diesel particulate matter as well, in that we could provide specific benchmarks for metals and for PAHs that are attached to small particulates, as well as provide ABCs for metals and PAHs under more typical circumstances.

Bill Lambert responded by saying that the beauty of using elemental carbon as a marker for diesel, is that it is also a marker for all of the interactions we've just discussed. He summarized the diesel particulate matter discussion by saying that the committee has advanced their thinking in terms of modeling and monitoring. As a committee, the ATSAC needs to study the rationale behind the California Office of Health Hazard Assessment value, so that the committee is clear why they end up choosing to retain our current ABC value, or whether they choose to identify a different value. This review needs to be completed by the ATSAC over the next few weeks in order to vote for a benchmark choice at the next meeting.

Both Bill Lambert and Dean Atkinson are out of town for the next ATSAC meeting, which is scheduled for Aug 19, 2015. Also, August is a busy month for many of the ATSAC members. Therefore, we will not meet in August, but will meet in this same location on the third Wednesday in September, which is September 16. We will extend the September meeting time to four hours, and the meeting will start at 8 a.m. rather than the usual 9 a.m. time. At the September meeting, the committee will attempt to finish the discussion on diesel, will review plan for work for the remainder of the year, and will deal with records and housekeeping. The committee is also tasked with reviewing the foundational studies used by California to identify their unit risk estimate value in order to try to make a decision on whether to retain the current ABC for diesel particulate matter or identify supporting evidence for choosing a more protective benchmark. Bruce Hope requested information on the 1999 lawsuit challenging California's diesel benchmark to understand if there was any scientific basis for the lawsuit and subsequent dismissal. Sue MacMillan said she would try to obtain this information and distribute it to the ATSAC.

Comments from audience:

Sabina Hilding – Alliance for Democracy
She stated that DEQ decisions and vested interests drive policy. She wanted to know which reference the ATSAC was using to decide that age-dependent adjustments shouldn't be applied to mutagenic compounds reviewed by the committee. She asked why it wouldn't be better to err on the side of safety and consider women and children. She requested that the committee consider pesticides and non-combustible emissions, and cited an example of increased smog attributable to ethanol added to gasoline in Sao Paulo.

John Krallman – Neighbors for Clean Air staff attorney.
He said he sent a comment letter to DEQ yesterday. Diesel is different from other air toxics because it has been called out by the legislature, especially in terms of school buses. The legislature set a risk goal, so it is appropriate to continue to have a diesel benchmark. The legislature made it clear that they are concerned about diesel pollution. He wanted to know if the current diesel benchmark is adequate to protect people from unacceptable cancer risk and hazard levels. The current ABC for diesel particulate matter is on the upper end of a range of values. The Vermeulen study suggests that this current ABC value is inadequate to protect public health. Using elemental carbon studies to determine diesel concentrations underestimates cancer risk.

Dale Feik
He requested that the committee use the precautionary principle to best protect public health, and go with a lower number. He feels we need to protect sensitive populations including old and young.