

Air Toxics Science Advisory Committee

Meeting minutes

April 15, 2015, meeting #5



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Introduction

The fifth meeting of the 2014/2015 Air Toxics Science Advisory Committee (also referred to as the ATSAC) was held on April 15 from 9 a.m. to noon in Conference Room EQC-A, Oregon Department of Environmental Quality Headquarters, 811 SW Sixth Avenue, Portland, Oregon. Committee attendees included Bill Lambert (ATSAC Chair), Kent Norville, Dean Atkinson, David Farrer, Bruce Hope, Max Hueftle, and Dave Stone. DEQ staff in attendance included Sue MacMillan (ATSAC lead), Chris Swab (emissions inventory specialist), Sarah Armitage (air toxics specialist), and Jeffrey Stocum. Downing and Barnack gave presentations during second half of the meeting.

Committee Administrative Items

The chair introduced David Stone as a newly-appointed member of ATSAC, as of the previous Wednesday's Environmental Quality Commission meeting. His skill set includes experience with pesticide toxicity and risk assessment, also air toxics. Stone told a little about himself.

The ATSAC Chair pointed out Todd Hudson in the audience, and asked him to tell a little about himself in relation to his just being appointed as a reserve ATSAC member by the Environmental Quality Commission as of the previous Wednesday. Hudson stated that he is a public health toxicologist at Oregon Health Authority. He has a Master of Science (MS) degree in public health, experience with toxicology, and is in the environmental health assessment program at Oregon Health Authority.

The committee discussed the addition of information on nickel and nickel compounds to the March ATSAC meeting minutes, based on emails exchanged by committee members prior to today's ATSAC meeting. Because Hope was one of the presenters of nickel toxicity information at the March ATSAC meeting, he described his additions to the March minutes regarding nickel and nickel compounds. Upon further review of the technical materials, Hope made the recommendations described below:

The original Ambient Benchmark Concentration (referred to as an ABC) for nickel didn't incorporate information for all of the different kinds of nickel compounds. These additional nickel compounds didn't have much toxicity information available during the identification of the earlier Ambient Benchmark Concentration, but now they do. A recommendation was made for the ATSAC to adopt the additional nickel compounds listed by California to the current nickel compound groups already discussed, to be current. Recommendations include:

(1) Nickel refinery dust - drop from the list of Ambient Benchmark Concentrations. Ambient Benchmark Concentrations are also referred to as ABCs.

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(2) "Insoluble" nickel compounds, most likely emitted as particles, and more carcinogenic than the "soluble" nickel compounds. Set ABC at 0.004 micrograms per cubic meter, based on the California Office of Environmental Health Hazard Assessment (most commonly referred to as OEHHA) 2011 value for nickel subsulfide.

(a) Nickel subsulfide (12035-72-2)

(b) Nickel oxide (1313-99-1) - During the meeting, we discussed giving this the same ABC as that recommended for the soluble nickel compounds, but the attached paper suggests to me that we should keep it with the insoluble group. It's also more likely to be emitted during refinery/metal working processes.

(c) Nickel sulfide (11113-75-0) - added from the OEHHA list.

(d) Nickel metal (7440-02-0) - added from the OEHHA list.

(3) "Soluble" nickel compounds, most likely emitted as aerosols (e.g., nickel plating operations) and less carcinogenic than the "insoluble" nickel compounds. Set ABC at 0.01 micrograms per cubic meter, based on the California Office of Environmental Health Hazard Assessment's 2011 Reference Exposure Level, supported by similar values established in other jurisdictions. California's Office of Environmental Health Hazard Assessment is commonly referred to as OEHHA.

(a) Nickel acetate (373-20-4)

(b) Nickel chloride (7718-54-9)

(c) Nickel carbonate (3333-39-3)

(d) Nickel carbonyl (13463-39-3)

(e) Nickel hydroxide (12054-48-7)

(f) Nickelocene (1271-28-9) - an organometallic nickel compound.

(g) Nickel sulfate (7786-81-4)

(h) Nickel sulfate hexahydrate (10101-97-0) - added from the OEHHA list.

(i) Nickel nitrate hexahydrate (13478-00-7) - added from the OEHHA list.

(j) Nickel carbonate hydroxide (12607-70-4) - added from the OEHHA list.

Hope noted that nickel subsulfide is the most potent carcinogen among the nickel compounds, which is part of the reason to include it in the group of insoluble nickel compounds. The committee stated that they understood changes.

ATSAC chair pointed out earlier descriptions regarding nickel used quotes around the terms "soluble" and "insoluble" in the original email on this subject (text of this email is shown above), and the chair understands the reason for doing that, because the groups were informally categorized. Suggest instead calling these two groups:

- Group 1 nickel compounds for group referred to as "insoluble" nickel compounds, with a recommended ABC of 0.004 micrograms per cubic meter, and which have lower water solubility, higher carcinogenicity, and are typically emitted as particles.
- Group 2 nickel compounds for group referred to as "soluble" nickel compounds. Group 2 nickel compounds are typically emitted as aerosols, for example during nickel plating operations; are less carcinogenic than the Group 1 nickel



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compounds, and are less water soluble. ABC of 0.01 micrograms per cubic meter is recommended for Group 2 nickel compounds.

The chair requested a show of hands in regard to approval of the March meeting minutes. ATSAC chair requested that MacMillan include today's discussion on new information for nickel compounds as part of April minutes, and state in the March meeting minutes that nickel compound groupings were unclear at the time, so further discussion was pushed to April ATSAC meeting.

Norville and Stone abstained from voting because they were not present during the previous discussion about nickel and nickel compounds. The other five ATSAC members approved changes to March meeting minutes.

The committee members now have in their possession a large spreadsheet and a large summary table (referred to informally as the "52-screen" tables) provided by MacMillan as a way to identify those ABCs related to chemicals for which no new toxicity information has become available in the past five to nine years (in other words, those ABCs assigned prior to the 2014/2015 ATSAC session, for which no new toxicity information has become available). If new toxicity information for a chemical were found to be available, this would require a review of a chemical and its ABC. Because of the large amount of information provided in the "52-screen" tables, it was suggested that the committee spend the next month or two reviewing these files, with an eye to discussing them in more detail soon. For the May ATSAC meeting, then, the ATSAC should consider review of chemicals or compounds that the committee already knows will require a review.

Diesel is such a compound, and should be considered for review by the ATSAC at the next meeting. The ATSAC should tackle polycyclic aromatic hydrocarbons (more typically referred to as PAHs) first, followed by diesel in the next couple of meetings. Then perhaps review approximately seven other compounds and benzene over the summer-month meetings. Eight other chemicals in MacMillan's "52-screen" tables are identified as "maybe" requiring review. There is concern about the committee being able to accomplish reviews of all the chemicals that need to be reviewed, including new ones, by September 2015.

MacMillan informed the ATSAC that the related rulemaking efforts, originally requiring that the ATSAC's review of ABCs be completed by late summer 2015, have been rescheduled for 2016 by DEQ. So, for the May ATSAC meeting, the committee will look at PAHs and begin discussion of diesel. Vetting of the "52-screen" tables by the ATSAC should also be going on "in the background" of these other review tasks, and so try to limit discussions on the "52-screen" decisions during ATSAC meetings, if possible and appropriate. The committee requested that MacMillan provide an even more streamlined summary table with four columns: 1) chemicals that need to be reviewed; 2) chemicals that may need to be reviewed (the "maybe's"); 3) chemicals where review is not necessary; and 4) new chemicals not previously considered by the ATSAC. The chair directed the ATSAC members to assign themselves subgroups of these chemicals to be responsible for, and do this via emails to each other.



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Discussion of Toxicity Information for Acrolein

Dean Atkinson and Bruce Hope, presenters.

Acrolein is extremely volatile, and so is almost always present in the gas phase. It is a powerful irritant, to wet tissues (eyes, mouth, etc.). Death can occur with high exposure; chronic exposure causes nasal mucosa lesions. Rats are the primary lab animal used in epidemiology studies. New information on acrolein since last ATSAC: 2008 study by Dorman, et al. A no-observed-adverse-effect level (also referred to as a NOAEL) was identified, and so no extrapolation of a NOAEL from a lowest-observed-adverse-effect level (also referred to as a LOAEL), is necessary. Not having to perform this extrapolation provides less uncertainty about the number, which is good. California OEHHA recommends a Reference Exposure Level value of 0.35 micrograms per cubic meter; this value incorporates an uncertainty factor related to potential exposure of asthmatic children. Due to acrolein's high volatility, it makes sense to apply a generous protective factor for asthmatic children.

The current ABC for acrolein is 0.02 micrograms per cubic meter. The value of 0.35 micrograms per cubic meter is based on new information; note that the value is greater than 10 times higher than the standing ABC of 0.02 micrograms per cubic meter. It appears that 0.35 micrograms per cubic meter is a very protective level, and should be used as a revised ABC for acrolein.

One committee member asked if acrolein is still used heavily as a roadside spray for drainage and irrigation ditches. If acrolein is still used for these purposes, there would be concern about possible air drift. But acrolein has a short half-life (in other words, it is not a persistent chemical), so it is not likely to last long if applied in roadside ditches. The Oregon Emissions Inventory indicates that acrolein is emitted state-wide at 1,900 tons/year, due primarily to residential wood combustion. Oregon doesn't collect extensive pesticide information and so there is not much about pesticides in the Emissions Inventory. This doesn't mean that acrolein is not being used as a pesticide. The chair reminded the committee that it still has to identify an appropriate ABC for acrolein, regardless of the above considerations.

The new study upon which OEHHA bases its new Reference Exposure Level is 30 years newer than the study that OEHHA previously depended on. Having a confident, straight-up NOAEL is significant. It makes the resulting Reference Exposure Level very credible. The Dorman et al. 2008 study appears to be an excellent study. ATSAC vote: Unanimous approval for use of 0.35 micrograms per cubic meter as new ABC for acrolein.

Discussion of Toxicity Information for Methylene Chloride

David Farrer and Max Hueftle, presenters.

Methylene chloride, also known as dichloromethane, is a paint stripper, degreaser, food "stripper" (coffee, tea). It is emitted at a rate of 14 tons per year statewide in Oregon, based on 2011 Emissions Inventory data. This chemical targets the liver by changing the way lipids are processed in the liver. But cancer is the most sensitive endpoint for methylene chloride. This chemical was recently determined to be carcinogenic via the process of mutagenicity. The best toxicity data for methylene chloride is likely part of the 2011 Integrated Risk Information System reassessment, which utilized pharmacokinetic



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modeling of methylene chloride toxicity from animals to humans, at the tissue sites of action, which is very credible information. Mice exposed to methylene chloride resulted in tumors in the liver and lungs, and presented good dose response information. The Unit Risk Estimate for methylene chloride is 1×10^{-8} per micrograms per cubic meter, which converts to 100 micrograms per cubic meter. The conversion is performed via dividing the acceptable risk limit of 1×10^{-6} by the Unit Risk Estimate value.

The committee discussed the fact that methylene chloride is a recognized mutagen, meaning that early-life exposure results in a higher rate of cancer in children (0 to two years, and three to 16 years of age) than the same exposure causes in adults. Thus, in terms of human health risk assessment, the increased risk of cancer appearing in children needs to be incorporated into the overall estimate of cancer risk over a lifetime of 70 years. However, the protocol that allows this incorporation utilizes not only toxicity factors, but also exposure factors – for example, how much air is inhaled per day, days per year of exposure, and other considerations. Thus, this protocol cannot be used to “adjust” a toxicity factor alone in order to reflect the fact that methylene chloride is a mutagen. Therefore, the ATSAC will continue to use toxicity factors based on adult exposure in their review of appropriate toxicity information. It is recommended that the converted value of 100 micrograms per cubic meter be used as the new ABC for methylene chloride. This value is consistent with the Agency for Toxic Substances and Disease Registry Minimal Risk Level and with the OEHHA Reference Exposure Level. Exposure to methylene chloride causes reduction of hemoglobin, and other types of damage. People are moving away from using methylene chloride, including furniture refinishers. It is still present in Rustoleum® products, and used by meth labs. ATSAC vote: Revise ABC for methylene chloride to 100 micrograms per cubic meter; unanimous agreement by committee.

Discussion of Toxicity Information for Perchloroethylene/tetrachloroethylene

Bill Lambert and Max Hueftle, presenters.

Perchloroethylene, also referred to as PCE, is a colorless nonflammable liquid with an ether-like odor. Its odor threshold is approximately 500 parts per million. The health effects of this compound are well-known. Physiologically-based pharmacokinetic models provide good information about how PCE behaves in the body. It has a low solubility in water, but is highly lipid-soluble. Inhaled PCE is largely exhaled in an unmetabolized form. Mixed-function oxidases cause breakdown of PCE. Hepatic toxicity follows in regard to repeated exposure of workers. At high concentrations, PCE is a central nervous system depressant; but it has never been used as an anesthetic because it is not powerful enough.

The current ABC for PCE is 35 micrograms per cubic meter, based on the 1991 OEHHA Reference Exposure Level. Prior to 2010, the ATSAC had noted the variability among different agency values for PCE. There was no clear evidence of carcinogenicity in humans at that time. This uncertainty in regard to PCE causing cancer in humans is still present. Neurological and other non-cancer health concerns result in protective values that are lower/more stringent than those associated with cancer effects. Loss of color vision, or portions of color vision, is one effect of PCE on heavily exposed workers. Other related toxicity information for PCE was discussed in detail.



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The EPA IRIS database values for PCE include both cancer and non-cancer toxicity values, and was updated in 2012. When the cancer unit risk estimate of 2.6×10^{-7} per microgram per cubic meter is converted to a concentration which is protective to an excess lifetime cancer risk of 1×10^{-6} , the result is a value of 4 micrograms per cubic meter. This concentration is more stringent than the current ABC for PCE, which is 35 micrograms per cubic meter. (Post-meeting clarification note: The cancer value is based on a weight-of-evidence approach using epidemiological and rat studies with a value derived from the BMCL₁₀, by dividing the risk [as a fraction] by the BMCL₁₀. A BMCL₁₀ is the lower bound on the 95 percent confidence limit of the 10 percent response limit related to a benchmark concentration. To obtain a cancer slope factor, the extrapolation method used was a multistage model with linear extrapolation from the point of departure (i.e., BMCL₁₀), followed by extrapolation to humans used the physiologically-based pharmacokinetic (PBPK) model of Chiu and Ginsberg [2011]).

For non-cancer effects, an inhalation reference concentration (typically referred to as an RfC) of 40 micrograms per cubic meter was obtained by averaging two different RfC values (15 micrograms per cubic meter, Cavalleri 1994; and 56 micrograms per cubic meter, Esheverria 1995). Uncertainty factors (commonly referred to as UFs) were applied according to EPA standard protocols: one UF of 10 was applied to account for the variability in the worker studies used and extrapolation from workers to the general population; another UF of 10 was applied for extrapolation from a LOAEL to a NOAEL value (in other words, from a lowest-observed-adverse-effect level to a no-observed-adverse-effect level); and a third UF of 10 was applied to account for data gaps. Thus, the final UF of 1,000 is the product of these three UFs of 10. The limbic system and pre-cortex region of the brain are impacted by exposure to PCE. Little information is available for non-cancer effects in animals.

Hueftle recommended that the cancer-based value of four micrograms per cubic meter should be used as the new ABC for PCE.

Hueftle observed that concentrations of PCE in air as monitored by Lane Regional Air Protection Agency concentrations are below four micrograms per cubic meter, so far. Due to regulatory pressure, PCE machines at dry cleaners are no longer co-located with residences. PCE concentrations and exposure indoors are very high due to the use of PCE by dry cleaners. It was noted by the committee that chemicals recommended as surrogates or replacements for PCE are at least as toxic, and probably moreso than PCE. Hope mentioned that he previously wrote a paper on these PCE surrogates for DEQ. The work was funded by a previous dry cleaner project, not ATSAC.

The chair mentioned that the Mutti study was not as credible as those of the other two authors mentioned. Previously, the ATSAC could not figure out how the WHO came up with the value that was chosen as the ABC for PCE. Another committee member guessed that the confusion with how the WHO arrived at their value might be a problem related to converting parts per million to micrograms per cubic meter.

One committee member requested that a footnote be added to the PCE toxicity table presented to the ATSAC to explain that the concentrations of 4 micrograms per cubic meter obtained from IRIS and the concentration of 40 micrograms per cubic meter obtained from the EPA Regional Screening Level tables (also referred to as RSLs) are based on the same study.



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One committee member was frustrated because even though human data is available for this chemical, an Uncertainty Factor of 1,000 was still assigned to the value. The committee discussed exactly why the three UFs of 10 each were applied in the study. The studies by Cavalleri and Escheverria are both based on worker populations. The same types of cognitive deficits are observed in the general population, and are consistent with worker effects. But EPA argued that an uncertainty factor of 10 was necessary to account for variability of studies of workers being applied to the general population. A committee member then asked if the protocol is, in effect, double-counting by including an uncertainty factor for the extrapolation of a LOAEL to a NOAEL? The fact that there are three orders-of-magnitude of uncertainty seems illogical, given that the values are already based on human information. Do we really need to apply an uncertainty factor of 10 for possible data gaps?

The chair responded that if the committee chooses to remove an uncertainty factor of 10 from a value established by another agency, then this would be a departure for the ATSAC. If we did this unusual step in this case, we would need to do a calculation and defend our decision.

Another committee member argued that the committee has agreed, for example, that IRIS values are IRIS values, and shouldn't be tinkered with. If we do this in this case, we would have to do it in others, and that would create work that the committee and DEQ don't have resources for, and goes against ATSAC policy.

The chair said that tinkering with how the values were calculated by other agency is like opening a Pandora's Box. If the committee does this for PCE, it would have to go back and look at a lot of the other decisions that have already been made. The value of 4 micrograms per cubic meter was arrived at by applying standard risk-assessment-based uncertainty factors.

The chair mentioned that the Agency for Toxic Substances and Disease Registry looked only at effect of color vision loss, but didn't consider other effects caused by exposure to PCE.

ATSAC vote: Revise the ABC for PCE to four micrograms per cubic meter, based on EPA IRIS value. Unanimous agreement.

Discussion of Toxicity Information for Toluene

Bruce Hope and Dean Atkinson, presenters.

Toluene is emitted at 10,000 tons/year in Oregon, is a widely-used industrial chemical, and is widely available. Glue sniffing became big for a while as related to toluene being a part of the glue used in constructing model airplanes and other hobby crafts. Toluene-based products are no longer available in hobby shops. Human populations (through substance abuse) and rats are used in most of the available studies on toluene toxicity.

The committee considered the various studies and toxicity values available from multiple agencies for toluene. On this basis, it was recommended that the current ABC of 400 micrograms per cubic meter be revised to match the new 2005 EPA Inhalation Reference



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Concentration value of 5,000 micrograms per cubic meter. A committee member asked about the odor threshold of toluene; 1 ppm might be the odor threshold.

ATSAC vote: Revise the ABC for toluene to 5,000 micrograms per cubic meter; unanimous agreement.

Discussion of Toxicity Information for Carbon Tetrachloride

Kent Norville and Dave Stone, presenters.

Carbon tetrachloride is a man-made chemical. It is a clear liquid, has a sweet odor, evaporates quickly, and has a low solubility in water. It is non-flammable. Carbon tetrachloride was once commonly used in various solvent and degreasing operations, and has been replaced in most processes. Today, the main use for carbon tetrachloride is as a fire-extinguisher fluid, and it is also used for the production of fluorocarbons and as a grain fumigant. It is a Class B2 carcinogen.

The current ABC of 0.07 micrograms per cubic meter is based on EPA IRIS information, a rat study in particular. In 2010, EPA re-evaluated this chemical using a 104-week-long inhalation study, using both rats and mice.

Committee member recommends updating the current ABC to information from the newer EPA updated 2010 study, and so go the ABC would increase from 0.07 micrograms per cubic meter to 0.17 micrograms per cubic meter. To be consistent with previous decisions made by the ATSAC, should round 0.17 up to 0.2 micrograms per cubic meter.

Also, it's good to see that the cancer-based Unit Risk Estimate of 6×10^{-6} per microgram per cubic meter (which converts to a concentration of 0.17 micrograms per cubic meter), is still in the ballpark of where the number was before, one committee member noted. The Chair mentioned that carbon tetrachloride is persistent in the environment, and thus high background concentrations are present. Chris Swab has heard that this information is correct, as well. Armitage mentioned that the next National Air Toxics Assessment should show decreases in carbon tetrachloride emissions, because it's breaking down.

ATSAC vote: Revise ABC to 0.2 micrograms per cubic meter for carbon tetrachloride in order to be consistent with new EPA results. Unanimous agreement.

Discussion of Toxicity Information for Chloroform

Dave Stone and Kent Norville, presenters.

Chloroform is colorless and has a sweet odor. Ninety percent of the chloroform in the environment comes from natural sources, both terrestrial and marine. According to the 2011 Air Emissions Inventory, it was emitted by man-made sources in Oregon at a rate of seven tons per year. Exposure to chloroform causes sublethal effects on the liver and kidney. In the presence of oxygen and UV light, chloroform generates phosgene and HCl, therefore old containers of chloroform must be handled according to hazardous waste disposal protocols.

Chloroform is dangerous on its own due to toxicity and carcinogenicity concerns. Chloroform is a threshold carcinogen; carcinogenicity occurs through cell death, and cell



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proliferation. Cancer is induced in animal studies where the test species is dosed via gavage and ingestion, but cancer has not been induced through inhalation studies. The current ABC for chloroform is 98 micrograms per cubic meter. A committee member pointed out that notes made during the prior ATSAC in 2006 stated that committee didn't use the California Office of Environmental Health Hazard Assessment value because it was based on an oral study; but this is not correct: the study was actually an inhalation study that assessed intermittent exposure. The same committee member also thought the study was very credible. Note that acute value for chloroform of 150 micrograms per cubic meter is half that of the chronic value, which is atypical and was based on some assumptions that the California agency made. Committee member recommended a value of 300 micrograms per cubic meter for ABC. No IRIS values for chloroform are available currently.

A committee member pointed out that the slope factor in IRIS can be used to come up with cancer values, but another committee member said the slope factor was based on oral, not inhalation, toxicity. The ATSAC will not consider the use of inhalation values that have been extrapolated from oral toxicity values.

ATSAC vote: Revise ABC for chloroform to 300 micrograms per cubic meter.
Unanimous agreement.

Committee Chooses Chemicals to Review Next

At the May meeting, the ATSAC will begin assessment of PAHs and probably diesel particulate matter. Diesel particulate matter discussions may continue in the June ATSAC meeting.

Lambert, Hope, and Stone will gather toxicity information for the PAHs. They will start with the typical 16 PAHs, and then look at PAHs of high cancer potency listed by other agencies. One committee member cautioned that many of the more-newly-listed PAHs are not analyzed by laboratories due to the high expense of required analytical equipment. In addition, many of these PAHs do not have good toxicity information available. Perhaps the committee could focus on PAHs that are used for fingerprinting (that is, used to identify which sources the PAHs originated from). The PAHs used for fingerprinting also have good toxicity information.

Kim Anderson at OSU has a repository of petrogenic and pyrogenic PAH data and information, which is related to fingerprinting – the committee should ask her to present her information at the May meeting. Committee also suggested asking Staci Simonich of Oregon State University to speak to the ATSAC about PAHs.

The committee requested that Stone create a primer of information for the Committee. The chair asked Stone to provide recommendations for potential grouping of PAHs to the committee by email.

MacMillan committed to distribute to the committee information available from the mid-2000s on previous discussions of PAHs, particulate organic matter, and diesel particulate matter.



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Hope offered to share technical literature that he has in his files with the committee. The chair also remembered some diesel information provided by the Port of Portland during previous ATSAC discussions on diesel. Lambert will summarize epidemiological data that is available for diesel particulate matter. Atkinson will research how PAHs are monitored, and might talk with Kim Anderson about what the committee is hoping to get from her presentation. Stone stated that the committee should also provide direction to Staci Simonich in regard to the content of her presentation to the committee. Lambert mentioned that there is ongoing work in China in regard to diesel particulate matter and related compounds; he will see what he can find to present to the committee. The committee requested that MacMillan ask Kevin Downing of DEQ to also present information on PAHs and diesel to the committee at the May meeting. MacMillan may also ask Anthony Barnack, a DEQ air monitoring and analysis expert, to present some relevant information.

Audience questions

Dale Feik stated that he has participated in the Diesel Group in Salem, and was impressed by Kevin Downing's presentation to that group. He is glad to hear that Downing will talk about diesel at the next ATSAC meeting.

Based on the right-to-know files that Feik provided to Lambert and MacMillan previously, he urged the ATSAC to look at fluorides and related compounds, especially in light of the Intel reporting error. He mentioned that although facilities may meet emission limits, it doesn't tell us much about actual human health exposure risk. Ended meeting at 11:45 am.



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