Appendix B

Comments on
Draft Final PBDE CAP
(December 2005)

Commenters: Draft Final PBDE CAP

Click on the commenter name (in blue) to view the selected letter.

Bromine Science and Environmental Forum (BSEF)
Puget Sound Action Team (PSAT)
State Representative Elaine Nekritz (57th District - Illinois - Des Plaines - Cook County)
Oregon Physicians for Social Responsibility
Tom Muir (Environment Canada, Retired)
Katherine Duff
National Association of State PIRGs
Boeing
Environmental Health Strategy Center, Bangor Maine
Washington Chapter -- American Academy of Pediatrics
Sarah Janssen, M.D., Ph.D.
State Representative Karen May (58th District - Illinois - Skokie, Highland Park - Lake County)
The Lands Council
Washington Toxics Coalition (WTC)
Lynn Sainsbury
1,000+ members of the public, signing and/or adding further comments to a basic letter provided by the WA Toxics Coalition - one sample letter included
Toxic-Free Legacy Coalition, which includes:

- American Lung Association of Washington
- Asian Pacific Environmental Exchange
- Basel Action Network
- Breast Feeding Coalition of Washington
- Coalition for Environmentally Safe Schools
- Citizens for a Healthy Bay
- Duwamish River Clean-Up Coalition
- Earth Island Institute Orca Recovery Program
- Earth Ministry
- Friends of the Columbia Gorge
- Healthy Building Network
- Healthy Mothers, Healthy Babies Coalition of Washington
- Institute for Children's Environmental Health
- Institute for Neurotoxicology and Neurological Disorders
- Kettle Range Conservation Group
- The Lands Council
- Lutheran Public Policy Office
- Newground Social Investment
- Northwest Environment Watch
- Nursing Program, University of Washington, Tacoma
- Oregon Center for Environmental Health
- People for Puget Sound
- RE Sources for Sustainable Communities

- Seattle Alliance for Good Jobs and Housing for Everyone (SAGE)
- Seattle Tilth
- S.H.A.W.L. Society (Sovereignty, Health, Air, Water, Land)
- The Breast Cancer Fund
- Washington Association of Churches
- Washington Citizens for Resource Conservation
- Washington Physicians for Social Responsibility
- Washington Public Interest Research Group (WashPIRG)
- Washington Toxics Coalition

December 21, 2005

Mr. Michael Gallagher
State of Washington Department of Ecology
Box 47600
Olympia, WA 98504
MGAL461@ecy.wa.gov
FAX: 360-407-6884

RE: Washington State Polybrominated Diphenyl Ether (PBDE) Chemical Action Plan: *Draft Final Plan,* Department of Ecology Publication Number #05-07-048, Department of Health Publication No. 334-079, Dated Dec. 1, 2005.

Dear Mr. Gallagher:

The Bromine Science and Environmental Forum (BSEF) is a global industry association comprised of the major manufacturers of brominated and other flame retardants and our mission is to further the scientific understanding of our products.

BSEF has numerous major concerns with the Washington State Polybrominated Diphenyl Ether (PBDE) Chemical Action Plan: *Draft Final Plan* with regard to Decabromodiphenyl ether (Deca-BDE). Those concerns have been previously expressed to the Departments of Ecology and Health (DOE and DOH, respectively) in comments filed or during meetings hosted by DOE and DOH on the subject of PBDEs.

It appears, however, that the comments, concerns and scientific data provided by BSEF and its representatives to DOE and DOH with regard to Deca-BDE have been largely ignored or dismissed. With few exceptions, most notably the acknowledgement in the Draft Final Plan that "safer alternatives" to Deca-BDE are not generally available, information on Deca-BDE provided to the DOE and DOH during the process of developing the Draft Final Plan is not reflected in that document.

BSEF and its representatives have participated in the development of the Draft Final Plan in good faith and with candor. We find, however, that the end result of that process is a document that adopts positions, draws conclusions and makes statements that are scientifically insupportable, contrary to publicly available evidence, and potentially damaging to fire safety, consumer choice and legitimate business interests.

Fundamentally, the Draft Final Plan makes its recommendations based on what DOE and DOH claim is NOT known about Deca-BDE, rather than on what is known.

Given the fact that Deca-BDE is clearly the most studied and analyzed flame retardant in history, brominated or not, it is hard to understand how or why DOE and DOH arrived at their conclusions and recommendations regarding Deca-BDE. A lack of knowledge or availability of reliable, published scientific information on Deca-BDE might explain the "precautionary principle" approach being taken by DOE and DOH but, in this situation, there is no lack of information – more information exists about Deca-BDE than any other flame retardant.

And, as is well known to DOE and DOH, the European Union conducted a comprehensive risk assessment of Deca-BDE from 1994 to 2004, which was then updated through August 2005. That assessment, which ultimately reviewed more than more than 580 studies on Deca-BDE from a wide variety of scientific perspectives, concluded that Deca-BDE does not pose a risk to humans or the environment. As a result of that risk assessment, the EU has exempted all polymeric applications of Deca-BDE from being further regulated under the RoHS Directive, an EU program designed to regulate chemicals and substances in electrical and electronic products.

It is worth noting that, should the State of Washington take action against Deca-BDE, it will be the first and only jurisdiction in the world to do so.

Attached please find complete copies of all information previously provided to the Departments of Ecology and Health during the development of the Draft Final Plan, and the parallel development of WAC 173-333 Persistent Bioaccumulative Toxins Regulation, which either include or reference the majority of the aforementioned information regarding Deca-BDE.

Summarily applying the major issues addressed in these documents to the Draft Final Plan, we note the following:

1. It is not proper to classify Deca-BDE as either toxic or bioaccumulative. Further, Deca-BDE does not meet the Department of Ecology's criteria for classification as a persistent, bioaccumulative and toxic substance (PBT), and therefore should not be treated or referred to as such in the Draft Final Plan. In fact, since Chemical Action Plans (CAPs) in Washington are part of the PBT strategy, and since Deca-BDE is not classified as a PBT by the U.S. Environmental Protection Agency and does not meet Department of Ecology's criteria for classification as a PBT, Deca-BDE should not be included in this CAP.

2. It is inappropriate, and at times misleading, to use the term PBDEs generically. Since Deca-BDE is a distinct and unique chemical, and both the Penta- and Octa-BDE products are no longer in production or use, DOE and DOH should refer to specific PBDEs formulations by name, rather than grouping all PBDEs together as

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a class. For example, the Draft Final Plan refers to "the experiences of other states and Europe where policies to reduce PBDEs have been crafted," while failing to specify that actions have been taken only against the Penta- and Octa-BDE products, not Deca-BDE.

3. The Draft Final Plan states as fact that Deca-BDE is "likely to breakdown in the environment to more toxic and bioaccumulative forms of PBDEs," but does so absent clear or even significant scientific evidence of such degradation. In fact, research suggests that while minimal degradation of Deca-BDE can be achieved in certain laboratory situations, that level of degradation is minimal and is not significant enough to be producing the levels of other PBDEs being found in the environment.

   In the environment, approximately 97 percent of the Deca-BDE that is found is located in sediments. Anaerobic degradation studies indicate no significant degradation of Deca-BDE to lower congeners in sediments. Of the remaining three percent of Deca-BDE found in the environment, some will be exposed to light and, therefore, photolysis may occur. While it is well-known that UV light can cause debromination, research performed by BSEF member companies shows that the pattern of BDE congeners that would be produced under photolysis is not the same as the pattern that is actually found in the environment; i.e., some of the congeners that would be expected from photolytic degradation of Deca-BDE are not found to a significant level in the environment. In addition there is little correlation in trends for levels of Deca-BDE and levels of the lower brominated congeners found in the environment. If Deca-BDE was a significant source of these congeners, then a strong correlation would be expected. The conclusion to be drawn is that Deca-BDE does not contribute in any significant way to the levels of Penta-BDE and Octa-BDE in the environment.

4. The Draft Final Plan essentially dismisses as inconsequential the conclusions of the comprehensive European Union Deca-BDE risk assessment noted above, and implies that Deca-BDE is under continuous scrutiny in the EU and that its exemption from further regulation could be reversed at any moment. In fact, all chemicals exempted from the RoHS Directive undergo similar routine, on-going analysis and scrutiny – Deca-BDE has not been singled out for special treatment.

5. The Draft Final Plan states that "there is a general lack of toxicity and other testing information on many of the alternatives [to Deca-BDE]." This is correct, as we had advised DOE and DOH throughout the process, but the statement fails to note that, in the alternative, there <u>is</u> a significant body of knowledge available on the toxicity of Deca-BDE and that Deca-BDE has a generally favorable toxicity profile.

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6. As the Draft Final Plan acknowledges, none of the potential alternatives to Deca-BDE has undergone a level of examination and analysis even remotely similar to Deca-BDE, nor are "safer" alternatives currently available. Regardless, however, the Draft Final Plan recommends establishing a ban on Deca-BDE that would, in practice, become effective immediately upon discovery of an allegedly "safer" alternative. BSEF believes such action is premature, that it could create pressure to allow a product onto the market that has not been properly tested for potential human and environmental effects, and that it effectively gives an unfair competitive advantage to flame retardants other than Deca-BDE for which little or no testing data is available.

7. The Draft Final Plan states as fact that "there are potentially serious health and environmental consequences as the amounts of PBDEs increase; likely health effects include neurotoxicity (i.e. effects to neurological development from exposures to unborn and newborn infants), leading to impacts to behavior, learning and memory" when, in fact, no evidence of such effects exists for the only PBDE still in production – Deca-BDE. Further, the potential human effects suggested appear to have been extrapolated from data on polychlorinated biphenyls (PCBs), distinctly different and unrelated chemicals, and arbitrarily applied to Deca-BDE. This approach is scientifically insupportable.

8. The Draft Final Plan and its accompanying news release assert that the Plan's recommendations can be implemented with no impact on fire safety, but fail to state or explain how this can be achieved.

   Despite advances in fire safety, technology and building codes, fires still represent a very serious risk, and the United States has the third highest overall fire death rate of all industrialized countries.[1] The Home Safety Council reports that fires and burns are the third leading cause of home-injury deaths, accounting for an average of 3,400 deaths per year from 1992-1999. Of all fire and burn-related injuries, 90 percent of all fatalities and 57 percent of non-fatal injuries occur in the home.[2]

   The very young, the elderly, and the economically disadvantaged are at particularly high risk. For example, the risk to children and those over age 65 of dying in a fire is twice the average for a U.S. adult. Individuals who are 85 and older have a risk that is almost 4.5 times the national average. Flame retardants reduce the overall number of fires, and lessen the spread and intensity of those that do occur and, as such, play a critical role in

[1] CDC Injury Center, *CDC's Unintentional Injury Prevention Program, Activity Report 2001*
[2] Home Safety Council, *The State of Home Safety in American: Facts About Unintentional Injuries in the Home, Second Edition 2004*

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making homes, apartments, hospitals, nursing homes, offices, cars and public transportation safer from the life-threatening consequences of fire.

The Draft Final Plan's recommendation to ban Deca-BDE has the very real potential to lower fire safety by forcing manufacturers to stop using the best, most proven flame retardant available, regardless of the human or environmental consequences. If Deca-BDE is banned in Washington State, the likely result will either be more fires and more unnecessary injuries or deaths, or greater use of less-tested substances. Alternatively, products in which ignition resistance is an important safety feature may not be available to consumers in Washington.

9. The Draft Final Plan acknowledges that, "Although PBDEs are present in people and many foods, these levels have not yet reached those shown to be toxic in lab animals and do not pose an immediate health threat." The Plan, however, goes on to speculate that "If PBDE levels continue to rise, however, real health risks can be expected, particularly for our children." There is no scientific information that children are at any increased risk from exposure to Deca-BDE and, with the termination of production and use of the Penta- and Octa-BDE products, it is unclear, at best, that PBDE levels will continue to rise.

10. The Draft Final Plan states that the Departments "kept a close watch on the experiences of other states and Europe where policies to reduce PBDEs have been crafted." While action has been taken against the Penta- and Octa-BDE products, no state or jurisdiction anywhere in the world has taken action against the commercial use of Deca-BDE – not one. As noted previously, and in stark contrast to the conclusions and recommendations of DOE and DOH, the European Union in October 2005 exempted Deca-BDE from further regulation under its RoHS Directive after completing the most complete and thorough examination ever undertaken of any flame retardant.

Conclusion

We urge the Departments of Ecology and Health, once again, to review these comments and the attached materials and to reconsider the recommendation to take action against Deca-BDE.

We noted to DOE and DOH in prior filings our concerns that that the Drat Final Plan Rule, with regard to Deca-BDE, would likely contain policy positions that were scientifically insupportable, contrary to state criteria for the classification of chemical substances, dangerous to fire safety and damaging to legitimate and significant business interests. Unfortunately, our concerns have been borne out, and the Draft Final Plan contains each of

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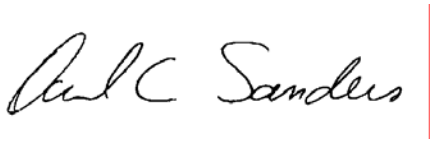
these elements. As such, we believe the entire process and any final policy that results will be open to question.

Sincerely,



Raymond B. Dawson, PhD.
Chairman

David C. Sanders, PhD.
Director, North America

Enclosure

Bromine Science and Environment Forum Comments to Ecology draft, Nov. 11, 2004
WA Alt Adv Comm BSEF Final, Aug. 10, 2005
WA Deca Survey Response BSEF Final, Aug. 10, 2005
WA State PBT Rule Comments 11-16-05 Final, November 16, 2005
Attachment A, Rule Redline, November 16, 2005
Attachment B, Deca Iuclid, November 16, 2005
Attachment C, Six Vols Table of Contents, November 16, 2005
Six Volumes, Deca Science, November 16, 2005
WA State Debromination Comments FINAL

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8. Polybrominated Diphenyl Ethers in the Aquatic Environment

8.1 Summary Letter

8.2 *Environmental Science Technology*, "Levels of Polybrominated Diphenyl Ether (PBDE) Flame Retardants in Animals Representing Different Trophic Levels of the North Sea Food Web"

8.3 Summary

8.4 RIVO Report

9. DBDPO: Potential for Bioaccumulation

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STATE OF WASHINGTON
PUGET SOUND ACTION TEAM
OFFICE OF THE GOVERNOR
P.O. Box 40900 • Olympia, Washington 98504-0900
(360) 725-5444 • (360) 725-5456

December 28, 2005

Mike Gallagher, PBT Coordinator
Department of Ecology
PO Box 47600
Olympia, WA 98504

RE: Comments on the *Washington State PBDE Chemical Action Plan: Draft Final Plan*.

Dear Mr. Gallagher:

Thank you for this opportunity to comment on the *Washington State PBDE Chemical Action Plan: Draft Final Plan*. This plan was two years in the making, and included many hours of stakeholder input and involvement, and this focused effort is reflected in the quality of the final product. I would particularly like to thank you and staff at the departments of Ecology and Health for your hard work in compiling the draft. The information included in the plan provides powerful evidence that flame-retardants must be treated as a serious threat to human health, wildlife and the environment in Washington.

Persistent bioaccumulative toxics are a significant concern in the Puget Sound ecosystem. The reduction in use of these compounds - with the aim of reducing the harm from such toxics - is a stated goal of the Puget Sound Management Plan. We are particularly concerned that PBDE contamination in Puget Sound not only harms marine organisms, but that the PBDE contaminants persist in the marine environment and may be a vector for contaminating people through the consumption of seafood.

The Puget Sound Action Team is charged by the legislature with responsibility for defining, coordinating and helping to implement Washington's environmental agenda for Puget Sound. The Action Team works through a partnership structure, including a chair appointed by the governor, directors from 10 state agencies and representatives from tribal, federal and local governments with direct responsibilities and authorities for conservation and restoration of the Puget Sound. This letter and comments are provided in my role as Director of Programs for the

Puget Sound Action Team staff and does not represent the views of any particular member of the partnership.

We have several comments on the final draft which are provided below:

We support the policy recommendation to ban the manufacture, distribution or sale of new products containing Penta-BDE and Octa-BDE in Washington State. Research and monitoring are providing growing evidence that PBDEs persist in the environment and accumulate in living organisms. Traces of the chemicals have been found in aquatic birds and mammals, fish, and in human blood and breast milk in many locations throughout the world. In particular we are concerned that, as stated in the final draft plan, that "Studies in the US and other countries report that fish contain the highest PBDE levels of different foods tested." Also, as reported in the plan, studies have shown correlations between the increasing concentrations of PBDEs in blood and breast milk and the consumption of fatty fish (salmon and herring) and shellfish. As a persistent, bioaccumulative chemical, PBDE will not be easily removed from the environment. But banning the use of Penta-BDE and Octa-BDE will ensure that these toxins will not continue to enter the Puget Sound ecosystem. We think the recommendation should go further and prohibit the import and use of products containing Penta-BDE and Octa-BDE. This is a significant loophole in the recommendation and given the types of products containing these chemicals – mattresses and furniture – we could see a significant amount of these products continuing to circulate in the waste stream.

We support the policy recommendation to ban the manufacture, distribution or sale of new products containing Deca-BDE, however we have concerns regarding delays relating to finding safer alternatives. While we understand the difficulties finding alternatives to Deca-BDE at this time, we agree with the statement in the rationale that "the benefits of reducing Deca-BDE use in Washington are likely to be significant to both pubic health and the environment." We therefore believe that we must continue to press for a ban of Deca-BDE. While we support the pursuit of safer alternatives for Deca-BDE, we believe that we should implement now the incentives and disincentives to encourage manufacturers to identify and develop safer alternatives or product design changes that eliminate the need for PBDEs, particularly Deca-BDE.

We support the recommendation for the departments of Ecology and Health to work with other states and interested parties to contribute to the national dialogue regarding the needed improvements to US chemical policy. Specifically, we urge Ecology to investigate, address and recommend solutions for failings in the Toxics Substance Control Act. One of the Action Team's priorities is to prevent future contamination to Puget Sound. Inadequate federal chemical policy hinders our ability to control toxic contaminants at a state level and jeopardizes our ability to protect Puget Sound. We would like to explore opportunities on how the Action Team staff can add value to this effort.

We support the policy recommendation that goods purchased through state contracts not contain PBDEs. State agencies are major purchasers of products and as such should provide an example by committing to purchasing products that do not contain PBDEs. Because state agencies consume a large volume of products, we can help support those companies providing products that do not contain PBDEs, and in so doing, we can create a market for these products.

We support the monitoring and research recommendations. While we recognize that more information about the sources, pathways, and baselines of PBDE contamination are needed, we believe that the existing state of understanding of the environmental and human health risks of PBDEs support the recommendations of this chemical action plan. Therefore, we support implementation of the recommendations in the plan while we pursue additional research. Particularly, we would recommend that future research on the potential environmental impacts of PBDEs include the marine environment. Because of the persistent and bioaccumulative nature of these chemicals, and because early research has indicated the accumulation of PBDEs in fish and marine mammals, and because of the potential pathway to humans through consumption, we recommend additional studies be conducted in Puget Sound.

If you have any questions about the comments provided, please feel free to contact Anne Criss (360-725-5439, acriss@psat.wa.gov) or me (360-725-5470, rshultz@psat.wa.gov).

Sincerely,

Ron D. Shultz
Director of Programs

December 29, 2005

Mr. Mike Gallagher

PBT Coordinator

Washington Department of Ecology

Dear Mr. Gallagher,

I am concerned about the impact of DecaBDE on our health and environment. As a legislator in Illinois, I look to Washington state to lead the efforts in banning Deca in consumer products. Washington's actions on Deca will greatly impact efforts in Illinois to eliminate DecaBDE and all other forms of toxic flame retardants. We urge you to recommend a ban on all three forms of PBDEs in consumer products, especially Deca.

Thank you for your time and consideration. Please feel free to contact me if you have any questions.

Sincerely,

Elaine Nekritz

State Representative

Illinois- 57th District

December 28, 2005

Mike Gallagher, PBT Coordinator

Department of Ecology

PO Box 46700

Olympia, WA 98504-7600

Dear Mr. Gallagher:

The board of directors of Oregon Physicians for Social Responsibility urges your agency to issue a final PBDE chemical action plan that takes strong action to phase out all forms of PBDEs, especially DecaBDE.

We are very concerned about these chemicals as they are known to cause problems with the brain development of animals and appear to disrupt development in the same manner as PCB's, which are well documented toxins in humans. Research has established that PBDEs are persistent, bioaccumulative, and toxic. They can cause liver damage, harm the developing brain and neurological system and affect thyroid hormone levels, which can cause decreased IQ levels. PCBs can still be found in salmon, orca whales, and humans. Businesses and taxpayers continue to pay millions of dollars each year to clean up PCB-contaminated sites. Clearly, we cannot afford another PCB tragedy. Unfortunately without swift state action, we are headed down a similar road.

The levels of Toxic Flame Retardants in humans concern us as health professionals. While the Penta and the Octa forms of PBDEs are being phased out around the world, DecaBDE is still widely used because it was originally thought to be stable and poorly absorbed. However, several new studies show that DecaBDE breaks down into Penta and Octa forms, among others, that are already known to be toxic. **While further studies are needed, there is more concerning research at this time about PBDEs than there were about PCB's when they were banned.**

We are especially concerned about the health and environmental impacts of the deca form of PBDEs for these reasons:

- **Deca is the most heavily used form of PBDEs in the United States.**

  Approximately 24,500 tons of deca is put into consumer products in the United States each year, four times as much as is used in Europe. This amount is expected to rise nearly 14% per year, primarily due to increased use in residential upholstered furniture and mattresses.

- **Deca is building up in our bodies and environment.**

  Deca is building up in people, wildlife, and our homes and work places. Studies have found deca in women's breast milk, our bodies, house dust, food, peregrine falcons, orca whales, and polar bears.

- **Deca breaks down into other toxic forms of PBDEs.**

  Studies show that deca readily breaks down into the already-banned penta and octa forms of PBDEs and into other harmful chemicals.

- **Deca and its breakdown products pose a threat to children's health.**

  Recent scientific studies link deca and its breakdown products to many of the same health effects that may result from exposure to the penta form of PBDE, which has been banned in numerous states. These health effects include thyroid problems and neurodevelopmental problems such as learning and behavior problems.

- **We are exposed to deca and its breakdown products on a daily basis.**

> Because deca is so prevalent in the consumer products we use everyday, like televisions and furniture, our families are exposed to deca on a daily basis. An estimated 500 million pounds of deca is already in consumer products in our homes, offices, schools, and landfills.

Many cost-effective alternatives to deca exist that do not compromise fire safety. Numerous companies have already announced plans to phase out of deca in favor of several alternatives, including using less problematic chemicals or switching to more inherently fire resistant materials. Sony, Philips, Electrolux, Dell, Intel, Apple, Ikea, Hewlett Packard, Panasonic, and Sharp are just a few of the companies that have switched, or will be switching, to deca-free alternatives.

We fully support the PBDE phase out plan and specifically urge you to recommend the following:

- **Ban all three forms of PBDEs in consumer products, especially deca.** Because deca is used in massive quantities and has been shown to break down into even more problematic forms of the chemical, it is prudent to eliminate its use to prevent future harm. Many companies have eliminated deca, including market leaders such as Sony, Dell, and HP.

- **Require state agencies to give preference to PBDE-free products when making purchasing decisions.** The government should lead by example and purchase products that do not contain these chemicals.

- **Improve U.S. chemical policy so that chemicals like PBDEs don't end up in products used in our homes, offices, and schools.** A key component of this federal reform starts at the state level. The state should start by preventing the use of toxic chemicals in consumer products.

Finally, since the report evaluates existing non-PBT alternatives to DecaBDE, the recommendations to ban DecaBDE and encourage use of alternatives should be stronger. Also, Ecology should recognize that safer materials, like bio-based plastics, currently are available and that several companies have already started using them.

Since PBDEs are found in many household products and also in food such as cheese and fish, it is nearly impossible for our patients to create a PBDE- free environment. Only after the use of PBDEs, including DecaBDE, are phased out will levels in humans and the environment decrease.

By putting forward a strong state plan to eliminate PBDEs, Ecology can help make sure our environment is not contaminated with PBDEs and that Washington state remains a healthy and safe place for our children to grow, play, and learn. A strong state plan will also set an example for your neighbors in Oregon. We urge you keep the plan recommendations strong.

We appreciate the time and resources your agency has put into developing the phase out plan.

Sincerely,

Dr. Jenny Pompilio

President

Oregon Physicians for Social Responsibility

Hi,

Just a quick note on this. You may be aware of all of this, but here it is anyways. It's really a line of argument that I have been exposed to in my own work.

Deca cannot really be assessed outside a context that includes cumulative effects and total exposure to all PBDEs and related PHAC analogs (at least). I attach a paper of mine that covers some of this and provides a perspective. It's in Organohalogen Compounds Vol.67.“Proceedings of Dioxin 2005 / ISPAC 20, Toronto, ON, August 2005”. At the moment they are working on the final CD.

We know that deca is reactive and degrades through several mechanisms, and is bioaccumulative, even though relatively poorly absorbed as parent compound. Some studies show it to be neurotoxic in rodents. It may be carcinogenic. The pro-deca camp point to the high doses required compared to other things, so the risk is said to be negligible.

This point, however, avoids the cumulative or additive effects. My argument in my paper is that there is no margin of exposure or safety left if you take account of analogs with similar mechanisms. Also, there is recent evidence that mice pups clear PBDE 47 at a slower rate than adults. There are now a number of papers on additive combinations of several compounds.

So if you combine these ideas, unless deca is not absorbed at all, does not degrade or is not metabolised into lower brominated, more toxic compounds, and does not occupy any of the transporter or clearance or excretion mechanisms actively involved in the pharmaco-toxicokinetics of all the other PBDEs and analogs and other many compounds of real world exposures, then it is effectively adding to the cumulative internal dose and dose at target because all the other compounds will be cleared at a slower rate than they would be in the absence of the deca. The transporters in the slower clearing mice pups show saturation in the dose-response, which adds to the point if deca is added to the exposure.

You can only avoid this fact if you ignore the reality of cumulative exposures and the pharmacokinetics, and treat deca in complete isolation.
This is stupid or lies.

I would like to know where this leads, and what you think of my comments.

Tom Muir

Are Thyroid and Neurodevelopmental Health Effects in North America Related to Rising PBDE Levels?

Tom Muir[1]

[1]Retired (Environment Canada)

Introduction

Exponentially increasing trends in environmental presence of a particular subgroup of brominated flame retardants (BFRs), the polybrominateddiphenylethers (PBDEs), especially in human mother's milk in Canada and the United States (North America (NA)), have been observed [1,2,3]. The toxicological endpoints of concern for PBDEs are similar to those for PCBs and DDT, and are likely to be thyroid hormone disruption, and neurodevelopmental deficits. There are indications that adults, and especially women, are experiencing thyroid disease, particularly hypothyroidism, which appears from the evidence to be increasing in prevalence and incidence in NA, and an apparent growing prevalence of neurodevelopmental deficits in children [4,5,6]. In previous work on this issue, the potential for the increasing body burdens of PBDEs to contribute to this expressed burden of disease was considered together with the trends of other POPs, especially PCBs and DDT [6,7]. In that work, Monte Carlo analysis was used to analyze population distribution co-exposure to trends in human breast milk (lipid) PBDE levels together with estimates of PCB and DDT human milk levels, for 2002, compared to a benchmark PCB level of 1250 ng/g, found to be associated with neurodevelopmental deficits [8]. This overlooked that the Jacobson's cohort exposure was to a complex mixture of contaminants, contained in Great Lakes fish, which included PCBs and DDT, among others, thus disallowing the adding together of these two compounds in that analysis. The aim of this paper is to reexamine this co-exposure analysis using another benchmark of 1650 ng/g total PCB only, found to be associated through postnatal exposure with behavioral impairment in monkeys [9]. Further aims are to report on updated Canadian PBDE milk data, consider estimates of relative potency, and to consider the possible importance of recent evidence on the neurotoxicity of PBDEs in rodents, which provides another benchmark for comparison to the actual distributions, and Monte Carlo simulated future trends, of exposure to these compounds [10].

Methods and Materials

The methods used involve an integrated examination of several lines of evidence, including empirical, toxicological, methodological, and theoretical. The data on milk concentrations, trends, and doubling times from related studies was compiled by literature review, and the relevant data was reviewed and extracted, and subject to summary statistical methods, and then to Monte Carlo (MC) analysis using Crystal Ball (Decisioneering Inc.).The MC analysis combines the probability distributions of several estimated doubling times and reported concentration data of PBDEs as initial conditions, and, assuming a first-order kinetic process, estimates the length of time, from the year 2002, to reach the critical valueof 1250 ng/g, or 1650 ng/g, and the population percentiles in each time estimate [8,9]. Estimates of initial PCB and DDT concentration distributions for 2002 will be introduced as add factors, or constants, first assuming similar potencies for all compounds, and then literature based estimates of different potencies. Synthesis and integration of the data and results are used to critically evaluate the single-chemical and "average" exposure approaches to regulatory risk and health assessments, and the ignoring of existing health conditions in the population.

Results and Discussion

The updated 2002 PBDE data set for Canada is by Ryan, for Ontario, Canada, with arithmetic mean of 125.6 ng/g, median 33.3 ng/g, and standard deviation (SD) of 225.0 ng/g, (range; 0.81 – 956 ng/g) [1]. In this sample, 5% and 2.5% had body burdens of greater than 496 ng/g and 567 ng/g respectively. The second data set (U.S., 2002) was from Schecter et al, with mean of 73.9 ng/g, median of 34.0 ng/g and standard deviation of 103.3 ng/g (range; 6.2 – 418.8) [2]. In this sample, 5% and 2.5% have body burdens of greater than 244 ng/g and 276 ng/g respectively. The third data set (U.S. 2002) is from the Environmental Working Group (EWG), with a mean of 158.75 ng/g and a

standard deviation of 272.75 ng/g (range; 9.0 – 1,078) [3]. In this sample 5% and 2.5% had body burdens of greater than 608 and 694 ng/g respectively. All concentrations are in human breast milk, lipid basis. This data is combined with doubling time estimates from reported trend data (in years: 1.73; 2.00; 2.22; 3.0; 5.0) with mean 2.8 years and standard deviation of 1.3 years [11]. To capture further uncertainty, a global doubling time in humans of 4.9 years with a standard deviation of 0.6 years, and a proxy U.S. doubling time of 3.4 years with a standard deviation of 0.3 years, were used [12, 7].

To estimate PCB and DDT human milk concentration information for 2002, recourse was made to data in several publications, which was then used, with assumptions, to construct a range of estimates [7]. The full explanation cannot be repeated here, so just the estimates will be provided. One estimate of PCBs for Canada/Ontario for 2002 is 103 ng/g, with a SD of 66 ng/g. This implies that 5% and 2.5% would have PCB body burdens of 212 and 232 ng/g respectively. An alternative PCBs level for 2002 is 240 ng/g, with a SD of 154 ng/g. This implies that 5% and 2.5% would have PCB body burdens of 493 and 542 ng/g respectively. If these ranges of PCBs levels are simply added to the similar levels calculated above for the Ryan PBDE data, 5% and 2.5% would have cumulative body burdens of 708-989 ng/g and 799 –1109 ng/g respectively. Assuming the same rates of change over the 1992 to 2002 period as for the PCBs above, yields 2002 mean concentrations for DDT that are basically identical to the PCBs, although for DDT the SD is higher – these are 106 ng/g with SD 103 ng/g, and 246 ng/g with SD of 239 ng/g. This implies that 5% and 2.5% of this sample range would have DDT body burdens of 275-639 ng/g and 308-714 ng/g respectively. If these estimated ranges of DDT 2002 levels were added to the Ryan, PBDE data for 2002, plus the ranges of PCB 2002 levels from above, 5% and 2.5% of the population would have total cumulative body burdens for these three compounds of 983-1628 ng/g and 1107-1823 ng/g, respectively. These PCB and DDT levels are assumed to be constant over the simulation period, although there may be a small ever-decreasing decline towards some positive asymptotic level.

Adding in the PCBs: Equal Potencies and Times to 1250 ng/g from 2002

Simulating these PCB concentration distributions as add factors to the PBDE first order kinetic process yields the selected results for the Ryan Ontario data shown in Table 1.

TABLE 1 – Simulated Times to Critical Value of 1250 ng/g from year 2002 for Addition of PCBs to PBDE (Equal Potency) For Selected Percentiles.

Data Source	T2-yrs	PCB	%-ile	T-yrs to 1250 ng/g
Ryan – mean	2.8	103	5%	-1.7
		103	10%	-0.6
		240	5%	-2.5
		240	10%	-1.4

These results in Table 1 indicate again the significance of considering the distribution of population body burdens rather than just the mean or median. They show that for the higher body burdens of the Ryan data, including the PCBs at either level indicates that the value of 1250 ng/g has already been surpassed prior to 2002 for 5 to 10% of the population. Not shown here, the simulations show similar results for the EWG data with the middle doubling time (3.4 years). Also not shown, for the lower body burdens of the Schecter et al data, simulated at the 3.4-year doubling time, the times to 1250 ng/g range from 2.0 to 3.6 years, from 2002, for 5% to 10% of that population.

Adding in the PCBs and DDT: Equal Potencies and Times to 1650 ng/g

Overlooked in the previous work, the critical value of 1250 ng/g for PCBs drawn from the Jacobson's studies must be taken as based on an exposure to both PCB and DDT (and to some small extent PBDE) as all those compounds, and others, were present in the fish consumed by the mothers in the study cohort. Therefore, we can't add DDT to the PCBs as separately contributing to the critical value of 1250 ng/g. However, we can use another exposure value for PCBs only of 50 ng/g wet weight or 1650 ng/g lipid weight for human breast milk, found to induce behavioral impairments in postnatally exposed monkeys [9].

Simulating these PCB and DDT concentration distributions as add factors to the PBDE first order kinetic process yields the selected results for the Ryan data shown in Table 2.

TABLE 2 – Expected Times to 1650 ng/g from year 2002 for sum of PBDE, PCB, and DDT, for Selected Percentiles – Ryan PBDE Data; Equal Potencies.

PBDE Data Source	T2-yrs	PCB	DDT	%-ile	Yrs to 1650 ng/g
Ryan – mean	2.8	103	106	2.5	-5.9
				5.0	-5.3
				10.0	-4.3
				50.0	0.4
		103	246	2.5	-6.8
				5.0	-6.1
				10.0	-5.2
				50.0	-0.5
		240	246	2.5	-7.6
				5.0	-7.0
				10.0	-6.0
				50.0	-1.3

The results in Table 2 show for selected population percentiles, the expected times from 2002 to the revised critical value of 1650 ng/g. It is apparent, that for the 2.5th, 5th, and 10th population percentiles, this exposure was realized several years in the past. Not shown here, the EWG data show similar results, and there is only one exception in the Schecter et al data.

Accounting for Potencies – Times to 1650 ng/g

It is reported that while exposure to PBDE 99 and PCB 52 individually show similar potencies on a molar basis, co-exposure enhances developmental neurotoxic effects [13]. These synergistic effects have been ignored here for illustrative and simplifying purposes. Since our dose-effect metric keys on PCBs, the relative potency of PCBs is taken to be one (1), and the relative potency of PBDEs from these in vivo studies is calculated as the relative molecular weight of PCB 52 to PBDE 99, which is 292/565 equals 0.52. In vitro studies indicate similar potencies on a molar basis for PBDE 47 and PCB 47 [14]. In this case, the relative potency of the PBDE is 292/486 equals 0.6. The average of 0.56 is used here. There are also reported data that can be used to estimate that DDT is about 30% as potent as PBDE 47 and PCB 47 on a molar basis in the same structure-activity assay measuring increases in protein kinase C (PKC) translocation [15]. Therefore, the potency of DDT relative to PCB was estimated here as 0.30.

The following Table 3 show the results of simulations of times from 2002 to 1650 ng/g adding PBDEs, PCBs and DDT together for the Ontario data and adjusting for relative potency as above. Results for the other two PBDE data sets are not reported here.

TABLE 3: Expected Times to 1650 ng/g from year 2002 for sum of PBDE, PCB, and DDT, for Selected Percentiles, Ryan PBDE Data; Includes potencies.

PBDE Data Source	T2-yrs	PCB	DDT	%-ile	Yrs to 1650 ng/g
Ryan et al – mean	2.8	103	106	2.5	0.5
				5.0	1.6
				10.0	3.1
				50.0	10.8
		240	106	2.5	-0.4
				5.0	0.7
				10.0	2.2
				50.0	10.0
		240	246	2.5	-0.6
				5.0	0.5
				10.0	1.9
				50.0	9.8

These simulation results in Table 3 show that, even allowing for one measure of relative potency, 2.5% of the population is above the 1650 ng/g level, or very near that level as of 2002. It also shows that 5% of the population was very near that level, being just 0.5 to 1.6 years short, and that 10% were just 2 to 3 years from that level based on the trends. Given that the data are for 2002, and the doubling time based on trends for the PBDEs is 2.8 years, the proportions which have reached or are near 1650 ng/g are likely even higher at present.

Conclusions and Recommendations

The data presented here support the need in regulatory safety and health assessments to move beyond the focus on the average or median body burden, to account for the population distribution of the concentrations, and the percentiles in the tails of the distribution, particularly the high exposure portion. This will move such assessments into the real world, and cannot be stated too strongly. The analysis and literature findings suggest that given the present trends for PBDEs, even looked at in isolation, the most highly exposed members of the North American population, including Ontario-Canada, across Canada, and the United States, could already be exposed to toxicologically relevant concentrations of PBDEs based on recent rodent evidence. This initial conclusion is supported by the recent findings where hyperactivity and decreased sperm counts were induced in rat offspring at a dose (single dose on GD6 of 60 ug/kg or 300 ug/kg) of PBDE-99 not much different than those experienced presently by some of the human population with the highest exposures and body burdens of total PBDEs [10]. Based on assumptions in that study, these two doses correspond to human milk lipid concentrations of 429 ng/g and 2143 ng/g respectively, both of which induced the noted effects in the offspring. As well, a significant proportion (2.5% – 5%) could be exposed to such relevant concentrations in as little as 3 to 4 years from 2002 based on a critical value of 1250 ng/g lipid in human breast milk, as per the Jacobson's findings.

Furthermore, even if a measure of relative potency, like the one estimated above, is factored in, and a critical concentration of 1650 ng/g is chosen, for the highest exposed percentiles, any of the summed combinations of the ranges of PBDEs, PCBs and DDT results in no margin of safety, as of 2002, in a time frame of between minus 0.6 years to 1.9 years for 2.5%, and between 0.5 years and 3.0 years for 5% (Table 3, and other data not reported). Based on the PBDE trends, these times have been reached as of now, 2005.

Adding the known body burdens of PBBs, PCDDs, PCDFs, mercury and lead, perchlorate and perfluorinated compounds, and bisphenol A, among many other substances, ups the odds of injury and clinical expression of disease further, and underlines the point. Overall, this study shows that since chemicals don't exist in splendid isolation, taking an initial account of just two of the cumulative past and current body burdens of other compounds with similar toxicological pathways and effects, which by pharmacological definition constitutes an additive effect at least, greatly worsens the situation based on human and animal exposure-effect evidence. Notwithstanding this,

each of these compounds is assessed for health and safety in isolation from the others.

Finally, it is not scientifically valid to ignore the real world and make pronouncements of chemical “safety” based on the assumptions that people are only exposed to the one chemical at a time, and to no others, and do not exhibit a clinically expressed prevalence of a condition that may be related to the toxicity of the chemicals being assessed. If there is such an existing condition, then the idea that a threshold or low dose exists below which no effect will be induced conflicts with the reality of an ongoing disease process that will be added to. Pharmacologically, these are false premises that are not tolerated in medical science, where drug interactions, and existing health conditions are a given, and should not be tolerated any longer in environmental health science.

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December 29, 2005

I am writing today to urge you to support the ban on PBDEs in Washington.
In 1992 I developed what is known as Multiple Chemical Sensitivity and learned a lot about the priorities of our society. When I was unable to find appropriate medical care, I eventually joined with the workers from Boeing and other employers who were also trying to get medical care and in their cases, worker's compensation for chemical injury.

As you may recall Washington had an active group that worked here in the state and networked nationally. When we worked to gain treatment and recognition of chemical injury in this state, we were told that recognition would "open the flood gates" and that was never going to happen. Boeing was threatening to leave the state. Needless to say, our efforts were not successful. We were then in the same position as the Agent Orange vets, who according to Admiral Elmo Zumwalt, could not have their injuries recognized because acknowledging the health effects of dioxin would throw the pulp and paper industry into economic ruin and take the economy of the US with it. We have since acquired another large group of chemically injured in the Gulf War vets.

Workers and soldiers have a history of being throw-way people. But today we are discussing the fact that we are feeding babies toxic chemicals in breast milk, specifically PBDEs. My honest reaction to this is that we need to account for all the chemicals found in breast milk and have proof that no harm to the child will occur. But I know this is not how it works.

I am sure the legislature, Department of Health and the Department of Ecology have been lobbied to prevent a ban of PBDEs but what does that mean? Do they want us to continue to expose our babies to the risk of a life lived with impaired brain function? Are they without a moral obligation to prove safety before PBDEs are fed to babies? Are their casualties the responsibility of taxpayers?

A lot of money was saved by not recognizing the illnesses of the Agent Orange vets, the Gulf War vets and those with MCS. But where do all these people end up? Social Security Disability and State Welfare and Medicaid programs. Now it looks like these programs are bankrupting state budgets so cuts in services are being enacted nationally. Unfortunately, this is where many of our children with disabilities end up too.

There is a report card for decisions such as this and that is the health of our children. Yes, infectious illness and infant mortality are down. But they have been replaced with higher rates of childhood cancer, doubling of asthma, neurodevelopmental and behavioral disorders and certain congenital defects. Dr. Philip Landrigan, a well respected advocate for children's health led a study that attempts to quantify the costs of these childhood illnesses caused by environmental sources. Maybe that will help make a more honest debate.

Corporation lobbyists have been successful in framing chemical debates to their needs. Regulations will always bankrupt them and the US and the existing science will never satisfy them. But what are the costs of not tending to the health of children and giving them a lifetime of impairment. I think it is our responsibility to figure that out and protect their interests in the meantime.

As a person who lived the first 40 years of my life as a healthy, reasonably intelligent, creative person and the last 13 years as someone struggling with brain damage I promise you it is not possible to put too high a cost on what that difference is.

Sincerely,

Katherine E. Duff

Dear Director Linda Hoffman and Director Mary Selecky,

We are writing on behalf of the National Association of State PIRGs, to express our thanks to the Washington Departments of Ecology and Health for their excellent work on the draft Chemical Action Plan for PBDEs, and to ask that the plan be strengthened to provide proper protections.

If properly strengthened, this plan could have national implications in protecting human health and the environment. For the past thirty years, state PIRGs and related environment groups have been working to protect people from dangerous toxic chemicals that could harm their health and the environment. For instance, in 2003, Environment California sponsored the first-ever ban of pentaBDE and octaBDE. This set the stage for many states to take action to protect their citizens, and helped to convince EPA to take action at the federal level as well. The National Association of State PIRGs has paid special attention to the problems associated with decaBDE, as well, and wrote a report titled *Body of Evidence: New Science In the Debate Over Toxic Flame Retardants and Our Health* in 2004 to bring public awareness to the problem. We have attached the report for your review.

There are four main ways the proposal should be changed in order to have the necessary impact to protect people. First, the rule should apply to all new products, not just to electronics and upholstery. Secondly, the proposal should require products that contain decaBDE to be labeled as such. U.S. PIRG Education Fund recently conducted a study of common baby products, hiring a professional laboratory to test for the presence of PBDEs. We found PBDEs in three of the seven products we tested. Without labeling, parents are unable to make purchasing decisions to protect their children. We have attached a copy of this report, called *The Right Start: The Need to Eliminate Toxic Chemicals From Baby Products,* for your review.

Third, the state purchasing recommendation in the proposal should be expanded to include decaBDE. Finally, the timeline should be moved up so that the deadline falls in 2006, not 2008.

The National Association of State PIRGs thanks the Washington Departments of Ecology and Health for their leadership on this issue. We look forward to reviewing the final rule, and encourage the Departments to strengthen the proposal as soon as possible.

Thank you,

Meghan Purvis
Environmental Health Advocate
National Association of State PIRGs
218 D Street, SE
Washington, DC 20003

The Right Start

The Need To Eliminate Toxic Chemicals From Baby Products

U.S. PIRG Education Fund

The Right Start:

The Need to Eliminate Toxic Chemicals from Baby Products

October 2005

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Executive Summary

A child's first few years are an exciting time for parents who hope, if for nothing else, that their child starts his or her life happy and healthy.

Unfortunately, not all products marketed for children and babies are completely safe for their use. Many contain toxic chemicals that may have detrimental health impacts for children exposed during critical stages of development.

Two Chemicals Linked to Health Problems

The media reports it, scientists have proven it, and American families are experiencing it: chronic diseases are on the rise in this country. Cancers, birth defects, childhood asthma, learning and behavior disorders, even obesity and early puberty are growing more prevalent in our society.

Scientists do not know why more children are developing these chronic problems. We do know, however, that this rise in chronic disease has occurred alongside a rise in the prevalence, use, and pervasiveness of toxic chemicals in the air we breathe, the water we drink, and the consumer products we use. Many of these chemicals are associated with chronic disease, and many others have never been tested for human health impacts. Moreover, there is often no "safe dose" of these chemicals for children. A growing body of evidence shows health effects at low doses, and chronic, multi-source exposure means that even a small amount of exposure from a variety of sources may add up to a major concern.

Even products designed for babies and young children may contain chemicals that pose a health concern. Unfortunately, because manufacturers are not required to label baby products as containing toxic chemicals, parents have inadequate information to make wise purchasing decisions. To begin to close this gap, we purchased some popular baby products and analyzed them for two chemicals of concern:

- **Toxic flame retardants (or PBDEs)** are a set of chemicals used to slow the spread of fire in a wide set of consumer products. Levels of these chemicals found in the breast milk of American women and some fetuses are approaching levels shown to impair learning and cause behavior problems in lab mice.

- **Phthalates** are a family of chemicals used in many plastic children's products to improve flexibility and in personal care products to bind fragrance. Adults and children are exposed to phthalates through everyday contact with these products as well as through contact with indoor air and dust. These chemicals have been linked to premature birth, reproductive defects, and early onset puberty.

Findings: Many Baby Products Contain Toxic Chemicals

We selected a sample of a variety of baby products from several manufacturers and tested them for toxic flame retardants or phthalates. We found:

- **Toxic Flame Retardants.** We tested seven infant sleep aids and other products for toxic flame retardants; three of those products tested positive for PBDEs in the foam material. The tests found multiple PBDEs in the foam material of the First Years' Air Flow Sleep Positioner, the

Leachco Sleep 'n Secure 3-in-1 Infant Sleep Positioner, and the PeeWees Disposable Crib Mattress Pads.

- **Phthalates.** We tested 18 bath books, teethers, bath toys, and other products for phthalates; 15 of these products tested positive for phthalates.

These tests show that some baby products may in fact contain toxic chemicals. Unfortunately, since manufacturers do not have to label their products as containing phthalates or toxic flame retardants, parents have no way of knowing whether or not a product poses a hidden hazard.

Recommendations for Parents

Parents have the right to know about chemicals in the products they purchase for their children. In the absence of good government regulations, but armed with the knowledge that some chemicals are a cause for concern, parents can take a few simple actions to limit their child's exposure to these and other toxic chemicals.

At the store, parents should select toys, baby dishware, and sleep aids made of materials that are less likely to contain toxic chemicals. At home, parents should avoid washing plastic dishware with harsh dishwashing soap and hot water, which may allow chemicals to leach out of the plastic. For a useful tip sheet, parents should visit www.safefromtoxics.org.

Recommendations for Policy Makers

Parents cannot deal with these issues alone. The U.S. government must ensure the safety of all products on the market for children.

- **Phase Out Dangerous Chemicals.**

  Despite some remaining data gaps about the hazards of some chemicals, the U.S. Environmental Protection Agency (EPA) must act based on the overwhelming weight of evidence showing that some chemicals might harm human health. The United States should phase out the use of hazardous chemicals – especially in children's products. Until the federal government acts, state governments should fill the regulatory gap and support policies to phase out these chemicals as well.

- **Reform U.S. Chemicals Policy.**

  Currently, manufacturers can put chemicals on the market without proving they are safe. Manufacturers should be required to provide all hazard and health-impact information to EPA so the agency can begin to assess the thousands of chemicals currently on the market for which it has little or inadequate data. Next, manufacturers of chemicals should be required to conduct an alternatives analysis, in order to determine if they really are using the least hazardous chemical for each application. Finally, EPA must have the authority to ban or restrict the use of a chemical if it can harm human health.

- **Consumer Product Safety Commission Should Protect Consumers.**

  The Consumer Product Safety Commission (CPSC) has an obligation to protect consumers from dangerous products. The CPSC should first label these products with the names of the chemicals they contain in order to allow parents to choose less toxic products. Second, the CPSC should take a precautionary approach and require manufacturers to remove chemicals that may pose a particular threat to fetuses, infants, and children, particularly when the chemical is not necessary for the product to function according to design.

Introduction

New parents wish for nothing but a healthy and safe start in the world for their new child, and they are ready to go to great lengths to ensure that happens. They shop for bedding, clothing, toys, shampoo, lotions, powder, bath accessories, feeding tools, pacifiers, and myriad other products to welcome their new baby. Parents spend hours and large amounts of money to ensure their child has the best of these products.

The sad reality is that many of these products may not be safe for our children. Toxic chemicals, many known to have adverse health effects and many others that have not been tested, are found in a variety of different products. Toxic flame retardants, such as polybrominated biphenyl ethers, and phthalates are two examples of compounds with known health consequences that are commonly found in products intended for use in the first few years of a child's life. Highly respected scientists have developed a vast body of scientific literature identifying a wide range of adverse health effects linked with exposure to these chemicals.

Parents have the right to know about the chemicals used in products intended for their children. But even the most educated parent with a scientific or medical background is going to have a hard time shielding his or her child from every harmful or potentially harmful chemical in products and in our environment. In a predicament such as this, the only answer is for our government to move forward to protect our children's health. Given the mounting scientific evidence demonstrating the harmful effects of many chemicals on the market, elected officials and regulators should exercise precaution by requiring the removal of any unnecessary and potentially hazardous chemicals from children's products. Regulating toxic chemicals and requiring manufacturers to use safer chemicals wherever possible is a good first step.

Parents should do three things after they read this report. First, they should write their governors and state legislators and their senators and representatives in Congress to urge them to help protect children's health. Second, they should follow the recommendations in this report as guidance for their product-purchasing decisions in order to decrease their children's exposure to toxic chemicals. Finally, parents should encourage their friends and family to follow the recommendations, and thereby send a market-wide message to manufacturers that they must start using safer alternatives in their products.

Only by encouraging our elected officials to change the laws and exerting pressure on the manufacturers of toxic children's products to use safer alternatives will we be able to rest easy, knowing that we're putting our children on the right path to lead long and healthy lives.

Theo Colborn, Ph.D.
President, The Endocrine Disruption Exchange, Inc. (TEDX)

Overview: Chemicals of Concern

While thousands of chemicals of concern are currently on the market, this report focuses on two of particular concern to children: toxic flame retardants and phthalates (Table 1). Children are exposed to these chemicals from a wide variety of sources, making it difficult to truly represent the exposure scenario for each child. A growing body of evidence, however, has raised concerns about health effects from exposure at low doses and the health consequences of exposure to a variety of chemicals with similar properties and mechanisms of action.

Table 1. Potential Health Effects of Exposure to Toxic Flame Retardants and Phthalates

Chemical	Health Concerns	Routes of Exposure
Toxic Flame Retardants (PBDEs)	• Impaired learning and memory • Delayed onset of puberty • Male and female reproductive defects • Cancer • Impaired immune system	• Common household products • Indoor and outdoor air • Water • Household dust
Phthalates	• Male reproductive defects • Premature birth • Cancer • Early onset puberty	• Plastic consumer products • Personal care products • Indoor air • Household dust

Toxic Flame Retardants

Polybrominated diphenyl ethers (PBDEs) are a class of brominated flame retardants. Widely used in foams, fabrics, and plastics to delay the spread of fire (Table 2), these chemicals can now be found practically everywhere scientists look.

There are three main types of commercially used PBDEs: Penta, Octa, and Deca. Starting in January 2005, manufacturers of Penta and Octa products agreed to cease manufacturing under a voluntary agreement with the U.S. Environmental Protection Agency (EPA). U.S. EPA issued a rule to phase out importation of these chemicals; however, companies will be allowed to import products containing these chemicals.[1] The European Union banned Penta and Octa in August 2004, and many states, including California, Maine, Hawaii, Michigan, Washington, Oregon, Illinois, Maryland, and New York, have taken action against these two products.

Table 2. Common Uses of Toxic Flame Retardants (PBDEs)

Type of PBDE	Added to:	Found in (partial listing):
Deca	High-impact plastics and textiles	Casings for electronic equipment, small electrical parts, fabric backings and coatings, rubber cables, and paints.
Octa	Plastics	Casings for electronic equipment and small electronic parts in office equipment.
Penta	Polyurethane foam and other materials	Primarily used in polyurethane foam in furniture and mattresses. Also used in small quantity in carpet padding, packaging, fabric backings and coatings, imitation wood, paints, sound-insulating panels, and plastic electrical parts.

Although flame resistant products certainly save lives and help avoid injury from fire, PBDEs may lead to other severe health consequences.

Toxic Flame Retardants Linked to Learning and Memory Effects

When infant mice are exposed to PBDEs during a key window of their growth, they develop irreversible deficits in memory and learning. These effects worsen as the animals grow older.[2]

Scientists suggest that these neuro-developmental effects could be a result of disruption of the thyroid hormone system. The thyroid hormone system is instrumental in normal brain development. Exposure to certain chemicals at an early age can disrupt thyroid levels, leading to serious problems.[3] In fetuses and infants, abnormal thyroid hormone levels as early as week eight in the womb through the second year of life can disrupt normal brain development and impair the intelligence and behavior of children.[4]

PBDE exposure produces lowered thyroid hormone levels and physical changes in the thyroid gland in lab experiments.[5] Depressed thyroid hormone levels have been shown to occur in mice when exposed to Penta at a single low dose.[6] These effects on thyroid hormone levels appear to be additive with the effects of related environmental contaminants known as polychlorinated biphenyls (PCBs) and dioxins.[7] This means that various chemicals could be working together in the body to produce greater effects.

PBDEs also may affect nerve impulse transmission and disrupt communication systems inside cells, which could prevent the cell from functioning properly.[8]

Toxic Flame Retardants May Cause Reproductive System Damage

Studies presented for the first time in 2003 point to yet another potential health consequence of PBDE exposure: irreparable damage to developing reproductive systems. These studies show that PBDE exposure can delay onset of puberty in both males and females and impair development of reproductive organs in laboratory animals.[9]

One study found that pregnant rats exposed to a single dose of Penta produced offspring with

structural changes in their ovaries.[10] Another study showed that adult male rats exposed to a single low dose of Penta while in the womb had significantly decreased sperm counts.[11]

Possible Links Exist Between Toxic Flame Retardants and Cancer

Deca is the only PBDE product that has been directly tested for carcinogenicity, in studies conducted more than 15 years ago. The U.S. National Toxicology Program found that high levels of Deca exposure created tumors in the liver, thyroid, and pancreas in laboratory animals.[12]

Penta and Octa have not been tested for carcinogenicity, but based on their similarities to PCBs, there is reason to suspect they could cause cancer. Scientists debate whether the structures are similar enough to draw this conclusion. One study suggests a positive association between the risk of Non-Hodgkin's lymphoma and tissue levels of Tetra BDE, another type of PBDE, in humans.[13]

Exposure May Cause Immune System Impairment

Conflicting studies present an unclear picture of the potential effects of PBDEs on immune systems. Suppression of the immune system can lead to increased susceptibility to infectious disease for years after exposure. Limited studies to date suggest that the Penta BDE product may impair the immune response in exposed rodents.[14] Contamination of commercial Penta with brominated dioxins and furans could explain this result,[15] as dioxins and furans have been linked to immune system impairment. Similar effects have been seen with PCBs. Other scientists, however, have not found immune system effects from Penta exposure.[16]

PBDEs Are Rapidly Accumulating in Our Bodies

In the last few years, scientists have discovered that PBDEs are rapidly building up in our bodies. Recent studies in the United States have found the highest human contamination levels yet recorded. Contamination levels in the breast tissue of California women and in the breast milk of women throughout America are up to 75 times higher than those found in European countries.[17]

American women's breast milk and breast tissue contain some of the highest levels of PBDEs in the world. Levels found in some mothers and fetuses are rapidly approaching the levels shown to impair learning and behavior in laboratory experiments.[18,19,20,21]

In addition, Canadian studies have found PBDE levels in humans doubling every 2.5 years.[22] Therefore, some segments of the U.S. population may already carry body burdens of PBDEs that in laboratory testing cause developmental damage.

How Toxic Flame Retardants Get into Our Bodies

Flame retardants are used in common products, such as couches and computers, which are found in the home or office and are often disposed of in landfills or incinerators. Flame retardants can escape from the products into the home and work environment or enter the food chain after disposal, ultimately ending up inside our bodies. Scientists need to conduct more research into exact routes of human exposure.

Toxic Flame Retardants Escape During Product Manufacturing

Toxic flame retardants also are released during manufacturing. For example, a 1999 study found heavy contamination of the River Tees in the U.K., downstream from a Great Lakes Chemical Company factory that produced the flame retardants.[23]

The millions of pounds of PBDEs that end up in landfills also may be another avenue for human exposure. Plastic products containing commercial Octa and Deca BDE in landfills may release these chemicals through decomposition, especially when exposed to sunlight, which tends to break down plastics more quickly. A Norwegian study recently confirmed that PBDEs escape from discarded products and seep out of landfills into the environment.[24]

High levels of PBDEs have been found in water coming out of wastewater treatment plants. Studies by Dr. Robert Hale and Mark LaGuardia found PBDEs in 87% of the fish tested from a stream near one Virginia plant.[25]

Toxic Flame Retardants Contaminate Indoor and Outdoor Air

Many types of PBDEs are found at low levels in both outdoor and indoor air. The air above Chicago contains PBDEs, including Deca, at levels 5-10 times higher than rural locations in the Great Lakes area.[26] Workers can be exposed to Deca and other PBDEs via inhalation of contaminated air in workplaces. PBDEs have been found in household air in rooms with electronics and in workplace air in electronics disassembly plants.[27]

Human Exposure Occurs through Inhalation or Ingestion of Household Dust

Inhalation, ingestion, or skin contact with household dust may be a significant route of human exposure to some PBDEs in the home and workplace.[28,29]

U.S. EPA and the National Institutes of Standards and Technology (NIST) surveyed a sample of 17 homes in the Washington, DC, and Charleston, SC, areas and found high concentrations of PBDEs in household dust.[30] The researchers in this study found PBDEs in every single sample, with Deca found in the highest concentrations. They also showed that the PBDE concentrations found in the U.S. samples were nearly 10 times higher than levels found in the European Union.

In 2003, Greenpeace published a study that looked at a variety of chemicals in household dust in the U.K. and in other European countries. Researchers found Deca at levels significantly higher than those detected in a similar 2001 Greenpeace study of Parliament buildings. In household samples from Finland and Denmark, where Deca is being phased out, Greenpeace found Deca at levels between 10 and 100 times lower than those found in the U.K.[31]

A 2003 study of indoor air and household dust samples from 120 homes in Cape Cod found many different types of chemicals, including PBDEs, used in products such as plastics, detergents, furniture, carpets, electronic equipment, pesticides, and cosmetics.[32] A 2005 study of the dust in 70 homes in 10 different states found toxic flame retardants in every single sample.[33]

Deca also has been found in high levels in the film that builds up on the inside and outside surfaces of household windows, in both rural and urban homes. Levels were significantly higher in the urban locations and on the inside surfaces of the windows.[34]

U.S. Regulation of Toxic Flame Retardants: State Action and Voluntary Phase-Outs

In 2003, Environment California successfully led the effort to ban two types of flame retardants in California, Penta and Octa. Since that time, several other states have followed suit, including Maine, Washington, New York, Illinois, Michigan, Maryland, Oregon, and Hawaii. Many of these states are considering a ban on a third type of toxic flame retardant, known as Deca.

Also in 2003, after the California ban, the U.S. EPA reached a voluntary agreement with the major toxic flame retardant manufacturers to cease production of Penta and Octa by the end of 2004. EPA then took the next step and finalized a rule prohibiting U.S. companies from manufacturing or importing the chemical without notifying EPA in advance. One loophole in this rule, however, will allow companies to import products manufactured in other countries that contain these chemicals. As a result, products on U.S. store shelves may still contain the chemical well into the future.

Phthalates

Phthalates are a family of chemicals, including diethyl phthalate (DEP), diethylhexyl phthalate (DEHP), dibutyl phthalate (DBP), butyl benzyl phthalate (BBP), diisodecyl phthalate (DIDP), diisononyl phthalate (DINP), di-n-octyl phthalate (DNOP), and many other distinct types. The polyvinyl chloride (PVC) plastic industry uses large amounts of phthalates as additives to improve the flexibility of its products, including home siding, flooring, furniture, food packaging, toys, clothing, car interiors, and medical equipment, including IV bags. In addition, other manufacturers use phthalates in personal care products such as soap, shampoo, deodorant, hand lotion, nail polish, cosmetics, and perfume, as well as industrial products like solvents, lubricants, glue, paint, sealants, insecticides, detergent, and ink.[35] Five years ago, the Worldwatch Institute estimated global phthalate production at roughly 5.5 million tons per year.[36]

Scientists began studying the toxicity of several phthalates as early as the 1950s and discovered significant evidence of environmental and human contamination in the early 1970s, including the leaching of phthalates into human blood from PVC bags used in hospitals.[37] As noted by the Worldwatch Institute, NASA scientists warned against using PVC in the space program in 1971 because of poor physical properties and the presence of phthalates.[38] They noted that "substitute polymers . . . are available and in many cases they have far superior physical properties at a small sacrifice in immediate cost."[39] Nonetheless, phthalates remain in wide use today.

Phthalate Exposure Linked to Reproductive Defects

A recently published study by Dr. Shanna Swan and her colleagues reveals that normal exposure to phthalates can harm the genital development of unborn baby boys. In a study of fetuses exposed to phthalates in the womb, the researchers found a strong relationship between phthalates and changes in the size and anatomy of the genitalia of male babies and toddlers. The findings were based on tests of 85 mothers and their sons, averaging nearly 13 months of age, born in three U.S. cities, including Los Angeles, Minneapolis, and Columbia, Missouri. Mothers with the highest levels of phthalates in their urine late in their pregnancies had babies with a shorter anogenital distance (the span between the anus and penis that forms into the scrotum in males), smaller penises, and more instances of incompletely descended testicles.

In the last three decades, the number of children born with hypospadias (a birth defect causing the opening of the urinary tract to develop on the underside of the penis) and cryptorchidism (a birth defect disrupting the descent of the testicles into the scrotum) has doubled.[40] Prior to Dr. Swan's human study, animal studies had shown that phthalates could cause such reproductive defects in male rodents. The similarities between the male reproductive defects induced by phthalates in rodents and the features of male birth defects seen in humans are strong.[41]

In 2000, Dr. L. Earl Gray and his colleagues at EPA reported that three types of commonly used phthalates (DEHP, BBP, and DINP) disrupt sexual development in male rats.[42] When female rats were fed these phthalates during pregnancy, they gave birth to male pups that weighed less and showed symptoms of hypospadias, cleft phallus, reduced testes weight, and other reproductive malformations, including cryptorchidism. Apparently, DEHP reduces testosterone production in the developing testes, interfering with the signals that direct normal male reproductive development.[43] Pregnant rats fed DEHP after the second week of pregnancy produced male offspring with reduced

testosterone levels in the testes to the same level as in female rodents.

In 2004, Dr. Gray and others at the EPA followed up on this finding, showing that the phthalates DEHP, BBP, and DINP reduce the levels of insulin-like hormone #3. Reduced activity of this hormone is another known cause of undescended testicles in mice.[44]

Other research groups have implicated another common phthalate, dibutyl phthalate or DBP, as a direct cause of hypospadias and cryptorchidism in rodents. When female rats are fed DBP during the third week of pregnancy, 60% of their male offspring suffer cryptorchidism, hypospadias, infertility, and/or other testicular defects.[45]

Phthalates May Lower Sperm Count

In 2003, Drs. Susan Duty and Russ Hauser of the Harvard School of Public Health published one of the first studies linking phthalate exposure with harm to human reproductive health.[46] They analyzed semen and urine samples from more than 150 men with no unusual exposure to phthalates in the Boston area. Men who had monobutyl or monobenzyl phthalate in their urine tended to have lower sperm counts, with the highest concentrations leading to the lowest sperm counts. These two chemicals are produced in the body from parent phthalates added to PVC plastics, food wrappings, nail polish, and a variety of other common items.

Phthalates Linked to Testicular Cancer

The cause of testicular cancer is unknown. The only known risk factor is cryptorchidism,[47] which has been linked to phthalate exposure as described above. In addition, Dr. Carl-Göran Ohlson and Dr. Lennart Hardell of the Orebro Medical Centre in Sweden found that men exposed in the workplace to PVC plastics had a significantly increased risk for one type of testicular cancer.[48]

Phthalates Associated with Premature Delivery

Rates of pre-term birth (defined as giving birth after 37 or fewer weeks of gestation) have been steadily rising at least over the last two decades.[49] A study published in November 2003 by a group of Italian scientists suggests a link between exposure to phthalates and pre-term birth. The scientists found phthalates and their breakdown products in the blood of newborn infants, with higher levels leading to a higher incidence of premature delivery.[50] They reported that babies exposed to common phthalates enter the world a week earlier on average than babies with less exposure. The scientists concluded that "human exposure to DEHP can begin *in utero*" and "phthalate exposure is significantly associated with a shorter pregnancy duration."[51]

Phthalate Exposure May Lead to Early Onset Puberty

One study of Puerto Rican girls suggests that phthalates may be playing a role in trends toward earlier sexual maturity.[52] Puerto Rican girls suffer from the highest rates of premature breast development ever recorded. Dr. Ivelisse Colon at the University of Puerto Rico and her colleagues searched for a link between chemical exposures and this phenomenon. They looked for foreign chemicals in blood samples from a set of very young girls with premature breast development, girls with an average age of 31 months. They found high levels of phthalates in these girls compared with normal children. In particular, levels of DEHP were seven times higher in girls with premature breast development than levels in normal girls.

Phthalates Are Rapidly Accumulating in Our Bodies

Scientists are finding phthalates everywhere they look. This class of chemicals is one of the most widespread contaminants in the environment today. In fact, according to EPA scientist Robert

Menzer, phthalates are so common that it "has become very difficult to analyze any soil or water sample without detecting phthalate esters."[53]

The human body has not escaped contamination. In 2000, Dr. Benjamin Blount at the Centers for Disease Control (CDC) found high levels of phthalates and their transformation products (known as metabolites) in every one of 289 adult Americans tested, including women of childbearing age.[54] CDC confirmed widespread exposure with a larger study in 2003, finding high levels of phthalates in practically every person they tested.[55] The metabolite of diethyl phthalate (DEP) was present in urine at levels over 2,000 parts per billion in five percent of test subjects.[56] The pattern of contamination reflected exposure to phthalates used mainly in personal care products.

A recent study found that infants exposed to DEHP from PVC plastics used in neonatal intensive care procedures had higher levels of the DEHP metabolite in their bodies. In fact, infants that had the highest levels of exposure had five times the level of the metabolite in their bodies than those in the lowest exposure group.[57]

How Phthalates Get into Our Bodies

Phthalates leach into our bodies through our everyday contact with household and personal care products containing the chemical. Another source of exposure to phthalates is through the air we breathe in our own homes. In a study that sampled indoor air and dust in 120 homes, phthalates were among the must abundant compounds in the air.[58] The ability of phthalates to leach from plastics also is well documented.[59]

U.S. Government Fails to Take Action on Phthalates

In 1998, the state Public Interest Research Groups (PIRGs) and several other environmental and consumer groups petitioned the Consumer Product Safety Commission (CPSC), asking the agency to ban polyvinyl chloride (PVC) plastic in all toys intended for children under the age of five because of the potential health hazards posed by diisononyl phthalates (DINP). While noting its position that "few if any children are at risk from the chemical,"[60] in December 1998 CPSC asked the toy and baby products industry to remove DINP from soft rattles and teethers. About 90 percent of manufacturers indicated at that time that they had or would remove DINP from soft rattles and teethers by early 1999. CPSC staff also asked the industry to find a substitute for phthalates in other products intended for children under three years old that are likely to be mouthed or chewed.[61]

CPSC also convened a Chronic Hazard Advisory Panel to examine the existing scientific data concerning the potential risks of phthalates to humans. In June 2001, the panel concluded that while the majority of children would not be adversely affected by diisononyl phthalate, "there may be a DINP risk for any young children who routinely mouth DINP-plasticized toys for seventy-five minutes per day or more."[62] Critics of this study pointed out the circular logic in the panel's conclusion, which came after manufacturers started phasing out DINP in teethers and other mouthing toys. Because the voluntary ban made PVC toys softened with DINP less available, CPSC staff recommended against a ban on phthalates because children in the study did not spend enough time mouthing soft PVC toys.[63] In addition, the study did not consider the possible effects from multiple exposures to multiple types of phthalates.

Unfortunately, in February 2003, CPSC denied the state PIRGs' petition to ban PVC plastic in toys for young children, noting the agency's position that "there is no demonstrated health risk" posed by the phthalates used in PVC toys or other products intended for children under the age of five.[64]

Other countries have taken action, however, to protect children's health. In September 2004, the European Union (EU) agreed to impose wide restrictions on the use of six phthalates in toys and childcare products.[65] The EU banned three phthalates classified as reproductive toxicants – diethylhexyl phthalate (DEHP), butyl benzyl phthalate (BBP), and dibutyl phthalate (DBP) – in all toys and childcare articles. The EU banned three other phthalates – DINP, diisodecyl phthalate (DIDP) and di-n-octyl phthalate (DNOP) – in toys and childcare articles intended for children under three years of age and that can be put in the mouth. Member states must now pass regulations in order to be in compliance with this instruction.[66]

European Union Action on Phthalates

Banned in all toys and childcare articles
Diethylhexyl phthalate (DEHP)
Butyl benzyl phthalate (BBP)
Dibutyl phthalate (DBP)

Banned in toys and childcare articles (that can be mouthed) for children under three
Diisononyl phthalate (DINP)
Diisodecyl phthalate (DIDP)
Di-n-octyl phthalate (DNOP)

Report Findings: Some Baby Products Contain Toxic Chemicals

Do common baby products contain these chemicals of concern? To answer this question, we analyzed a sample of products—ranging from teethers to baby mattresses—for phthalates and toxic flame retardants. Our laboratory tests found that some baby products contain phthalates or toxic flame retardants, showing that toxic chemicals are found in common consumer products intended for use by infants and children.

We tested sleep aids, such as sleep wedges and mattresses, for the presence of PBDEs in the foam material. We tested bath accessories, teethers and other soft plastic baby products for phthalates. The products are just a sample of the products on the market and are not intended to represent a comprehensive list.

This section details which baby products tested positive in the lab for phthalates or toxic flame retardants. In Appendix A, we report how much of each type of chemical the laboratory found in each product. The presence of these chemicals at any level in the products tested is cause for concern; there is no "safe" level. These chemicals are found in many everyday consumer products, and they build up in our bodies over time, particularly through our daily exposure to them.

These findings will clearly be alarming for parents and others who care about the health and safety of their children. Unfortunately, parents do not currently have the information they need to ensure the products they purchase do not contain toxic chemicals. In "Recommendations for Parents," later in this report, we give parents some tips they need in order to begin to protect their children. Parents will be unable to fully protect their children, however, without adequate action by policymakers. We list these actions in "Recommendations for Policymakers."

Toxic Flame Retardants in Baby Products

We tested seven common baby products for PBDEs. Three of the products tested positive for toxic flame retardants in the foam materials (Table 3).

We chose to test mattresses, mattress pads, changing pads, and sleep aids, including sleep wedges and positioners, because each of these products contain foam padding, in which PBDEs are commonly found. Moreover, infants and small children spend many hours of the day in direct contact with these products. As noted earlier, studies have shown PBDEs may escape from household products, providing a common and direct route of exposure.

Table 3. Summary of Testing for PBDEs

	Number Tested	Number Containing PBDEs
Sleep Positioner/Wedge	3	2
Changing Pad	1	0
Mattress/Mattress Pad	3	1

Based on the laboratory tests, two different baby sleep positioners, used primarily to place and keep a child in a correct sleeping position, contained PBDEs. The Air Flow Sleep Positioner, by First Years, contained three different congeners of PBDEs, while the Leachco Sleep 'N Secure 3-in-1 Infant Sleep Positioner contained two different types of the chemical class. The laboratory did not find detectable levels of PBDE chemicals in the foam of the Dex Secure Sleeper Ultra 3-in-1 Sleep positioner.

Air Flow Sleep Positioner by The First Years: Testing Found Three Different PBDEs

The laboratory found three different types of PBDEs in one of the mattress pads tested for toxic flame retardants, the PeeWees Disposable Crib Mattress Pads. We did not find detectable levels of this chemical class in the Portacrib Mattress Pad by Simmons Juvenile and the Sealy Baby Soft Classic Mattress by Kolcraft.

Disposable Crib Mattress Pad by PeeWees: Testing Found Three Different PBDEs

The laboratory did not find detectable levels of PBDEs in the one changing pad tested, the Contoured Changing Pad by Simmons.

See Appendix A for more detailed information about the amount of chemicals found in each product.

In conclusion, we found that some of the products we tested for toxic flame retardants contained these chemicals, and some did not contain detectable levels. In order for parents to make informed decisions about the products they purchase, they need to know which products contain these chemicals and which do not. Moreover, given the potential health effects of these chemicals, they simply do not belong in products intended for infants or small children.

Phthalates in Baby Products

Most of the products we tested contained phthalates, either one or a few of the distinct types (Table 4).

We tested a variety of products for phthalates, including bath toys, soft plastic books, teethers, and other products. We tested softer plastics that we suspected might contain phthalates, as phthalates are used to increase the flexibility of plastic products.

Table 4. Summary of Phthalates Testing

	Number Tested	Number Containing Phthalates
Soft Plastic Books/Bath Books	8	8
Bath Toys	3	2
Teethers	4	3
Toys for Infants	3	2

As detailed earlier, phthalates can leach out of soft plastic products, providing a common route of exposure. Some of these products are intended for mouthing, such as the teethers; however, infants are likely to mouth the other products as well. In addition, phthalates are found in indoor air and dust, indicating that the chemicals can escape from the products.

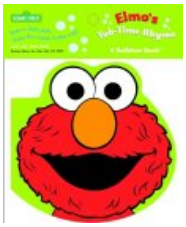
Notably, the laboratory testing did not find di-isononyl phthalates (DINP) in any of the products we tested. As detailed in the box on page 15, in 1998 CPSC asked the toy and baby products industry to remove DINP from soft rattles, teethers, and other "mouthing" toys. The laboratory did find several other types of phthalates, however.

Two of the bath toys we tested contained phthalates. The Especially for Baby brand Bath Squirties contained one type of phthalate; the Splash Gear Fish Squirties contained two different types of phthalates. We did not find detectable levels of phthalates in the Especially for Baby brand Color Change Ducky.

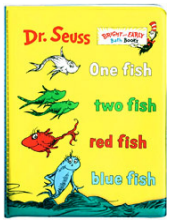
We tested multiple bath books and other soft plastic books and found phthalates in all of the books we tested, including Random House's *Elmo's Tub-Time Rhyme*; Simon & Schuster's *Where Is Slippery Soap?* (Blue's Clues); DK Publishing's *Duckling* bath book; Cook Communications' *Splish Splash: Jesus*; Random House's *One Fish, Two Fish, Red Fish, Blue Fish*; Penguin's Beatrix Potter *Benjamin Bunny*; and Sassy's *Hello Bee, Hello Me* bath book and *Who Loves Baby?* photo book.

Sassy's *Who Loves Baby?* photo book, in which we found both DEHP and DBP, included a label on the packaging that read: "This product is phthalate-free." When our researchers contacted the company, Sassy customer service representatives stated that the company had phased out phthalates from this product and modified the product's design to differentiate between old books and "phthalate-free" books.[67] Books with red handles were manufactured before the company changed its practices, and newer versions have handles of other colors, such as blue or purple. Sassy even has offered to replace those products with a red handle. We tested a book sent directly from the manufacturer, finding two types of phthalates. Sassy should clarify its "phthalate-free" label for this book.

Elmo's Tub-Time Rhyme Bath Book:
Testing Found Two Phthalates



One Fish, Two Fish, Red Fish, Blue Fish:
Testing Found Two Phthalates



Sassy's Hello Bee, Hello Me Bath Book and
Who Loves Baby? Photo Book:
Testing Found Two Phthalates

We also tested a few teethers for phthalates and found the chemicals in some and not in others. We found phthalates in the Little Teethers Teething Ring, Baby Gund Jungle Collection Teether, and a small amount in Especially for Baby's Water Filled Teethers. We did not find phthalates in Cool Baby's Soft Freezer Teether.

Baby Gund Jungle Collection Teether:
Testing Found One Phthalate

Teething Ring by Little Teethers:
Testing Found One Phthalate

We also tested a few toys marketed for infants. The Infantino AquaDuck Water Filled Playmat contained two different types of phthalates. The Hasbro Gloworm contained the largest amount of phthalates of any of the products we tested. We did not find phthalates in Fisher Price's Ocean Wonders Suction Spinner.

AquaDuck Water Filled Playmat by Infantino:
Testing Found Two Phthalates

Hasbro's Gloworm:
Testing Found Three Phthalates

In conclusion, most bath accessories, teethers, and other products for small children that we tested contained some types of phthalates, but some did not. As with products containing PBDEs, parents have the right to know which products contain phthalates so they can make more informed purchasing decisions for their children.

Failures of U.S. Chemicals Policy

Many people think, incorrectly, that the U.S. government would not allow chemicals to enter the market if they were not safe. In truth, the regulatory process has failed to work the way the public believes it should.

In 1976, Congress passed the primary law regulating toxic chemicals, the Toxic Substances Control Act (TSCA), which grandfathered all existing chemicals on the market into use without health-effects testing or analysis. Most of these chemicals emerged in the 1940s and 1950s when few laws governed chemical safety. Today, U.S. EPA reviews new chemicals that come onto the market but does not require full health effects testing for approval. With an estimated 2,000 chemicals introduced each year, EPA approves an average of seven new chemicals each day.[68]

Toxic Chemicals Missed By Regulation

Stories of the mass production, marketing, and release of a dangerous chemical that damages the public's health and the environment are all too familiar. Phthalates and PBDEs are two examples of how the Consumer Product Safety Commission (CPSC), in conjunction with U.S. EPA and U.S. Food and Drug Administration (FDA), have failed to adequately protect the public from these harmful chemicals.

Current Law Leaves EPA with Little Power to Protect Public Health

The U.S. government's regulation of chemicals is based on the premise that chemicals are presumed innocent until they are proven to harm human health.

Throughout its nearly 30-year history, TSCA has rarely been amended, but clearly fails to effectively regulate toxic chemicals. Since the law's inception, U.S. EPA has never used its authority to ban a chemical and has only offered regulations on five different chemicals, including PCBs, which Congress ordered regulated. U.S. EPA's lax regulation can be attributed to the unreasonably high burden of proof the law places on the agency to show that a chemical poses an unreasonable risk to human health and the environment.

TSCA divides all the chemicals on the market into two categories: existing chemicals and new chemicals. Existing chemicals are chemicals already on the market before 1980. These make up approximately 99 percent by volume of the chemicals on the market today. Existing chemicals are considered safe until U.S. EPA can establish that they pose an unreasonable risk to people's health or the environment, that the benefits of action outweigh the risks of inaction, and that U.S. EPA is employing the least burdensome method when taking action.[69]

Companies that wish to introduce new chemicals to the U.S. market must notify U.S. EPA at least 90 days before producing or importing a new chemical. U.S. EPA has been able to ensure review of the new chemicals. The new chemicals program, however, could be improved by increasing the testing requirements of the chemicals.

U.S. EPA should have the authority and means to guarantee chemicals on the market are safe for human health and the environment. In its 1998 review of high production volume chemicals, U.S. EPA estimated the cost for a full round of basic screening tests, including tests for reproductive and developmental toxicity, at about $205,000 per chemical.[70] The chemical industry, with profits of $13.5 billion in 2004, should pay this price to protect both health and the environment.[71]

Recommendations for Policy-Makers

Parents cannot be expected to track the thousands of potentially harmful toxic chemicals they and their families come into contact with everyday. Instead, the U.S. government must act to adequately protect those most vulnerable in its population. Parents should call on decision-makers to take the following actions.

Label Products Containing Potentially Hazardous Chemicals

Parents currently have little decision-making power when purchasing products for their family. With no government-ordered labels on products and no ability to readily gain information about the ingredients used in a product at the point of purchase, parents are left in the dark as to how they can best protect their children. The first step to protecting children is to give parents the tools they need to make safe choices. The U.S. Consumer Product Safety Commission (CPSC) should label children's products if they contain a chemical that is either known to be hazardous or has the potential to be hazardous.

Phase Out Hazardous Chemicals

Despite some remaining data gaps about the hazards of each of these chemicals, the U.S. EPA and CPSC should take action based on current evidence. Given the scientific studies that show these chemicals are present in humans, disrupt chromosome sorting, interfere with hormone function, impair development and learning, and may cause cancer, the United States should phase out the use of these chemicals – especially in products used by our most vulnerable population, children.

In the absence of federal action, several states have passed legislation to protect public health. California, Maine, Washington, New York, Maryland, Illinois, Oregon, Michigan and Hawaii have regulated toxic flame retardants, and many other states are considering such regulations. The California Legislature is considering a ban of phthalates and another endocrine-disrupting chemical, bisphenol-A, from children's products. Washington has taken steps to phase out persistent toxic chemicals, and Massachusetts is considering new rules that would change the way toxic chemicals are regulated in the state. States should continue to exercise their authority to pass laws that fill gaps and supplement federal law.

Reform Chemicals Policy

Chemicals that are untested or known to be hazardous and chemicals that can harm the developing fetus should not be on the market or in widespread use and distribution. U.S. chemicals policy should ensure that manufacturers and industrial users provide regulatory agencies and the public with adequate information about their products so that agencies can act to protect public health from potentially dangerous substances before damage is done. The United States must prevent exposure to toxic chemicals when there is evidence of potential harm.

Currently, manufacturers can put chemicals on the market before detection methods have even been developed to test for the presence of the chemical in air, water, soil, and our bodies. The burden falls on federal and state governments to develop these analytical methods – an expensive and time-consuming process. The costs of developing analytical methods and methods to test for a chemical's safety should fall to the manufacturers who stand to profit from the product. California is currently considering legislation that would require chemical

manufacturers to provide the state with these detection methods.

The European Union is currently considering a policy, known as REACH (Registration, Evaluation, Authorization of Chemicals), which would require industry to supply large amounts of data to the EU so that regulators can assess and address chemical use. The chemical industry has pressured the EU to weaken this proposed policy over the past five years, but it remains a step forward in toxic chemical regulation.

In order to protect its most vulnerable citizens, the U.S. must adopt a similar but stronger chemicals policy. Here in the U.S., manufacturers should be required to provide all hazard and health-impact information to U.S. EPA so the agency can begin to assess the thousands of chemicals currently on the market for which the U.S. EPA has little or inadequate data. Next, manufacturers of chemicals should be required to conduct an alternatives analysis, in order to determine if they really are using the least hazardous chemical for each application. Finally, U.S. EPA must have the authority to ban or restrict the use of a chemical if it can harm human health.

Recommendations for Parents

A few small, easy changes in how you store and heat foods, which toys your child plays with, and which foam furnishings and linens you use can help reduce your child's exposure to toxic chemicals.

At the Store

Choose safer toys and teethers.

- **Look for "PVC-free" on the labels of soft plastic toys and teethers.** Some manufacturers have removed PVC from their children's products, especially products intended to be put into children's mouths. Unfortunately, no law requires or regulates these labels, and few products are labeled as such. When parents have a question about the chemicals in a product, they should call the manufacturer.

- **Choose wooden toys.** There are countless manufacturers of high quality wooden toys in the market. Everything from baby rattles to kitchen play-sets are now made out of wood. Some commonly available brands include Plan, Haba, Jake's Room, Turner Toys, and Holztiger.

Choose safer food packaging and serving containers.

- **Avoid PVC plastic in food containers.** Check the bottom/underside of the product. If you find the number "3" in the recycling triangle, it is made from PVC plastic and should be avoided. Choose plastics labeled #1, #2, #4, or #5 in the recycling triangle, but do not heat beverages or food in plastic containers of any kind.

- **Avoid foods wrapped in plastic.** Almost all commercial grade plastic cling wrap contains PVC plasticized with phthalates or adipates (another hormone-disrupting PVC plasticizer that leaches out of the cling wrap), and other plastic food packaging may be made of PVC, as well. Avoid buying foods wrapped in plastic, especially cheeses and meats. Buy deli-sliced cheeses and meats and have them wrapped in paper. If you can't avoid buying plastic-wrapped foods, cut off a thin layer of the cheese or meat when you get home and store the remainder in glass or less-toxic plastic.

- **Choose safer containers for sippy cups and water bottles.** Look for plastics labeled #1, #2, #4, or #5 in the recycling triangle. As an alternative to hard plastic water bottles (such as the polycarbonate Nalgene bottles), try a lightweight stainless steel bottle instead.

- **Choose metal feeding utensils and enamel or ceramic plates.** While many manufacturers have removed phthalates from products intended to be put into young children's mouths, without a law prohibiting their use, there is no guarantee that these products, such as soft plastic-coated feeding spoons, are made without phthalates. Look for PVC-free labels or buy stainless steel, enamel, ceramic, or glass. (Note that enamel cannot be put in the microwave, and you should not use old pottery that could have lead-based glazes).

Choose safer sleeping accessories and furniture.

- **Choose natural materials for mattresses and linens.** Buy products with natural fibers (cotton and wool), which are naturally fire resistant. For example, Lifekind sells organic mattresses, linens, and receiving blankets without PBDEs.

- **Purchase furniture without PBDEs.** Several retailers sell PBDE-free furniture. For example, European Sleep Works sells mattresses, bedding, and furniture without PBDEs. Ikea is another retailer of PBDE-free foam furnishings.

At Home

- **Use glass to heat food or liquid in the microwave. You should not heat food in plastic containers or on plastic dishware, or heat liquids in plastic baby bottles.** Heating food and liquids in plastic containers can cause chemicals and additives in the plastics to leach out more readily—right into baby's food and milk. While some plastic containers are marketed as "microwave safe" it is safest to avoid them for heating.

- **If you do use plastic bottles, containers, or dishware,** to reduce exposure, take care to avoid harsh detergents or hot water when washing them. Do not put plastic bottles, containers, or dishware in the dishwasher. Also, throw out any plastic bottles, containers, and dishware that start to look scratched or hazy. Do not let milk sit for long periods of time in plastic.

- **Avoid letting your child put plastic toys in his/her mouth.** Toys designed for older children are more likely to contain phthalates. It is assumed that young children will not mouth these toys—such as action figures and Barbie dolls. To be safe, keep all plastic toys out of children's mouths. Call the manufacturer if you want to know if a product contains phthalates.

- **Avoid degraded or crumbling foam that might contain PBDEs.** Replace or cover couches, stuffed chairs, and automobile seats that have exposed foam. Reupholster padded furniture in homes where children or pregnant women live.

- **Be careful when removing and replacing the foam padding beneath your carpet.** Remove old carpet padding from your home and clean up well when finished.

Methodology

We selected a sample of baby products available at popular retail outlets and online vendors. These baby products are not intended to be comprehensive nor representative statistically of all products on the market; rather, they are examples of common products a parent might purchase.

We hired professional and accredited labs using approved testing methods to conduct all product testing.

Paradigm Environmental Services in Rochester, New York performed the PBDE testing. The lab followed standard procedures, essentially EPA Method 8270 (GC/MS), modified to include multi-point calibration for the indicated compounds. To determine the PBDE levels in the foam material of each product, the laboratory began by cutting a foam sample into smaller pieces about ¾ of an inch in diameter. The laboratory used methylene chloride to extract PBDEs from the sample and gas chromatography/mass spectrometry to analyze the sample. The reporting/quantitation limits varied based on the product tested, as detailed in Appendix A. A detailed methodology is available upon request.

Stat Analysis Corporation in Chicago, Illinois performed the phthalate testing. Stat Analysis followed standard procedures, using EPA Method 8060 for phthalate extraction and EPA Method 3580A for waste dilution. The reporting/quantitation limits varied based on the product tested, as detailed in Appendix A. A detailed methodology is available upon request.

Appendix A. Results of Laboratory Testing for Toxic Flame Retardants and Phthalates

Product Testing Results: Toxic Flame Retardants

Product Name	Type	Product Number	Brand	Reporting/ Quantitation Limit (ppb)	Type of PBDE						
					BDE-28 (tri)	BDE-47 (tetra)	BDE-99 (penta)	BDE-100 (penta)	BDE-153 (hexa)	BDE-154 (hexa)	BDE-183 (octa)
Air Flow Sleep Positioner	Sleep Aid	Item #: 4064	The First Years	< 8,570	ND	**47,900**	**10,800**	**61,900**	ND	ND	ND
Sleep 'N Secure 3-in-1 Infant Sleep Positioner	Sleep Aid	UPC: 45516135082	Leachco	< 8,330	ND	**13,000**	ND	**10,800**	ND	ND	ND
Dex Secure Sleeper Ultra 3-in-1 Sleep Positioner	Sleep Aid	ASIN: B00016S2X0	Dex	< 828	ND	ND	ND	ND	ND	ND	ND
Contoured Changing Pad	Changing Pad	Item #: 90409	Simmons	< 1,770	ND	ND	ND	ND	ND	ND	ND
PeeWees Disposable Crib Mattress Pad	Mattress Pad	UPC: 7895540006	PeeWees	< 90.0	ND	ND	**717**	ND	**93**	**143**	ND
Portacrib Mattress Pad	Mattress Pad	SKN: 927948; ASIN: B00067VWRW	Simmons Juvenile	< 82.8	ND	ND	ND	ND	ND	ND	ND
Sealy Baby Soft Classic Mattress	Mattress	SKN: 074060; ASIN: B00067TA1C	Kolcraft	< 863	ND	ND	ND	ND	ND	ND	ND

Results in parts per billion (ppb).

ND = Non Detect. Indicates that the laboratory could not detect the chemical at levels above the reporting/quantitation limit noted.

The Penta commercial mixture is composed of BDE-47,-99, -153, and -154. The Octa commercial mixture is composed of BDE-153 and -154. The Deca commercial mixture is composed of BDE -209 and some -183.

Product Testing Results: Phthalates

Product Name	Type	Product Number	Brand	Reporting/ Quantitation Limit (ppb)	Type of Phthalate*						
					DEHP	BBP	DINP	DBP	DNOP	DEP	DMP
Elmo's Tub-Time Rhyme Bath Book	Bath Book	ISBN: 0375826920	Random House	< 7,800	**65,000**	**84,000**	ND	ND	ND	ND	ND
Where Is Slippery Soap? Blue's Clues Book	Bath Book	ISBN: 0689829485	Simon & Schuster	< 7,700	**760,000**	ND	ND	ND	ND	ND	ND
A Beatrix Potter Bath Book: Benjamin Bunny	Bath Book	ISBN: 0723200181	Penguin	< 8,300	**20,000**	ND	ND	ND	ND	ND	ND
Duckling Bath Book	Bath Book	ISBN: 0789498855	DK Publishing	< 7,800	**37,000**	ND	ND	**190,000**	ND	**60,000**	ND
One Fish, Two Fish, Red Fish, Blue Fish	Bath Book	ISBN: 0375811648	Random House	< 7,700	**370,000**	ND	ND	ND	**210,000**	ND	ND
Splish Splash: Jesus	Bath Book	ISBN: 0781434203	Cook Communications	< 6,600	**840,000**	ND	ND	**16,000**	**4,600,000**	ND	ND
Who Loves Baby? Photo Book	Soft Plastic Book	Item #: 844	Sassy	< 7,600	**660,000**	ND	ND	**39,000**	ND	ND	ND
Hello Bee, Hello Me Book	Bath Book	Item #: 871	Sassy	< 8,500	**450,000**	ND	ND	**45,000**	ND	ND	ND
Bath Squirties	Bath Toy	Item #: 40157	Especially for Baby	< 7,800	**26,000**	ND	ND	ND	ND	ND	ND
Fish Squirties	Bath Toy	UPC: 075656011823	Splash Gear	< 6,800	**39,000**	ND	ND	ND	**6,100,000**	ND	ND
Color Change Ducky	Bath Toy	Item #: 26158	Especially for Baby	< 8,600	ND	ND	ND	ND	ND	ND	ND
Soft Freezer Teether	Teether	Item #: 333	Cool Baby	< 7,800	ND	ND	ND	ND	ND	ND	ND
Baby Gund Jungle Collection Teether	Teether	Item #: 58090	Gund	< 8,400	ND	ND	ND	**760,000**	ND	ND	ND
2 Water Filled Teethers	Teether	Item #: 40142	Especially for Baby	< 6,000	ND	ND	ND	**10,000**	ND	ND	ND

Product Name	Type	Product Number	Brand	Reporting/ Quantitation Limit (ppb)	Type of Phthalate*						
					DEHP	BBP	DINP	DBP	DNOP	DEP	DMP
Teething Ring	Teether	(sold with oral pain relief gel or tablets) UPC: 5618412090	Little Teethers	< 8,700	**410,000**	ND	ND	ND	ND	ND	ND
Ocean Wonders Suction Spinner	Toys for Infants	unknown	Fisher Price	< 6,600	ND	ND	ND	ND	ND	ND	ND
AquaDuck Water Filled Playmat	Toys for Infants	Item #: 150-2063	Infantino	< 9,400	**420,000**	ND	ND	ND	ND	**490,000**	ND
Gloworm	Toys for Infants	Item #: 124126	Hasbro	< 7,800	**82,000**	ND	ND	**9,500**	**17,000,000**	ND	ND

Results in parts per billion (ppb).

* Key to chemical abbreviations: Di (2-ethylhexyl) phthalate (DEHP); Butyl benzyl phthalate (BBP); Di-isononyl phthalate (DINP); Di-n-butyl phthalate (DBP); Di-n-octyl phthalate (DNOP); Diethyl phthalate (DEP); and Dimethyl phthalate (DMP).

ND = Non Detect. Indicates that the laboratory could not detect the chemical at levels above the reporting/quantitation limit noted.

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December 28th, 2005

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Mr. Gallagher:

The Boeing Company provides the following comments on the "Washington State Polybrominated Diphenyl Ether (PBDE) Chemical Action Plan: Draft Final Plan December 1, 2005" (Department of Ecology Publication No. 05-07-048 / Department of Health Publication No. 334-079). The Boeing Company has participated in the stakeholder process surrounding the development of this plan since its inception, subsequent to Governor Locke's executive order. During this time we wish to commend the professionalism of the Ecology and Health staff during our discussions on the general PBDE and specifically the Deca-BDE risks and concerns.

In summary the draft PBDE Chemical Action Plan (CAP) is seen to be seriously flawed in both its conclusions and analysis of supporting science. The Boeing Company recommends that staff recommendations on banning or restricting the use of PBDEs, and in particular Deca-bde, be removed from this CAP. The Department is encouraged to request funding for an independent and impartial science advisory board (SAB) to evaluate the current and future state of science on PBDEs. This SAB will apply best available science to determine the realistic risk posed by each chemical under consideration. It will report back to the Department and legislature with a majority and minority opinion. Thus a scientifically based, unbiased and politically neutral statement of facts can be delivered to policy makers in the legislature for action, if needed.

Our recommendation is based on the long experience with the PBDE stakeholder process and supported by the following aspects of the draft CAP:

The staff is correct in its assertions that:

.

> "*At each step of the way, staff from Ecology and DOH have struggled with limited data and limited access to data, and the uncertainty that comes with a new field of study (emerging information).*"

It is thus presumptuous that the Department staff can in turn make claims of harm to the public based on information they admit is insufficient and they do not fully comprehend.

An example of this presumption is the contention that

"*There are potentially serious health and environmental consequences as the amounts of PBDEs increase; likely health effects include neurotoxicity (i.e. effects to neurological development from exposures to unborn and newborn infants), leading to impacts to behavior, learning and memory*"

Within this statement are two flaws: 1) The failure by staff to differentiate between the three types of PBDE under consideration as to particular toxicity and 2); with particular oversight in mention that Deca-BDE does not qualify as bioaccumulative or toxic either under Ecology's definition in draft PBT rule or subsequent to European Union findings in 2005.

A related example of presumption exceeding available science lies in this statement:

"We (Ecology and Health staff) know that:
Deca-BDE is likely to breakdown in the environment to more toxic and bioaccumulative forms of PBDEs."

This is in direct contradiction of information provide by the Bromine Science & Environment Fourm in letters of Nov 16, 2005 and, July 26, 2005 to Mr. Gallagher. In these letters the current science was evaluated in terms of applicability of "laboratory science" to real world conditions. The information supports the conclusion that laboratory studies can not be extrapolated to real world for a range of reasons. Further, environmental studies evaluating cogeners distributions demonstrate that there is no discernable coordination between alleged deca-bde degradation products and those found in the environment. Thus, in reality- "*We (Ecology and Health staff) do NOT know about breakdown products in the real world or even if they degrade at a rate sufficient to be detected."*

The staff statement that:

"What we want to avoid is adopting a policy that allows the continued build-up of PBDEs in our bodies and in the environment as we try to resolve the unknowns."

Points to a preconceived notion of what the staff thinks is appropriate, rather than a scientific analysis of the actual facts and development of risk analysis. This approach is a paradigm shift in the approach to chemical management in Washington State -- a shift neither debated nor authorized by the Washington legislature. It is an approach that is inconsistent with Federal chemical management concepts in existence since the 1970's. It is a shift in which preconceived notions are more important that proper risk analysis and scientific evidence in setting State chemical management policy.

The subsequent staff assertion: (bolded in part for emphasis)

"*Banning these substances, as long as a safer alternative exists, can avoid negative health effects from PBDEs for people, and to the environment in Washington.*
Unfortunately, there is a lot we don't know. We lack adequate toxicity information on the alternatives to Deca-BDE. *This is likely due to the fact that, under current U.S. chemical policies, toxicity studies are not required or are not readily accessible for these chemicals.* ***We don't know the rate of breakdown of PBDEs in the environment, or exactly what congeners are produced as a result***

of breakdown of PBDEs. *(However, the evidence suggests that the breakdown products will be more toxic than the parent compounds.)* ***We don't know exactly how PBDEs move from products into our bodies and the environment.*** *And we don't know how much more PBDEs could be produced and sold as manufacturers try to comply with future fire protection rules from the Consumer Product Safety Commission*."

The staff's own words acknowledge that the Department has insufficient information to make more than an educated guess about the impact of DecaBDE. A reasonable person must conclude that the Department has insufficient information to meet even the most minimal standard for invoking the "precautionary principle". Hence, any recommendation to ban or restrict, even in specific narrowly construed applications, must be considered subjective and unreliable for lack of sufficient scientific, economic or environmental supporting information.

Additional comments appropriate to this Draft CAP can be found in Boeing's November 2005 comments on the draft PBT rule and will not be repeated here for brevity. Boeing also has reviewed and concurs with the technical comments on Deca-BDE provided by the Bromine Science & Environment Forum. Attached is a markup of the Draft PBDE CAP with some suggestions on removing unsupported or confusing statements.

The Boeing Company will continue to work to use the least environmentally impacting materials available in the construction of its products, consistent with flight safety and employee health. Coordination with the Departments of Ecology and Department of Health are important aspects of Boeing's effort to identify through best available science those materials that present a realistic, identifiable risk. Please contact the undersigned or Mel Oleson 253 988-0378 if you have any questions.

Respectfully,

Kirk Thomson
Director, Enterprise Environmental Affairs
The Boeing Company
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Attachment: Markup of Draft PBDE CAP

Comments from The Boeing Company on Draft PBDE Chemical Action Plan:

- **Executive Summary: The department fails repeatedly to differentiate between the toxicity and known impact / risk of of each type of PBDE. This is particularly confusing to the layman reader who may not be aware of the non-toxic nature of Deca-BDE when compared to Octa or Penta. Also, the risk posed by Deca is merged with the other PBDEs when insufficient science is avaialbe to substantiate these assertions by the Department. Detailed markups examples are provided in the executive summary to illustrate these concerns. Recommend the department have this section reviewed by an independent party to identify additional errors and omissions.**

(editor note 1: deletions are shown as strikethroughs, additions are in { })
(editor note 2: Sections on which no comment were made were deleted to reduce size of document and aid review in focusing on relevant sections)

Executive Summary

This is the draft final version of the Chemical Action Plan (CAP) for a class of flame retardants called polybrominated diphenyl ethers, or PBDEs. It is the second CAP done as part of the Department of Ecology (Ecology)'s *Proposed Strategy to Continually Reduce Persistent, Bioaccumulative Toxins (PBTs) in Washington State* (issued December, 2000). Ecology is also developing a rule (WAC 173-333 Persistent Bioaccumulative Toxins Regulation) to guide the development of CAPs. This CAP is consistent with both the *Strategy* and the draft PBT rule. The first CAP, for mercury, was completed in January 2003.

In January 2004, Governor Locke directed Ecology, in consultation with the Department of Health (DOH), to investigate and recommend options to reduce the threat of PBDEs in the environment. The final result is this PBDE CAP, which has been developed through a multi-program, multi-agency effort, with external stakeholders involved at each step. External advisory committees included representatives from such varied interests as business and consumer and environmental protection.

- {TBC: This paragraph is combination of speculation, staff opinion that is misleading to the reader.}

~~When Governor Locke directed Ecology and DOH to focus on these chemicals, staff knew very little about them. What was known was that PBDEs were showing up in people and in the environment in increasing amounts, and those levels were significantly higher in North America than elsewhere. PBDEs are a source of growing interest and concern around the world. New studies and information continue to appear on an almost daily basis.~~

~~This document builds on the Interim PBDE CAP which was released in December, 2004. Based on the available information at that time, staff at Ecology and DOH believed that a ban on products containing PBDEs was warranted. However, further study of how a ban could be structured was needed, including research on chemical alternatives for PBDEs and on costs and benefits. This research, and a thoughtful review of the most current scientific information about the environmental and human health risks of PBDEs, was considered in the development of this plan. In addition, Ecology and DOH kept a close watch on the experiences of other states and Europe where policies to reduce PBDEs have been crafted.~~

A great deal has been learned, and there is still a great deal more to understand. At each step of the way, staff from Ecology and DOH have struggled with limited data and limited access to data, and the uncertainty that comes with a new field of study (emerging information). We know that:

- There is already a reservoir of PBDEs in humans and in the environment. Globally, almost 70,000 metric tons of PBDEs are produced every year, almost half of which is used in products sold in the U. S. and Canada.

- The various commercial grades of PBDEs have been used in a wide variety of products, from carpet pads to TV plastic. The production of two PBDEs, Penta-BDE and Octa-BDE, have been phased out. However, the use of Deca-BDE is anticipated to increase.

- TBC{Path for exposure is uncertain at this time and may include}exposed to PBDEs through indoor dust and various foods.

- PBDEs have been found in fish, in polar bears, in grizzly bears and in orcas in Puget Sound.

- PBDEs initially drew attention because they were found in women's breast milk and the levels in breast milk were rising quickly. While levels of PBDEs found in breast milk in the U.S. are not yet at a level of concern, ~~levels in U.S. women are 10 to 100 times that found in women in Europe.~~ {TBC(inflammatory and lacks relevance to Washington State)}

- There are potentially {~~serious}~~ health and environmental consequences as the amounts of {Octa and Penta }PBDEs increase; likely health effects include neurotoxicity (i.e. effects to neurological development from exposures to unborn and newborn infants), leading to impacts to behavior, learning and memory. TBC{No adverse health affects are attributed to Deca-BDE.}

- Deca-BDE ~~is likely to~~ TBC{under some laboratory conditions }breaks down to more toxic and bioaccumulative forms of PBDEs. TBC{Collarborating evidence of a similar breakdown in the natural environment has not been demonstrated to any level that could pose a risk.}

- Banning TBC{ Octa and Penta-BDEs}, as long as a safer alternative exists, can avoid negative health effects for people, and to the environment in Washington. TBC {Insufficient information is available to recommend action on Deca-BDE}

Unfortunately, there is a lot we don't know. We lack adequate toxicity information on the alternatives to Deca-BDE. This is likely due to the fact that, under current U.S. chemical policies, toxicity studies are not required or are not readily accessible for these chemicals. We don't know the rate of breakdown of PBDEs in the environment, or exactly what congeners are produced as a result of breakdown of PBDEs~~. (However, the evidence suggests that the breakdown products will be more toxic than the parent compounds.)~~ (TBC note: speculation) We don't know exactly how PBDEs move from products into our bodies and the environment. And we don't know how much more PBDEs could be produced and sold as manufacturers try to comply with future fire protection rules from the Consumer Product Safety Commission.

The recommendations in this Chemical Action Plan were developed after a thorough consideration of what is known and what is not known. We believe these recommendations represent prudent policy, and that the suggested actions are commensurate with the risk involved, both to human health and the environment as well as to Washington businesses. What we want to avoid is adopting a policy that allows the continued build-up of TBC {Octa and Penta} PBDEs in our bodies and in the environment as we try to resolve the unknowns.

PBDE basics

PBDEs are members of a broad class of brominated chemicals used as flame retardants. Flame retardants like PBDEs are added to products so that they will not catch on fire or burn so easily if exposed to flame or high heat. PBDEs have been added to plastics, upholstery fabrics and foams in such common products as computers, TVs, furniture and carpet pads.

There are three main types of PBDEs used in consumer products: Penta-BDE, Octa-BDE and Deca-BDE. Each has different uses and different toxicity. In 2001, the total PBDE volume worldwide was estimated at over 67,000 metric tons, including 56,100 metric tons of Deca-BDE. Manufacturers of Penta-BDE and Octa-BDE agreed to voluntarily stop producing these two forms of PBDEs at the end of 2004. With the discontinuation of Penta- and Octa-BDE, Deca-BDE will account for 100 percent of PBDE usage.

The highest levels of PBDEs in people have been found in Canada and in the U.S., which are the largest producers and consumers of products with PBDE flame retardants. Levels of TBC{Octa & Penta} PBDEs in human tissues in the U.S. are 10 to 100 times higher than reported for Europe and Japan. While these numbers are significant, it is important to understand that the mere presence of chemicals does not necessarily represent a health risk. Although PBDEs are present in people and many foods, these levels have not yet reached those shown to be toxic in lab animals and do not pose an immediate health threat. If TBC{Octa and Penta} PBDE levels continue to rise, however, real health risks can be expected, particularly for our children. This is especially significant given the existing large volume of PBDEs already in the environment and the possibility of the increasing use of them in products.

New work completed since December, 2004

With production of Penta- and Octa-BDE discontinued, Deca-BDE became the focus of Ecology and DOH's PBDE work**.** Since the release of the Interim PBDE CAP, DOH and Ecology focused on three key areas related to the need for action on Deca-BDE. As a result, three new chapters have been added to the Plan: 1) an alternatives assessment (Chapter VI); 2) a cost-benefit analysis (Chapter VII); and 3) a review of studies on the degradation of Deca-BDE (Chapter IV). The additional information discussed in these chapters provided the framework for assessing whether or not to ban Deca-BDE from commerce in Washington State.

Deca-BDE Alternatives Assessment

DOH conducted an extensive survey of the available literature to determine if safer, effective alternatives[1] to Deca-BDE exist for use in electronic enclosures. DOH limited its focus to electronic enclosures because the black plastic used to enclose the rear of TVs accounts for somewhere between 45 and 80% of Deca-BDE commercial use. DOH considered only those alternatives previously shown to work in the same plastics and products as Deca-BDE while providing adequate fire protection. As with so much of the PBDE work, the undertaking was hampered by both limited and emerging information. There is a general lack of toxicity and other testing information on many of the alternatives. What testing information there is for these alternatives is not readily available or only available from the chemical manufacturers. However, there was sufficient data collected to conclude that promising alternatives exist, ones which are already in use and meet fire protection standards, and we want to continue this research.

Cost Benefit Analysis

- **(TBC comment: Considering the limited utility as identified by Department recommend the entire section be moved to an appendix. Placement in body of CAP may imply validity to a study where none exists. A brief summation of the difficulties in obtaining and analyzing the data would be sufficient.)**

Ecology conducted a Cost Benefit Analysis (CBA) of a statewide ban on Deca-BDE in electronic enclosures in order to weigh the benefits to human health and the environment against the costs to business.

Information on costs was hindered by difficulties getting information from businesses about their Deca-BDE use. Many businesses were reluctant to share cost data with us. When it became apparent that critical data would not be available, Ecology developed an alternative model that we believe might be successfully used to compare costs to benefits. However, this model hinges on the identification of at least one safer, effective alternative to Deca-BDE, which has not yet

[1] It is important to note that "safer" relates to impacts on human health and the environment. It does not refer to the ability of the alternative to work as a flame retardant. The alternatives assessment considered only those chemicals already proven to meet fire protection standards.

been identified. In addition, there is considerable uncertainty in the data needed to quantify health benefits. Ecology is therefore unable to determine whether benefits exceed costs (or vice versa). Consequently, Ecology has concluded that the cost benefit analysis has limited utility at this time to inform decisions on phasing-out uses of deca-BDE.

Degradation

Even at the time the Interim PBDE CAP was published, Ecology and DOH's research indicated that while Deca-BDE in its original form is considered relatively safe, it is likely to degrade into more toxic forms~~. A more in-depth review (presented in Chapter IV) continues to suggest this, and the degradation of Deca-BDE is central to Ecology and DOH's concern about the human health and environmental safety of this flame retardant.~~

- **(TBC: Unsubtantiated assertion. Studies by multiple scientist have not found evidence that degradation occurs exposure outside the laboratory. Department should focus on creating a real risk anlaysis to substantiate or refute impact for each chemical.)**

Laboratory studies indicate that the breakdown of Deca-BDE takes place through exposure to sunlight and through biological activity. ~~Therefore, the Deca-BDE that is already in the environment is likely to be a long-term source of the more toxic forms of PBDEs long into the future.~~

- **(TBC: Assumption not supported by facts. Department is encouraged to refrain from making judgements on science for which they do not have adequate evidence to support opinions.)**

Recommendations

Recommendations for reducing PBDEs in the environment and for protecting human health are detailed in the body of this plan. Many of the policy options that were considered are also presented, and the rationale for the policies recommended is provided. Key recommendations are summarized as follows:

- The Washington State Legislature should prohibit the manufacture, distribution (but not transshipment) or sale of new products containing Penta-BDE and Octa-BDE in Washington state. The ban may include an exemption for new products that contain recycled material from products that contained Penta-BDE and Octa-BDE, pending further review.

- ~~The Washington State Legislature should ban Deca-BDE provided that safer alternatives are found or upon additional evidence of Deca-BDE harm.~~

  (TBC: as noted in previous comments, science provided by experts in field, European Union science / policy declarations and through application of Ecology's own proposed standards DECA-BDE is not a PBT and poses minimal risk to public or environment. Allegations of degradation risk are highly speculative, failing to meet even a minimum scientific standard for justifying restrictions on DecaBDE use)

- ~~If safer alternatives are not identified, Ecology and DOH should explore incentives to encourage manufacturers to develop safer, effective alternatives as well as product redesign changes that eliminate the need for PBDEs.~~

- **(TBC: Ecology is neither sufficiently staffed nor expert in the aspects of manufacturing necessary to support this recommendation.)**

- Ecology should establish, by July 2006, appropriate disposal and recycling practices for products containing {Octa / Penta} PBDE flame retardants.

- Ecology and DOH should {seek authority from the legislature to }work with other states and interested parties in a dialogue toward {TBC}~~improving~~ revising U.S. chemical policy. Current U.S. chemical policy, based upon the Toxic Substances Control Act (TSCA), has resulted in only minimal testing of many chemicals currently in use. The lack of adequate testing data on promising alternatives to Deca-BDE already in use exemplifies the need to improve TSCA and/or its implementation.

- The state's purchase of products containing {Octa / Penta} PBDEs should be restricted in appropriate contracts, consistent with Executive Order 04-01.

- DOH should continue to develop methods and materials for educating the public on how to minimize exposure to PBDEs. This will include information on the benefits of breastfeeding and advice about eating fish as part of a healthy diet.

- To ensure that workers in certain industries are not exposed to unacceptable levels of PBDEs, DOH and the state Department of Labor and Industries should continue to investigate the feasibility of implementing a workplace exposure study in collaboration with the federal Center for Disease Control and Prevention.

Note: A number of the recommendations presented in the Interim CAP are underway, and some have been completed. For example, the state Department of Labor and Industries has already begun providing information to employees on how to minimize PBDE exposures. And DOH has created brochures and a website to educate the public on reducing exposure to PBDEs.

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Comments on this draft Final PBDE CAP will be incorporated into the final document, to be published in early January 2006. A Responsiveness Summary of those comments will be posted separately on the web. This version reflects comments that were received on the first iteration of the document, a Draft PBDE CAP (released in October 2004).

II. Purpose and Use of PBDEs

Market Changes

Consumer Electronics Manufacturers and Deca-BDE Alternatives

With the phase-out of Penta-BDE and Octa-BDE, it is expected that manufacturers are identifying alternatives. In addition, as of mid November 2005, a number of electronics manufacturers are phasing out all PBDEs, including Deca-BDE. Specific company policies (with references) are listed in Appendix C. Electronics manufacturers phasing out PBDEs in some or all of their electronic products include: Apple, Brother, Canon, Daikin, Dell, Ericsson, Hewlett Packard, Matsushita, Mitsubishi, NEC, Panasonic, Samsung, Sharp, Sony, ViewSonic, and Xerox. The following mattress companies, comprising 70% of that market do not have Deca-BDE in their mattresses: Sealy, Kingsdown, Simmons, Englander, Tempur-Pedic, Int'l Bedding Corp, Select Comfort, Restonic, King Koil, Corsicana, Lady Americana. Out of 14 mattress manufacturers in Washington, 11 indicated they do not use any PBDEs. IKEA has also phased out all PBDEs. [2]TBC{ The recent ruling in the European Union that Deca-BDE may be used without any restrictions beyond those in manuafacturing facilties has an unknown impact on the use of this material in the market. It is possible that some manufactures may revert back to use of Deca-BDE.}

Environmentally Preferable Purchasing

According to Dell Corporation, many governments and large corporations have developed green procurement guidelines that prohibit the use of PBDEs in electronic products.[3] Three government requests for proposal (RFPs) for computers with restrictions on PBDEs were identified.

Commonwealth of Massachusetts

Massachusetts' RFP for computers specifies that no brominated flame retardants be used. http://www.state.ma.us/osd/enviro/info/factsheets2/Computer_EPP_Language.pdf

Denver, CO

[2] M. Bjork, 2004. Banning brominated flame retardants, BFR2004.
[3] Dell Corporation, "Industry Use of Brominated Flame Retardants," www.dell.com, viewed 27 April 2004.

Denver's RFP for computers specifies that the vendor must offer equipment that has been certified by third-party certification organizations such as TCO, Blue Angel, or others.

Seattle, WA

Seattle's RFP for laptops specifies that vendors must disclose the use of halogenated flame retardants. http://www.seattle.gov/environment/Documents/Laptops.pdf

III. Unintended Consequences: PBDEs, Human Health, and the Environment

IN BRIEF: Although PBDEs are present in people and many foods, these levels have not yet reached those shown to be toxic in lab animals and do not pose an immediate health threat. For instance, while PBDEs have been detected in breast milk and fish, the detected levels are so low that breastfeeding remains the healthiest way to nurse a baby and fish remains a beneficial part of a healthy diet. Studies on lab animals, however, suggest that exposure in the womb to higher levels of PBDEs than currently exist in the environment can impact the brain affecting behavior and learning after birth. Animal studies have also shown that PBDEs can affect the thyroid and liver. Most of these studies point to the components of Penta- and Octa-BDE formulations as being of primary concern with respect to human health. Deca-BDE is the least toxic of the three forms ~~but is likely to degrade into the more toxic Penta-BDE or Octa-BDE components.~~

The highest levels of PBDEs in human tissues have been found in the U.S. and Canada, which use about 98 percent of the world's supply of Penta-BDE. Levels of PBDEs in human tissues in the U.S. are 10 to 100 times higher than reported for Europe and Japan. Moreover, while levels in Japan and some European countries appear to have begun decreasing recently, levels in the U.S. appear to be increasing. People are exposed to PBDEs in food, household dust and indoor air although the contribution of each pathway remains unclear. PBDEs, like PCBs, can build up in the body and remain stored there for years.

Once in the environment, PBDEs can last a long time or break down into other forms, depending on surrounding conditions such as the availability of fluids or UV light. Similarly, ~~depending on~~ TBC {under some laboratory} conditions, Deca-BDE – which is considered safe in its original state – can break down into more harmful forms;{ significant breakdown has not been demonstrated in natural environment.} What happens to PBDEs once PBDE products are placed in landfills is unknown~~, but there are concerns that Deca-BDE in landfills may build up in large stockpiles that could over time break down into more harmful forms. It is possible that PBDE products that are incinerated will release furans and dioxins into the environment~~.

- TBC note: above paragraph is speculation not supported by research)

PBDEs and Human Health

Human exposure to PBDEs

PBDEs in human tissues

PBDEs have been measured in a variety of human tissues, including blood, fat, and breast milk collected from people around the world. Between 1972 and 1997, PBDE levels in human breast milk from Sweden were shown to exponentially increase, doubling every 5 years (Figure 2).[4] During this same time period, levels of PCBs and other organic pollutants in breast milk had

[4] Noren and Meironyte, 2000. Certain organochlorine and organobromine contaminants in Swedish human milk in perspective of past 20-30 years. Chemosphere 40:1111-1123.

decreased. Levels of PBDEs in Swedish breast milk are similar to those reported for many other European countries and Japan.[5] Levels of PBDEs in breast milk samples from Sweden began to decrease in the late 1990s.[6]

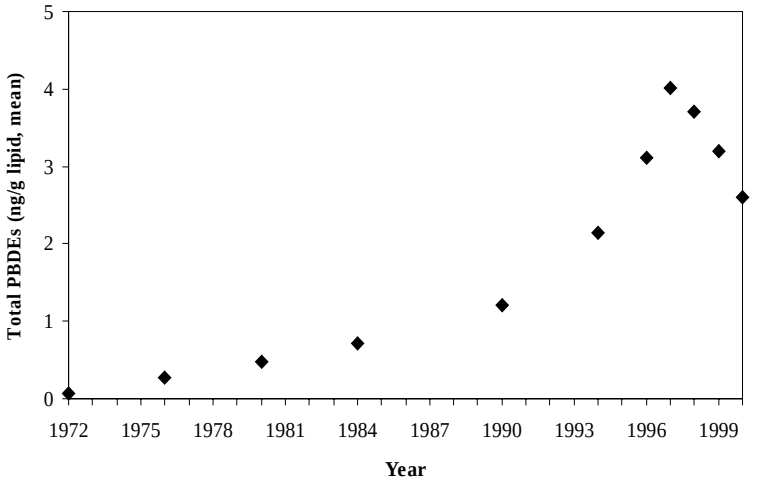


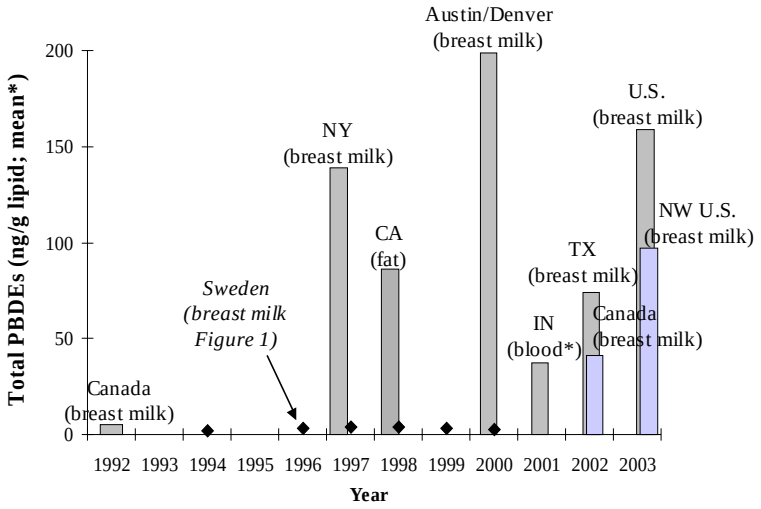
Figure 2. PBDEs in Swedish breast milk, 1972-2000.[7,8]

The highest levels of PBDEs in human tissues collected from the general public have been found in the U.S. and Canada (Figure 3).[9,10,11,12,13,14] Levels of PBDEs in human tissues in the U.S. are between 10-100 times higher than levels reported for Europe and Japan. One reason for the higher levels of PBDEs in U.S. and Canadian tissue samples may be that North America has used about 98% of the world's supply of the Penta-BDE commercial product.[15,16] While levels

[5] Sjodin et al., 2003. A review on human exposure to brominated flame retardants – particularly polybrominated diphenyl ethers. Environment International 29:829-839.
[6] Meironyte, 2002. Organohalogen contaminants in humans with emphasis on polybrominated diphenyl ethers. PhD Thesis. Karolinska Instituted, Stockholm, Sweden. (data summarized in Sjodin et al., 2003)
[7] Noren and Meironyte, 2000. Certain organochlorine and organobromine contaminants in Swedish human milk in perspective of past 20-30 years. Chemosphere 40:1111-1123.
[8] Meironyte, 2002. Organohalogen contaminants in humans with emphasis on polybrominated diphenyl ethers. PhD Thesis. Karolinska Institute, Stockholm, Sweden. (data summarized in Sjodin et al., 2003)
[9] Sjodin et al., 2003. A review on human exposure to brominated flame retardants – particularly polybrominated diphenyl ethers. Environment International 29:829-839.
[10] Schecter et al., 2003. Polybrominated diphenyl ethers (PBDEs) in U.S. mother's milk. Environmental Health Perspectives 111(14): 1723-1729.
[11] Mazdai et al., 2003. Polybrominated diphenyl ethers in maternal and fetal blood samples. Environmental Health Perspectives 111(9): 1249-1252.
[12] She et al., 2002. PBDEs in the San Francisco Bay area: measurements in harbor seal blubber and human breast adipose tissue. Chemosphere 46:697-707.
[13] Environmental Working Group (EWG), 2003. Mothers' milk, record levels of toxic fire retardants found in American mothers' breast milk. Available at www.ewg.org.
[14] Northwest Environment Watch, 2004. Flame retardants in Puget Sound residents. Available at: www.northwestwatch.org/pollution
[15] Hale et al., 2003. Polybrominated diphenyl ether flame retardants in the North American environment. Environment International 29: 771-779.

in Japan and some European countries appear to have begun decreasing recently, levels in the U.S. appear to be increasing.[17,18,19]

- **(TBC: No significant correlation between exposure pathways, risk, chemical actions, toxicity or bioacculation has been demonstrated between PCBs and PBDEs; and particularly for DecaBDE. Attempts to relate the two only create confusion and generate unfounded concern in the public. All reference to PCBs should be removed from this report as not relevant to the discussion)** ~~In contrast, levels of another group of persistent environmental contaminants that were banned in the 1970s, PCBs, have been decreasing. Currently, U.S. levels of PBDEs in human tissue samples are similar to or greater than levels of PCBs.[20, 21]~~



~~Figure 3. PBDE levels in human tissues from Sweden, Canada and the U.S., 1992-2003.[22]~~

~~There is a wide range of PBDE levels in tissues, including some people with very high tissue levels (high-end) compared to the average tissue levels among all people tested.[23] For example,~~

[16] Sjodin et al., 2003. A review on human exposure to brominated flame retardants – particularly polybrominated diphenyl ethers. Environment International 29:829-839.
[17] Lind et al., 2003. Polybrominated diphenyl ethers in breast milk from Uppsala County, Sweden. Environmental Research 93:186-194.
[18] Akutsu et al., 2003. Time-trend (1973-2000) of polybrominated diphenyl ethers in Japanese mother's milk. Chemosphere 53:643-654.
[19] Sjodin et al., 2004. Retrospective time-trend study of polybrominated diphenyl ether and polybrominated and polychlorinated biphenyl levels in human serum from the United States. Environmental Health Perspectives 112(6): 654-658.
[20] Sjodin et al., 2004. Retrospective time-trend study of polybrominated diphenyl ether and polybrominated and polychlorinated biphenyl levels in human serum from the United States. Environmental Health Perspectives 112(6): 654-658.
[21] Schecter et al., 2004. PBDE contamination of U.S. food and human milk; and PBDE, PCDD/F, PCB, and levels in the U.S. human blood (1973-2003). Abstract presented at BFR 2004 Conference in Toronto Canada, June 2004.
[22] Data from Noren and Meironyte, 2000; Meironyte, 2002; Sjodin et al., 2003; Mazdai et al., 2003 (*median value; mean value not published); Schecter et al., 2003; She et al., 2002; EWG, 2004; and Northwest Environment Watch, 2004.
[23] McDonald, 2004. Distribution of PBDE levels among U.S. women: estimates of daily intake and risk of developmental effects. Abstract presented at BFR 2004 Conference in Toronto Canada, June 2004.

~~a study in Texas reported levels of total PBDEs measured in breast milk ranging from 6 to 419 nanograms/gram lipid with an average of 74.[24] This wide variability is seen in tissue samples from the U.S. and from other countries.[25, 26] The reasons for the large variability in tissue levels and why some people have high-end exposures to PBDEs are not known.~~

~~Studies indicate that there are differences in routes and timing of human exposures between PCBs and PBDEs. People are mainly exposed to PCBs through the diet and age has been shown to be a predictor of PCB levels in human tissues.[27] Levels of PCBs and PBDEs were not correlated in a study that measured both in breast milk, i.e. the levels of these compounds were not both high in the same individuals.[28]~~ Additionally, a study of PBDEs in adipose tissue of women in California found that the levels of PBDEs were not correlated with age.[29] Studies in Sweden and Norway have also found that PBDE tissue levels were not correlated with age.[30, 31] This suggests that exposures to PBDEs have occurred recently, i.e. PBDEs have not accumulated in older people over time.

BDE-47 is the PBDE congener reported at the highest concentration in human tissues analyzed from the general population and in wildlife including fish, birds, and marine mammals. BDE-47 is the second most abundant congener in the Penta-BDE commercial mixtures (BDE-99 is the most abundant congener). Differences in uptake and excretion between Penta-BDE congeners may account for BDE-47 being found at the highest levels even though it is not the most abundant congener in the Penta-BDE products.[32] Penta-BDE-associated congeners, BDE-99, -100 and -153, have also been detected at higher levels than other PBDE congeners in general population samples. A recent report from the Faroe Islands, found BDE-153, instead of BDE-47, as the most abundant PBDE congener in breast milk samples.[33] Faroe island residents consume more seafood (pilot whale) than does the average U.S. citizen. The difference in congener levels suggests differences in exposure pathways.

[24] Schecter et al., 2003. Polybrominated diphenyl ethers (PBDEs) in U.S. mother's milk. Environmental Health Perspectives 111(14): 1723-1729.
[25] Petreas et al., 2003. High body burdens of 2,2',4,4'-tetrabromodiphenyl ether (BDE-47) in California women. Environmental Health Perspectives 111(9):1175-1179.
[26] Lind et al., 2003. Polybrominated diphenyl ethers in breast milk from Uppsala County, Sweden. Environmental Research 93:186-194.
[27] Tee et al., 2003. A longitudinal examination of factors related to changes in serum polychlorinated biphenyl levels. Environmental Health Perspectives 111(5):702-707.
[28] Meironyte Guvenius, et al., 2003. Human prenatal and postnatal exposure to polybrominated diphenyl ethers, polychlorinated biphenyls, polychlorobiphenylols, and pentachlorophenol. Environmental Health Perspectives 111(9):1235-1241.
[29] She et al., 2002. PBDEs in the San Francisco Bay area: measurements in harbor seal blubber and human breast adipose tissue. Chemosphere 46:697-707.
[30] Sjodin et al., 2003. A review on human exposure to brominated flame retardants – particularly polybrominated diphenyl ethers. Environment International 29:829-839.
[31] Thomsen et al., 2002. Brominated flame retardants in archived serum samples from Norway: a study on temporal trends and the role of age. Environmental Science & Technology 36:1414-1418.
[32] Hakk et al., 2003. Metabolism in the toxicokinetics and fats of brominated flame retardants – a review. Environment International 29:801-828.
[33] Fangstrom et al., 2004. A retrospective study of PBDEs in human milk from the Faroe Islands. Abstract presented at BFR 2004 Conference in Toronto Canada, June 2004.

Toxicity of PBDEs

Information on the possible health impacts of PBDEs comes primarily from animal toxicity studies. In general, these studies indicate that Penta-BDE commercial products, and specific PBDE congeners found in these products, are more toxic than Octa-BDE and Deca-BDE (i.e. Penta-BDE produces adverse effects in animals at lower levels than Octa-BDE or Deca-BDE) (Table 7). Doses (milligrams PBDE per kilogram bodyweight per day; mg/kg/day) at which health effects were observed in animal studies are provided to allow comparisons between PBDE products. An overview of health effects associated with each of the three flame retardant commercial products (Penta-BDE, Octa-BDE and Deca-BDE) is also provided below. Several recent reports and articles provide reviewsof available PBDE toxicity studies and are recommended as sources of additional background information.[34, 35, 36, 37, 38]

[34] Birnbaum et al., 2004. Brominated flame retardants: cause for concern? Environmental Health Perspectives 112(1): 9-17.
[35] Darnerud, 2003. Toxic effects of brominated flame retardants in man and wildlife. Environment International 29:841-853.
[36] Agency for Toxic Substances and Disease Registry. 2004. Toxicological Profile for Polybrominated Diphenyl Ethers. ATSDR, Atlanta GA.
[37] Environ. 2003. Voluntary Children's Chemical Evaluation Program Pilot (VCCEPP). Tier 1 Assessment of the Potential Health Risks to Children Associated with Exposure to the Commercial Pentabromodiphenyl Ether Product. CAS No. 32534-81-9. Prepared for Great Lakes Chemical Corporation. April 21. 2003; American Chemistry Council/Brominated Flame Retardant Industry Panel (BFRIP). 2002. Voluntary Children's Chemical Evaluation Program (VCCEP) Data Summary: Decabromodiphenyl ether (a.k.a decabromodiphenyl oxide, DBDPO) CAS # 1163-19-5. December 17, 2002.
[38] Environmental Protection Agency. 2005a. Voluntary Children's Chemical Evaluation Program: Data Needs Decision Document of Decabromodiphenyl Ether (DBDPO). Prepared by Risk Assessment Division (7403M), Office of Pollution Prevention and Toxics. June 2005; Environmental Protection Agency. 2005b. Voluntary Children's Chemical Evaluation Program: Data Needs Decision Document of Pentabromodiphenyl ether. Prepared by Risk Assessment Division (7403M), Office of Pollution Prevention and Toxics. June 2005; and Environmental Protection Agency. 2005c. Voluntary Children's Chemical Evaluation Program: Data Needs Decision Document of Octabromodiphenyl ether. Prepared by Risk Assessment Division (7403M), Office of Pollution Prevention and Toxics. June 2005.

Penta-BDE

Animal toxicity studies have been used to evaluate commercial Penta-BDE products (consisting of a mixture of PBDE congeners- see Table 2) and the predominant congeners in the commercial product (BDE-47 and BDE-99). Based on available studies, the toxicity endpoints of greatest concern are adverse effects on neurobehavioral development, thyroid hormone disruption and possibly liver toxicity. The most sensitive toxic effect (i.e. effect that occurs at the lowest dose) associated with Penta-BDE congeners appears to be developmental neurotoxicity. Impacts on brain function (including changes in behavior, learning and memory) have been observed in rodents exposed to Penta-BDE products either in the womb (*in utero*) or soon after birth (post-natally). Some of these effects persisted and worsened into adulthood. The lowest dose that produced developmental neurotoxic effects in these studies is 0.8 mg/kg.[39, 40, 41]

Exposure to Penta-BDE commercial products and BDE-99 has been shown to decrease thyroid hormone levels in rodents exposed *in utero* and after birth at doses of 1 mg/kg.[42] Adequate thyroid hormone levels are necessary for normal brain development *in utero* and post-natally.[43] In humans, the critical time of rapid brain growth occurs during the final trimester of pregnancy and extends after birth until the age of two years.[44] However, similar impacts on thyroid hormone levels have not been observed in humans and scientists are continuing to evaluate the relevance of bioassay results for predicting human health hazards. Penta-BDE may also impact other hormone systems, with estrogen-like activity being one possible mechanism.[45] Recent animal studies report impacts on both male and female reproduction, occurring at doses as low at 0.06 mg/kg. [46, 47]

No animal cancer studies have been conducted on the commercial PentaBDE product or the congeners present in the commercial mixture. PentaBDe has been found to be negative in several mutagenic tests. However, various congeners present in pentabromodiphenyl ether mixtures display dioxin-like activity (binding to the aryl hydrocarbon receptor (AhR)). ATSDR

[39] Eriksson et al., 2001. Brominated flame retardants: a novel class of developmental neurotoxicants in our environment? Environmental Health Perspectives 109(9):903-908.
[40] Eriksson et al., 2002. A brominated flame retardant, 2,2',4,4',5-pentabromodiphenyl ether: uptake, retention, and induction of neurobehavioral alterations in mice during a critical phase of neonatal brain development. Toxicological Sciences 67:98-103. The results from these studies have been questioned because littermates were considered to be independent observations for purposes of statistical analysis. Standard procedures use the litter (not the individual animal) as the basis for statistical analysis.
[41] Birnbaum et al., 2004. Brominated flame retardants: cause for concern? Environmental Health Perspectives 112(1): 9-17.
[42] Zhou et al., 2002. Developmental exposure to brominated diphenyl ethers results in thyroid hormone disruption. Toxicological Sciences 66:105-116.
[43] Zoeller et al., 2002. Thyroid Hormone, Brain Development, and the Environment. Environmental Health Perspectives 110(Supp. 3): 355-361.
[44] Meironyte Guvenius, 2003. Human prenatal and postnatal exposure to polybrominated diphenyl ethers, polychlorinated biphenyls, polychlorobiphenylols, and pentachlorophenol. Environmental Health Perspectives 111(9): 1235-1241.
[45] Birnbaum et al., 2004. Brominated flame retardants: cause for concern? Environmental Health Perspectives 112(1): 9-17.
[46] Talsness et al., 2003. Ultrastructural changes in the ovaries of adult offspring following single maternal exposure to low dose 2,2',4,4',5-pentabromodiphenyl ether. Organohalogen Compounds 61: 88-91.
[47] Kuriyama et al., 2003. Maternal exposure to low dose 2,2',4,4',5-pentabromodiphenyl ether (PBDE 99) impairs male reproductive performance in adult rat offspring. Organohalogen Compounds 61: 92-95.

(2004) observed: (1) binding affinities vary among PBDE congeners and measurement endpoints; (2) most environmentally prominent congeners display binding affinities that are 2 to 5 orders of magnitude lower than 2,3,7,8 TCDD; (3) influences of the ether bridge and bromine positions preclude classifying PBDE congeners as either dioxin like (coplanar) or non-dioxin-like (non-coplanar).

EPA (2004a) has published a chronic reference dose (0.008 mg/kg/day) for PentaBDE based on changes in liver enzymes. ATSDR (2004) has established several Minimal Risk Levels for lower brominated polybrominated diphenyl ethers (intermediate inhalation exposure (0.006 mg/m3 based on endocrine effects), acute oral (0.03 mg/kg/day) and oral intermediate exposure (0.007 mg/kg/day based on endocrine effects) chronic oral exposure (0.0008 mg/kg/day based on liver toxicity). Evaluations sponsored by the Great Lakes Chemical Corporation through EPA's Voluntary Children's Chemical Evaluation Program (VCCEP) included toxicity assessment which producted toxicological values based on thyroid effects (0.04 mg/kg/day) and developmental effects (0.07 mg/kg/day).

Octa-BDE

Octa-BDE and/or congeners present in the commercial mixture have been shown to be neurotoxic (Eriksson et al. 2004) and are able to disrupt the endocrine system (thyroid hormone levels) in animals (Zhou et al. 2001). Fetal toxicity has been identified as a sensitive toxic endpoint in rat and rabbit studies involving Octa-BDE.[48] Exposure in the womb resulted in bone malformations and decreased fetal weight in rat and rabbit offspring beginning at doses of 2 mg/kg with fetal death occurring at higher doses. Liver changes were also observed in animal studies following exposure to Octa-BDE products at 10 mg/kg or higher.[49, 50]

No animal cancer studies have been conducted on the commercial Penta-BDE product or the congeners present in the commercial mixture. Penta-BDE has been found to be negative in several mutagenic tests.

EPA (2004a) has published a chronic reference dose (0.003 mg/kg/day based on increased liver enzyme induction) for octa-BDE in the IRIS database. Environ (2002) reviewed available toxicological studies as part of the Voluntary Children's Chemical Evaluation Program (VCCEP) and calculated toxicity values for three non-cancer endpoints: reproductive/developmental effects (0.09 mg/kg/day based on decreases in maternal and fetal body weights); thyroid effects (0.09 mg/kg/day based on decreases in thyroid hormone (T4) levels and thyroid hyperplasia); and liver enzyme induction (0.003 mg/kg/day = IRIS RfD value).

Deca-BDE

[48] Darnerud, 2003. Toxic effects of brominated flame retardants in man and wildlife. Environment International 29:841-853.
[49] Health Canada, 2004. Screening assessment report – Polybrominated diphenyl ethers (PBDEs). Available at: http://www.hc-sc.gc.ca/hecs-sesc/exsd/screening_assessment.htm (accessed Sept. 2004).
[50] Darnerud et al., 2001. Polybrominated diphenyl ethers: occurrence, dietary exposure and toxicology. Environmental Health Perspectives 109(Supplement 1): 49-68.

BDE-209 is a large molecule and is generally considered to be less toxic than less-brominated congeners. Indeed, many of the concerns about BDE-209 are driven by its potential to degrade in the environment to less-brominated congeners. (The degradation of Deca-BDE is discussed in detail in Chapter IV and Appendix D.) In the past, researchers had thought that the molecule's size would prevent it from being absorbed into the body.[51] However, recent studies indicate that BDE-209 is partially absorbed from the gut of rats and has been found in human tissue samples indicating that some absorption occurs.[52]

Results from animal bioassays provide some evidence of toxic effects associated with exposure to BDE-209 including neurotoxicity[53, 54] , thyroid hyperplasia, liver toxicity and carcinogenicity. As noted above, the results of some of these studies have been questioned because of statistical design, relevance of animal test results for predicting human health hazards (e.g. relevance of thyroid effects in animals) and the high dose levels used in the animal bioassays. EPA (2004a) has published a chronic reference dose (0.01 mg/kg/day) for deca-BDE in the IRIS database. ATSDR (2004) has established a Minimal Risk Level for deca-BDE (oral intermediate exposure (10 mg/kg/day based on developmental effects)).

Deca-BDE is the only PBDE product that has been evaluated in rodent cancer studies.[55] The National Toxicology Program reported that dietary intake of Deca-BDE is associated with liver hyperplasia (considered to be a precursor of liver tumors) in rats and mice. This study has been criticized because of the high dose levels. Based on the results of this study, EPA classified this substance as possibly carcinogenic to humans. However, BDE-209 has not been shown to be mutagenic and the National Toxicology Program (NTP), the International Agency for Research on Cancer (IARC) and the Occupational Safety and Health Administration (OSHA) have not classified BDE-209 as a carcinogen.

[51] Birnbaum et al., 2004. Brominated flame retardants: cause for concern? Environmental Health Perspectives 112(1): 9-17.
[52] Sjodin et al., 2003. A review on human exposure to brominated flame retardants – particularly polybrominated diphenyl ethers. Environment International 29:829-839.
[53] Viberg et al., 2003. Neurobehavioral derangements in adult mice receiving decabrominated diphenyl ether (PBDE 209) during a defined period of neonatal brain development. Tox. Sciences 76: 112-120.
[54] Vijverberg et al., 2004. Letter to the Editor. Toxicological Sciences 79:205-206.
[55] NTP, 1986. Toxicology and carcinogenesis studies of decabromodiphenyl oxide (CAS. No. 1163-19-5) in F344/N rats and B6C3F1 mice (feed studies).

Table 7. Lowest observed effect levels in PBDE animal toxicity studies.

Associated PBDE product	PBDE congener or product	Endpoint	Duration/time of exposure (animal)	Lowest Observed Effects Level (mg/kg bodyweight/day)	Ref.
Penta-BDE	BDE-47	Developmental neurotoxicity	1 day/post-natal day 10 (rat)	0.8	56
	Penta product	Decreased thyroid hormone (exposure during development)	15 days/gestational days 6-20 (rat)	1.0	57
	BDE-99	Developmental reproductive effects	1 day/ gestational day 6 (rat)	0.06	58
Octa-BDE	Saytex 111[a]	Fetotoxicity	13 days/ gestational days 7-19 (rat)	2-5	59
	Octa-BDE product	Liver changes	28 days and 13 weeks (rabbit)	10	60;61
Deca-BDE	BDE-209	Developmental neurotoxicity	1 day/post-natal day 3 (mouse)	20.1	62
	Deca-BDE	Thyroid changes, liver and kidney effects and fetal death	30 days (rat)	80	63
	Deca-BDE	Cancer	103 weeks (rat and mouse)	1120 - 3200	64

Notes: mg/kg, milligram per kilogram bodyweight per day;
[a] Saytex 111 is an Octa-BDE commercial product.

[56] Eriksson et al., 2001. Brominated flame retardants: a novel class of developmental neurotoxicants in our environment? Environmental Health Perspectives 109(9):903-908.
[57] Zhou et al., 2002. Developmental exposure to brominated diphenyl ethers results in thyroid hormone disruption. Toxicological Sciences 66:105-116.
[58] Kuriyama et al., 2004. Developmental exposure to low dose PBDE-99: 1 – effects on male fertility and neurobehavior in rat offspring. Environmental Health Perspectives. Available online Nov. 4, 2004.
[59] Darnerud et al., 2001. Polybrominated diphenyl ethers: occurrence, dietary exposure and toxicology. Environmental Health Perspectives 109(Supplement 1): 49-68.
[60] Health Canada, 2004. Screening assessment report – Polybrominated diphenyl ethers (PBDEs). Available at: http://www.hc-sc.gc.ca/hecs-sesc/exsd/screening_assessment.htm (accessed Sept. 2004).
[61] Darnerud et al., 2001. Polybrominated diphenyl ethers: occurrence, dietary exposure and toxicology. Environmental Health Perspectives 109(Supplement 1): 49-68.
[62] Viberg et al., 2003. Neurobehavioral derangements in adult mice receiving decabrominated diphenyl ether (PBDE 209) during a defined period of neonatal brain development. Tox. Sciences 76: 112-120.
[63] Darnerud et al., 2001. Polybrominated diphenyl ethers: occurrence, dietary exposure and toxicology. Environmental Health Perspectives 109(Supplement 1): 49-68.
[64] Darnerud et al., 2001. Polybrominated diphenyl ethers: occurrence, dietary exposure and toxicology. Environmental Health Perspectives 109(Supplement 1): 49-68.

Comparing PBDE Effects Levels from Animal Studies to Estimates of Human Exposure

Environmental health agencies, including the U.S. EPA, rely on both animal and human toxicity studies to establish various criteria for the protection of human health. Key to the development of such criteria is the derivation of human exposure doses for specific chemicals below which adverse health effects are not expected. These so called "safe doses", as derived by EPA, are known as oral reference doses (RfDs). In order to provide adequate protection of health, toxic effects levels observed in animals or humans are divided by uncertainty (or safety) factors to give the lower, and more protective RfD. Factors of 10 to 10,000 are typically used to account for uncertainties when using animal toxicity data to derive an RfD. A nearly identical process is used by the Agency for Toxic Substances and Disease Registry (ATSDR) to set minimal risk levels (MRLs). It is the RfD, not the toxic effect level itself, that should be used to estimate whether or not exposure to a contaminant in the environment represents a potential health risk. The magnitude of the risk can be inferred by the degree to which the RfD is exceeded. Background information on safety factors and the derivation of RfDs can be found in several U.S. EPA guidance documents.[65, 66]

The levels at which toxic effects have been observed in animal studies for Penta-BDE congeners (Table 7) are between 10 to 1,000,000 times higher than estimates of daily human intake of total PBDEs (Table 6). Estimates of adult intake based on multiple sources of exposure have yielded higher intakes compared to estimates based on food intake only. For example, recent daily intake estimates based on diet, air and other sources range from 0.0002 – 0.0026 mg/kg/day for total PBDE (tetra to deca-BDE congeners) and 0.00004 – 0.0009 mg/kg/day for Penta-BDE congeners. This intake estimate for Penta-BDE congeners is between about 60 to 1,500 times lower than the lowest effect level reported from animal studies for BDE-99 of 0.06 mg/kg/day. This indicates that at least one study has predicted human intakes of Penta-BDE within the range of RfDs or MRLs that could be derived from existing animal studies. Newly emerging research will better define appropriate toxicity studies and human exposure estimates upon which new RfDs and MRLs can be derived.

Build Up of PBDEs in the Body

PBDEs, TBC ~~like PCBs,~~ can build up in the body and remain stored there for years. The term biological half-life, refers to how long it takes the body to excrete half of an accumulated amount.[67] Different PBDEs have different half-lives.[68] For BDE-47 and BDE-153, human half-lives of 2 to 26 years have been predicted, respectively[69] BDE-209 has a much shorter half-life, estimated to be about two days to one week in people, while the half-life estimated for BDE-183

[65] U.S. EPA, 2004. RfD Background Document. Available at: http://www.epa.gov/iris/rfd.htm. Accessed 12/20/04.
[66] U.S. EPA, 2002. A review of the reference dose and reference concentration processes. EPA/630/P-02/002F. Available at http://www.epa.gov/iris/RFD_FINAL[1].pdf.
[67] Casarett & Doull's Toxicology, 1996. C.D. Klaassen editor. McGraw-Hill Publishers, New York.
[68] Hakk et al., 2003. Metabolism in the toxicokinetics and fate of brominated flame retardants – a review. Environment International 29:801-828.
[69] Geyer et al., 2004. Terminal elimination half-lives of the brominated flame retardants TBBPA, HBCD, and lower brominated PBDEs in humans. Organohalogen Compounds 66:3867-3872.

is three months.[70] [71] Half-lives of tetra-, penta- and hexa-BDEs in rats are much shorter than for people and range from about 19 to 119 days.[72]

Many of the rodent toxicity studies described above, especially the studies evaluating developmental toxicity, involve exposing rodents to PBDEs for durations of a single day to weeks. However, people are most likely exposed to PBDEs continually from many sources resulting in a build up of many PBDEs over time. Therefore, the toxic effects levels presented in Table 7 are not directly comparable to most of the human exposure estimates presented in Table 6 because of differences in half-lives and exposure durations between rodents and people.

Body burden (i.e. accumulated amount of PBDEs in the body) is a better measure than daily intake when comparing rodent and human exposures. Body burdens will vary depending on the type of PBDE, the amount and duration of exposure, as well as on individual differences in absorption, metabolism and excretion. One recent report suggests that after adjusting for PBDE body burdens between rodents and humans, high-end human exposures appear to be approaching toxic effects levels observed in animal studies, mainly for Penta-BDE associated congeners.[73]

[70] Watanabe et al., 2003. Environmental release and behavior of brominated flame retardants. Environment International 29:665-682.
[71] Sjodin et al., 2003. A review on human exposure to brominated flame retardants – particularly polybrominated diphenyl ethers. Environment International 29:829-839.
[72] Hakk et al., 2003. Metabolism in the toxicokinetics and fate of brominated flame retardants – a review. Environment International 29:801-828.
[73] McDonald, 2004. Distribution of PBDE levels among U.S. women: estimates of daily intake and risk of developmental effects. Abstract presented at BFR 2004 Conference in Toronto Canada, June 2004.

Products Containing PBDEs at End-of-Life

IV. Degradation of Deca-BDE

IN BRIEF: Considerable scientific research on deca-BDE has been conducted in recent years (see scientific literature documented in Appendixes D and E). These studies have been conducted using a wide range of media (sediments, sewage sludge, and water) and conditions (aerobic, anaerobic, sunlight, UV light, etc). This section includes several studies that were not reviewed as part of the Interim CAP. The degradation of deca-BDE was evaluated in detail in laboratory studies[74] and in environmental samples[75]. In laboratory tests, deca-BDE was found to degrade to lower substituted PBDEs[76].

The relevancy of these results to conditions deca-BDE may experience in the environment has been questioned. Many of these concerns are legitimate and can only be addressed with additional research. As with many laboratory tests, conditions were often accentuated in order to determine chemical degradation and dynamics within a useful time period. {TBC note: This statement is speculation without substantiation. Science studies supplied by BSEF is directly counter to this assumption that laboratory studies can be extrapolated to the real environment. As agency staff has noted; much is unknown about Deca-bde modes of action or paths of exposure. } ~~However, the main difference between laboratory studies and the fate of deca-BDE in the environment is thought to be the rate at which these reactions occur. Therefore, the laboratory results provide valuable information to support the concern that deca-BDE breaks down in the environment~~.

Ecology and DOH also reviewed many, if not all, of the same technical articles included in the EU Risk Assessment and its two updates, and have monitored scientific progress since this document was initially published. While further research is needed, Ecology and DOH believe the following conclusions are appropriate.

1. Deca-BDE undergoes degradation TBC{in the laboratory}. The most common path in laboratory studies is the debromination of deca-BDE to lower PBDE species, i.e. PBDEs with lower numbers of bromines. Other products have been found in some studies including brominated dioxins, phenols and dibenzofurans. The impact these degradation products have upon human health and the environment is unquantified ~~but of concern~~.
2. Debromination of deca-BDE occurs through light exposure (both UV radiation and direct sunlight) and biological activity. These pathways lead to a variety of degradation products.
3. The rate of debromination has been determined in laboratories studies. Further work is needed to determine the debromination rate under environmental conditions. Degradation will occur in both situations although at different rates with degradation in the environment occurring more slowly~~. This phenomenon has been shown on compounds with similar chemical structure.~~

[74] Keum et al. (2005), Rahm et al. (2005), Parsons et al. (2004), Gerecke et al. (2004, 2005), Eriksson et al. (2004), Bezares-Cruz et al. (2004), Soderstrom, U. et al. (2003), Palm, W-U. et al. (2003), Olsman, H. (2002), see Appendix E for more details.
[75] La Guardia et al. (2004a), Gerecke et al. (2005), Sellstrom, et al. (2005) see Appendix B for more details.
[76] Keum and Li (2005), Bezares-Cruz, J. et al. (2004), Soderstrom, G. et al. (2003), Palm, W-U. et al. (2003), Ohta, S. et al. (2001), Jafvert, C. et al. (2001), Sellstrom, U. (1998), see Appendix B.

4. ~~Deca-BDE will continue to be a source of lower brominated diphenyl ethers and other degradation products for some time.~~TBC: {speculative as the products, extent and rates are unknown. Inclusion of this statement creates a unsubstantiated impress of long term harm when none can be demonstrated }

- {TBC} The following sections on degradation need to be carefully reviewed to remove or clarify speculative and unsubstantiated statements.

Photolytic Degradation

Photolytic degradation occurs when the energy from light is used to break chemical bonds. In the case of PBDEs, light (sunlight or UV radiation alone) can cause the molecule to debrominate or lose a bromine atom. A number of studies have demonstrated that photolytic degradation of PBDEs can occur, and that it can occur in a variety of circumstances including those that mimic environmental conditions.

In one study[77], the degradation of deca-BDE was evaluated using several solvents including those more typically found in the environment. For example, in addition to subjecting deca-BDE to both sunlight and UV radiation with a range of organic solvents, tests were conducted on deca-BDE in water both with and without humic acids as would be found in the environment. Deca-BDE was found to degrade via debromination under all test conditions. Control samples were used in all tests and degradation did not occur in the absence of light.

Sellstrom demonstrated that deca-BDE degrades relatively quickly when subjected to light[78]. These studies took place in a hydrogen rich environment provided by organic solvents and there was concern that the solvent used was affecting the degradation rate. As part of a later study, Sellstrom analyzed a single sample of biosolids amended farm soil but was unable to reproduce earlier laboratory results which indicated photolytic degradation of deca-BDE occurs.[79] These results need to be treated with caution as they represent only one sample and were conducted over a relatively short period of time (21 days.) Other evaluations have been conducted for much longer periods of time such as 40 to 238 days.

Another study was conducted in aqueous media with the addition of naturally occurring organics such as humic acid[80]. These studies proved that similar degradation occurred in aqueous media as with the organic solvents although at a slower rate. A study was also conducted on household dust samples which were spiked with deca-BDE and subjected to sunlight for a total of 90

[77] Eriksson et al., 2004, Photochemical decomposition of 15 polybrominated diphenyl ether congeners in methanol/water, Environ. Sci., Technol., 38, 3119-3125
[78] Sellstrom *et al.* (1998) and Tysklind *et al.* (2001)
[79] Sellstrom, et al., 2005 (?), Effect of Sewage-Sludge Application on Concentrations of Higher-Brominated Diphenyl Ethers in Soils and Earthworms, pre-publication from Environ. Sci. Technol.
[80] Soderstrom *et al.*, 2003, Photolytic debromination of decabromodiphenyl ether (BDE 209), Environ. Sci. Technol., 38, 112-119

hours.[81] Deca-BDE was observed to degrade to lower congeners along with other, unidentified products. Controls were also used and no degradation was observed in control samples not subjected to sunlight. Additional studies are being conducted by the author to expand upon the conclusions of this study and to address concerns raised with the analytical method.

Biological Degragdation

In addition to photolytic degradation, PBDEs can also degrade via biological mechanisms including microbial degradation and cellular metabolism.

In a new study, analysis of the inputs and outputs from a sewage plant anaerobic digester[82] indicated deca-BDE degraded to octa- and nona-BDEs. The analyses were conducted both with and without organic compounds that were believed to facilitate the degradation process. Deca-BDE degraded in both tests. Degradation was observed to occur at a slower rate in the samples without the organics. Control samples were also used and exhibited no degradation under sterilized conditions. These results agreed with data from laboratory studies reported in the same article.

The same authors also attempted to quantify deca-BDE degradation using inlet and outlet samples from an anaerobic digester operating in a wastewater treatment facility. Although an increase in possible degradation products was observed, deca-BDE degradation could not be confirmed.

Other Degradation Processes

Other degradation processes for PBDEs have been identified. Studies were conducted in aqueous media using a variety of reducing agents including iron, iron sulfide and a solution of sodium sulfide[83]. These tests were conducted to determine if the catalysts could be used to decontaminate deca-BDE polluted sites. The data showed that deca-BDE degrades rapidly to lower brominated compounds including many of the components of Penta-BDE. For example, over the full 40 days of the experiment, deca-BDE was found to degrade into BDE-47, -99, -100, -153 and -154[84], all of which are found in Penta-BDE. After 14 days, Deca-BDE concentrations were reduced as much as 90% for iron, 33% for sodium sulfide and 2% for iron sulfide.

Some concern was raised about the presence of these chemicals in the environment and the validity of comparing these test results to the fate of deca-BDE in the environment. Additional studies remain in this area to better approximate conditions actually experienced in the external environmental including the impact of small particles upon the attenuation of light, adsorption of the deca-BDE onto small particles and the presence of less favorable hydrogen donors.

[81] Stapleton, *et al.*, 2004. Debromination of Decabromodiphenyl Ether (BDE 209) in House Dust Following Sunlight Exposure, Report prepared for the Environment Agency, Chemical Assessment Section.
[82] Gerecke, et al., 2005, Anaerobic degradation of decabromodiphenyl ether, Environ. Sci. Technol., 39, 1078-1083
[83] Keum and Li, 2005, Reductive debromination of polybrominated diphenyl ethers by zerovalent iron, Environ. Sci. Technol., 39, 2280-2286
[84] Ibid, Table 2, page 2281

Degradation Products

In addition to the methods of breakdown, it is also important to understand what the breakdown products are in order to assess their toxicity. One hurdle which complicates deca-BDE degradation studies in the environment is the large amount of PBDE congeners already present from the commercial production and use of Penta- and Octa-BDEs. It is often difficult to determine contributions from deca-BDE degradation because of the large background concentrations from other PBDE mixtures. In addition, standards for many PBDE congeners do not exist and little is known about other possible degradation pathways which makes identification of degradation products difficult.

In laboratory tests where deca-BDE was subjected to direct sunlight, the debromination reactions continued to lower substituted PBDEs (tri, tetra and penta-BDEs)[85]. Very little degradation was found to include the mono- and di-BDEs. In one study[86], the degradation of deca-BDE was monitored in detail. Deca-BDE was found to degrade to nona- and octa-BDE congeners. One nona-BDE congener (BDE-208) increased in concentration by more than ten-fold (from below the quantitation limit to 0.15 nmole/bottle). A second nona-BDE (BDE-207) increased more than six-fold (from 0.024 to 0.16 nmole/bottle). Similarly, the amount of octa-BDE congeners increased from below the quantitation limit to 0.21 nmole/bottle.

The same study[87] evaluated the degradation of two nona-BDE congeners (BDE-206 and 207) separately from deca-BDE. Both nona-BDE congeners were found to debrominate to octa-BDEs. Insufficient tests were done to obtain a degradation rate for these compounds. Another study[88] conducted experiments with di-, tri-, tetra- and penta-BDEs. All were found to undergo debromination although the debromination rate was found to decrease with decreasing number of bromines.

Another recent study[89] evaluated the degradation of deca-BDE in house dust. When subjected to a total of 90 hours of direct sunlight, the deca-BDE in the samples lost approximately 30% of its total mass and a corresponding increase was found in nona-, octa- and hepta-brominated congeners. Evaluation of the mass balance for the reaction indicated that 17% of the total mass could not be accounted for. The author suggested this was due to the generation of unknown compounds and/or loss due to volatilization.

These findings agree with the chemistry of other compounds with high electron densities such as deca-BDE. In compounds such as these, bromine radicals (bromine atoms that, due to presence of an unpaired electron, are extremely reactive and exist only for a short period of time) typically exit the compound with a minimal impact upon the electron density of the remaining structure. Electron density is an evaluation of the amount of electrons present in a compound. Deca-BDE has a high electron density due to the presence of ten bromine atoms. Bromine atoms have a

[85] Eriksson et al. (2004) and Bezares-Cruz et al. (2004)
[86] Gerecke, et al. (2004 and 2005)
[87] Ibid.
[88] Keum and Li, 2005, Reductive debromination of polybrominated diphenyl ethers by zerovalent iron, Environ. Sci. Technol., 39, 2280-2286
[89] Stapleton, 2005, Degradation of Decabromodiphenyl Ether (BDE 209) in House Dust Following Sunlight Exposure, Report for the Environment Agency, Chemical Assessment Section

large number of electrons (35) compared with carbon (6) and oxygen (8). Deca-PBDE, therefore, has 430 total electrons. The exit of one bromine radical has a small impact on the relative number of electrons in the compound (the nona-BDE congeners have 396 electrons for an 8% reduction in electron density from deca- to nona-BDE). The percentage reduction increases with each bromine removal.

As more bromine radicals exit the compound, subsequent debromination reactions occur at a slower rate. The rate of debromination would be highest (fastest) for electron rich compounds such as deca-BDE and would decrease with each subsequent debromination. The debromination rate would be lowest (slowest) for compounds such as mono- and di-BDE as these compounds have the lowest electron density of any of the PBDEs. This agrees with laboratory studies which indicated deca-BDE is chemically susceptible to debromination reactions.[90]

Many studies were able to account for only a percentage of the total degradation products, usually within 40-50%[91]. Several reasons were proposed including: 1) insufficient standard availability for all 209 PBDEs which prevented identification of all PBDEs created in the degradation process, 2) generation of other compounds for which no standard exists, 3) formation of bound (non-extractable) deca-BDE residues, and 4) imprecision in the analytical procedures used.

Evidence exists for reaction pathways other than debromination and replacement of bromine with hydrogen. Degradation products have been observed in which methoxy (CH_3-O- or methanol based) and exothy (CH_3CH_2-O- or ethanol based) groups have replaced one of the bromine atoms forming oxygenated PBDEs. Other compounds containing oxygen are also theorized. Additional studies have indicated the presence of brominated dibenzofurans[92], brominated phenols[93], and potential brominated dioxins[94]. However, the exact structure and composition of many of the decomposition products remain unknown.

Studies have demonstrated that deca-BDE degrades relatively quickly when subjected to light[95]. These studies took place in a hydrogen rich environment provided by organic solvents and there was concern that the solvent used was affecting the degradation rate. Additional studies have been conducted in aqueous media with the addition of naturally occurring organics such as humic acid[96]. These studies proved that similar degradation products were produced in both aqueous media and organic solvents although the aqueous degradation occurs at a slower rate.

In addition, attempts were made to determine whether deca-BDE degradation could be observed from soil and sediment samples taken in the vicinity of facilities either using or producing deca-

[90] Rahm, S. et al., 2005, Hydrolysis of environmental contaminants as an experimental tool for indication of their persistency, Environ. Sci. Technol., 39, 3128-3133
[91] Keum et al. (2005) and Parsons et al. (2004)
[92] Soderstrom, G. et al. (2003), Palm, W-U. et al. (2003), Eriksson, J. et al. (2001)
[93] Orn, U., 1997, Synthesis of polybrominated diphenyl ethers and metabolism of 2,2',4,4'-tetrabromo (14C) diphenyl ether, Thesis, Dept. of Environ. Chem., Stockholm University
[94] Olsman, H. et al., 2002, Formation of dioxin-like compounds as photoproducts of decabromodiphenyl ether (DEBDE) during UV-irradiation, Organohalogen Compounds, 58, 41-44
[95] Sellstrom et al. (1998) and Tysklind et al. (2001)
[96] Soderstrom et al., 2003, Photolytic debromination of decabromodiphenyl ether (BDE 209), Environ. Sci. Technol., 38, 112-119

BDE[97]. Core samples were analyzed to determine if any deca-BDE degradation could be measured over time. The results of this study were inconclusive. The samples indicated a wide range of PBDEs including many of the congeners thought to be deca-BDE degradation products. However, no statistically significant relationship could be identified between deca-BDE and possible degradation products. Therefore, no conclusion on the degradation of deca-BDE could be obtained. It was suggested that the manufacture and release of substantial amounts of Penta- and Octa-BDE may have masked any deca-BDE degradation products and would make determination of deca-BDE degradation in the environment difficult, if not impossible to determine.

Concern has been raised that deca-BDE will remain a long-term source of lower substituted PBDEs[98]. Potential degradation products include other PBDEs such as lower brominated congeners found in Penta-BDE which have been proven to have a greater environmental impact and are known to bioaccumulate, biomagnify and have greater toxicity. As it has been shown that deca-BDE does degrade readily under laboratory conditions, deca-BDE will also degrade in the environment with time. Therefore it is likely deca-BDE will remain a constant source of lower substituted PBDEs and other degradation products over time.

[97] La Guardia et al., 2004, Environmental Debromination of Decabrominated diphenyl ether, Abstract from "Third International Workshop on Brominated Flame Retardants, BFR2004", University of Toronto, Canada, June 6-9, 2004.
[98] Parsons, J. et al. 2004, Eriksson, J. et al. 2001, Stapleton, H. 2005

V. PBDEs and the Regulatory Environment

IN BRIEF: Industry voluntarily ceased manufacture of Penta and Octa-BDE in December 2004. U.S. EPA followed this action with a proposed Significant New Use Rule (SNUR) that will require notification of, and evaluation by, EPA of any new use of Penta or Octa-BDE.

The EPA is developing a rule to complement a national flammability standard for residential upholstered furniture under consideration by the Consumer Product Safety Commission. The rule would require notification to, and review by the EPA of Deca-BDE and 15 other flame retardant chemicals or categories of chemicals likely to be used on furniture fabrics.

Several U.S. states and the European Union have taken action on PBDEs, including manufacturing bans on Penta and Octa-BDE. Actions on Deca-BDE have not included restrictions on manufacturing.

The following section provides an overview of existing regulatory requirements and proposed actions governing PBDEs at the state, federal and international levels. Activities other than those identified below may also exist.

Washington State Overview

Only one Washington State regulation was identified that pertains to PBDEs, WAC 173-303-100, Dangerous Waste Regulations, Persistence Criteria. The regulation describes methods for determining whether a solid waste is a dangerous waste based on toxicity and/or persistence. Persistent constituents are defined as chemical compounds which are either halogenated organic compounds (HOC), or polycyclic aromatic hydrocarbons (PAH). PBDEs are HOCs. Under these criteria, many products containing PBDEs would probably be considered dangerous waste at end-of-life.

Federal Overview

Toxics Release Inventory

Deca-BDE is the only one of the commercial PBDE formulations for which reporting is required for the U.S. EPA's Toxic Release Inventory (TRI). TRI is a publicly available EPA database that contains information on toxic chemical releases and other waste management activities reported annually by certain covered industry groups as well as federal facilities. This inventory was established under the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) and was expanded by the Pollution Prevention Act of 1990. Covered industry groups and federal facilities that dispose of more than 10,000 pounds of Deca-BDE annually are required to report how much they discard. Only one facility in Washington has reported on the use of Deca-BDE under TRI. The company operating the facility, Matsushita, has stated an intent to phase out the use of all PBDEs.

Toxic Substances Control Act

In November 2003, the Great Lakes Chemical Corporation (now Chemtura) agreed to phase out use of Penta and Octa-BDE by the end of 2004. On December 6, 2004, EPA proposed a Significant New Use Rule (SNUR) under Section 5 of the Toxics Substances and Control Act (TSCA) requiring manufacturers and importers to notify EPA at least 90 days before commencing the manufacture or import of Penta-BDE or Octa-BDE on or after January 1, 2005. The required notice would provide EPA with the opportunity to evaluate any intended new use and associated activities and, if necessary, to prohibit or limit that activity before it occurs. The proposed rule would not prohibit the import of products containing Penta-BDE or Octa-BDE (e.g., mattresses, upholstered furniture).

All three PBDE formulations must be tested for dioxin and furan contamination under EPA's 1987 TSCA Section 4 Dioxin/Furan Test Rule (40CFR 766).

EPA is also developing a rule under TSCA to complement a national flammability standard for residential upholstered furniture under consideration by the Consumer Product Safety Commission (CPSC). The rule would require notification to, and review by, EPA of 16 flame retardant chemicals or categories of chemicals, including Deca-BDE, identified by CPSC and industry as likely to be used to flame retard fabrics on furniture in order to comply with such a standard.[99]

Other Federal Activities

Industry-sponsored risk assessments for Penta, Octa and Deca-BDE were developed through EPA's Voluntary Children's Chemical Evaluation Program (VCCEP). VCEPP is an EPA effort to work with chemical manufacturers to provide more data on the potential health risks to children associated with certain chemical exposures. In September 2005, following review of the VCEPP documents, EPA requested manufacturers to voluntarily provide additional data on the fate and transport of Deca-BDE along with reproductive toxicity tests for Penta and Octa-BDE.[100]

In addition to VCEPP, EPA is sponsoring and conducting their own research on PBDEs within the Office of Research and Development. This research is aimed at determining PBDE levels in children, house dust, food, and breast milk; developmental and reproductive toxicity of PBDEs; and the environmental fate of PBDEs upon release or after disposal and incineration of electronic equipment. [101]

[99] Kenneth Moss, "BFR Regulatory Update" The Third International Workshop on Brominated Flame Retardants: BFR 2004 abstracts, p. 7.
[100] Ibid.
[101] Ibid.

EPA is currently re-assessing toxicity data for PBDEs in order to update existing reference doses and/or cancer assessments on their Integrated Risk Information System. The new assessment is expected to be released for external review in December 2005.[102]

The furniture manufacturing industry and EPA's Design for the Environment Program have initiated a partnership to explore a variety of approaches to achieve environmentally sound fire protection. Approaches include identifying and evaluating environmentally preferable flame retardants and identifying and evaluating technological barriers to sustainable design as well as alternative formulations for foam.[103]

The Interagency Working Group on Fire and Materials (IWGFM), formed in 1993, is a group of federal scientists and engineers from over 40 agencies that implements coordinated, long-range, national research efforts to understand the fire and thermal behavior of materials and develop advanced materials with improved performance.[104] IWGFM objectives are:

- Develop uniform test procedures for fire performance evaluation of materials for consideration by government agencies
- Provide a mechanism to coordinate and communicate among government/ industry/ university research activities
- Analyze current research, development and technology in light of present and projected national needs
- Advance defense/ civilian agency dual-use objectives
- Promote research and development of advanced fire-safe materials by strengthening the case for more government and industrial funding.

- TBC: Suggest this be moved to an appendix. The political activities in other states are fluid and will change quickly. Thus, this section will be out of date by the next legislative session. Since these actions have no direct affect on a risk assessment for Washington State they are interesting; but not relevant to the debate.

Other States: Overview

California

In August 2003, the California State Legislature passed AB 302, which prohibits, on and after January 1, 2008, a person from manufacturing, processing, or distributing in commerce a product containing more than one-tenth of 1% Penta-BDE or Octa-BDE, by mass.[105] In 2004, the

[102] Integrated Risk Information System. IRIS Chemical Assessment Tracking System at http://cfpub.epa.gov/iristrac/index.cfm. US Environmental Protection Agency. Accessed November 2005.
[103] Design for the Environment at http://www.epa.gov/dfe/. US Environmental Protection Agency. Accessed November 2005.
[104] Interagency Working Group on Fire and Materials (IWGFM) at http://www.dt.navy.mil/sur-str-mat/fun-mat/fir-pro-sea/int-wor-gro/. Naval Surface Warfare Center, Carderock Division. Accessed November 2005.
[105] State of California Legislative Counsel, http://www.leginfo.ca.gov/, viewed 15 September 2004. See http://www.leginfo.ca.gov/pub/bill/asm/ab_2551-2600/ab_2587_bill_20040921_chaptered.pdf for the text of the law

California State Legislature passed into law AB 2587, which moves the date of the California ban from 2008 to June 1, 2006.[106]

As required by AB 302, in June 2004 the Senate Office of Research submitted a report entitled "Polybrominated Diphenyl Ethers (PBDEs): Potential Hazards from Deca-BDE and Unresolved Issues from AB 302" to the President Pro Tempore of the Senate and the Senate Environmental Quality Committee. The report stated that, based on the "likely potential harm to humans posed by Deca-BDE and the known human exposures to this chemical, it does not appear that human exposure to Deca-BDE is occurring at a level that is likely to be unsafe for human health or development." The report concluded that, at this time, it would be premature to add Deca-BDE to the list of banned PBDEs contained in AB 302.[107]

The report went on to state that, because of inherent problems in extrapolating from rodent studies to human effects and the limited data on human exposure, it was not possible to say that Deca-BDE does not pose a danger to human health. Rather, the data available does not conclusively show that there is a danger to human health at this time. While the potential breakdown of Deca-BDE is mentioned in the body of the report, potential breakdown products are not referenced in the conclusion or its rationale. [108]

The report recommends that California's Office of Environmental Health Hazard Assessment set a reference dose for Deca-BDE based on the level in human tissue that would represent an unsafe level. It also recommends that the state create a breast milk monitoring program. [109]

Proposed Legislation:

In June 2005, the California Assembly passed AB 263, which imposes civil penalties of a minimum of $10,000 for violating the existing statutory ban on Penta-BDE and Octa-BDE, scheduled to start June 1, 2006, on the manufacture, processing or commercial distribution of any product containing any significant amount of pentabrominated diphenyl ether (Penta-DBE) or Octa-DBE. [110]

Connecticut

Proposed Legislation:

In June 2005, the Connecticut State Senate passed SB785. This bill prohibits the sale of the penta and octa mixtures of polybrominated diphenyl ethers and requires study of the relevant risk

[106] Official California Legislative Information, http://www.leginfo.ca.gov/pub/03-04/bill/asm/ab_2551-2600/ab_2587_bill_20040921_chaptered.pdf, viewed 30 November 2004
[107] Wiley and McCarthy, 2004. Polybrominated Diphenyl Ethers (PBDEs): Potential Hazards from DecaBDE and Unresolved Issues from AB 302. California Senate Office of Research.
[108] Wiley and McCarthy, 2004. Polybrominated Diphenyl Ethers (PBDEs): Potential Hazards from DecaBDE and Unresolved Issues from AB 302. California Senate Office of Research.
[109] Wiley and McCarthy, 2004. Polybrominated Diphenyl Ethers (PBDEs): Potential Hazards from DecaBDE and Unresolved Issues from AB 302. California Senate Office of Research.
[110] See California Assembly at: http://www.leginfo.ca.gov/pub/bill/asm/ab_0251-0300/ab_263_bill_20050414_amended_asm.pdf

assessments relating to the deca mixtures of polybrominated diphenyl ethers. SB785 passed from the Senate to the House on June 4, 2005, where it awaits further action.[111]

Hawaii

In June 2004, Hawaii enacted HB2013/SD2/CD1, which prohibits the manufacture, processing, or distribution of a product or flame-retarded part of a product containing more than 0.1% by mass of Penta-BDE, Octa-BDE, or any other chemical formulation that is part of these classifications, on or after January 1, 2006.[112]

Illinois

In July 2005, Illinois HB2572 was signed into law. The new law creates the Brominated Flame Retardant Prevention Act and provides that effective January 1, 2006 a person may not manufacture, process, or distribute in commerce a product, or a flame-retarded part of a product containing more than one-tenth of 1% of Penta-BDE or Octa-BDE by mass. The law includes exemptions for the sale of used penta- or octa-containing products by businesses, charities, or private parties; the distribution of original equipment replacement service parts manufactured prior to January 1, 2006, and for the processing of recyclables containing Penta- or Octa-BDE in compliance with applicable state and federal laws. The law does not restrict a manufacturer, importer, or distributor from transporting products containing PBDEs through the state or from storing PBDEs in the state for further distribution [113].

The law also requires that by January 2, 2006, the Illinois Environmental Protection Agency shall submit to the General Assembly and the Governor a report that reviews the latest available scientific research to address certain issues related to the effects of Deca-BDE. The Illinois Department of Public Health is required to submit by February 28, 2006 a report to the General Assembly and the Governor a report that reviews the Illinois Environmental Protection Agency's Deca-BDE study[114.]

Maine

In April 2004, Maine enacted legislation [PL 2003, c 629] to reduce contamination from PBDEs. Section 1 of the bill prohibits the sale of products that contain more than 1% Penta-BDE or Octa-BDE beginning January 1, 2006. Section 2 expresses the intent of the Legislature to reduce risks associated with Deca-BDE either by implementing risk management measures or by prohibiting the sale of products that contain more than 1% Deca-BDE beginning January 1, 2008, provided a safer, nationally available alternative is identified. To assist the Legislature in deciding which if either of these strategies to pursue, the Department of Environmental Protection is required to review emerging information on PBDEs and other BFRs, including information on alternatives

[111] See: http://www.cga.ct.gov/asp/cgabillstatus/cgabillstatus.asp?selBillType=Bill&bill_num=SB00785&which_year=2005
[112] Hawaii State Legislature, http://www.capitol.hawaii.gov/, viewed 1 September 2004.
[113] See "Illinois General Assembly, Full Text of Public Act 094-0100 at: (http://www.ilga.gov/legislation/publicacts/fulltext.asp?Name=094-0100&print=true.
[114] Ibid.

to Deca-BDE, and report annually to the Legislature's Committee on Natural Resources beginning January 5, 2005.[115, 116]

Maryland

In May 2005, the State of Maryland enacted HB83, which prohibits, on or after October 1, 2008, the manufacture, processing, sale, or distribution in the State of a product or flame-retardant part of a product that contains more than a specified amount of Penta- or Octa-brominated diphenyl ether. In addition, the law also requires that on or before January 8, 2007, the Maryland Department of Environment must report on the use of Deca-BDE and recommend restrictions on its use and sale[117].

Massachusetts

Bills H 2275/S 1268 relate to alternatives to the use of toxic chemicals. PBDEs are included on the list of chemicals to be phased out. The bills were heard in September 2003 in the Joint Committee on Natural Resources and Agriculture and were eligible for Executive Session.

Deca-BDE is subject to the Massachusetts Substance List. [118]

Michigan

On January 3, 2005, Michigan enacted HB 4406, and SB 1458, Public Acts 562 and 526 respectively, which amend Michigan's Natural Resources and Environmental Protection Act[119]. The laws ban, as of June 1, 2006, the manufacture, process, or distribution of products or materials containing more than 1/10 of 1% of penta-BDE. The law includes exemptions for original equipment manufacturer parts, or the processing of recyclables containing Penta- or Octa-BDE in compliance with applicable state and federal laws. SB 1458 also authorizes the Michigan Department of Environmental Quality to establish a PBDE advisory committee to review scientific information gathered on PBDEs, specifically on Deca-BDE. Should new information indicate a significant risk for human health and the environment, the Department will advise the legislature of the risk for possible action[120].

New Jersey

[115] Maine State Legislature, http://janus.state.me.us/, viewed 29 April 2004.
[116] pers. comm., J. James, Maine DEP, to C. Peele, 3 December 2004.
[117] See Maryland House Bill 83at: (http://mlis.state.md.us/2005rs/billfile/HB0083.htm)
[118] Great Lakes Chemical Corporation, Material Safety Data Sheet for Great Lakes DE-83R and DE83, viewed at http://www.greatlakes.com/common/msdspdf/00001.pdf on March 29, 2004.
[119] See Michigan House Bill 4406 and Senate Bill 1458 at http://www.michiganlegislature.org
[120] Michigan Department of Environmental Quality. About the Air, Volume 13, Issue 1, January 2005. Available at http://www.deq.state.mi.us/documents/deq-aqd-air-aqe-newlt-jan05.pdf, viewed November 22, 2005

Deca-BDE is subject to the New Jersey Right to Know Hazardous Substance List (1 percent reporting limit). [121]

New York

In August 2004, New York enacted A 10050/S 7621, which prohibits the manufacture, process, or distribution of brominated flame retardants, specifically penta- and octa-BDE, but does not prohibit the use or sale of such products. The bill also establishes a Task Force on Flame Retardant Safety to study the risks associated with Deca-BDE and the availability, safety and effectiveness of alternatives to Deca-BDE.[122]

Oregon

In 2005, the Oregon legislature approved SB 962, a bill to phase out the use of Penta-BDE and Octa-BDE. The legislation also included a provision to study the effects of Deca-BDE[123.]

Pennsylvania

Deca-BDE is subject to the Pennsylvania Environmental Hazard List.[124]

- TBC: Same comment as for states. Move to appendix or independent document that can be referenced. The appendix or document can be updated as needed to reflect the latest political decisions in international discussions.

International Overview

European Union

The European Union currently has two main laws which regulate the market and use of PBDEs in Europe. Directive 2003/11/EC of February 6, 2003, passed by the European Parliament and European Council, banned the marketing and use of Penta-BDE and Octa-BDE as of August 15, 2004.[125] In January 2003, the European Parliament and the Council of the European Union passed Directive 2002/95/EC, "Restriction of Certain Hazardous Substances to Electrical and Electronic Equipment" (RoHS), which lists the substances which are to be phased out of electrical and electronic equipment by July 1, 2006. The list includes Polybrominated Diphenyl Ether (PBDE) flame retardants, among them Penta-, Octa-, and Deca-BDE.

[121] Great Lakes Chemical Corporation, Material Safety Data Sheet for Great Lakes DE-83R and DE83, viewed at http://www.greatlakes.com/common/msdspdf/00001.pdf on March 29, 2004.
[122] New York State Assembly, http://assembly.state.ny.us/leg, viewed 8 October 2004.
[123] See Oregon Legislature Web Page at: (http://www.leg.state.or.us/05reg/measpdf/sb0900.dir/sb0962.en.pdf)
[124] Great Lakes Chemical Corporation, Material Safety Data Sheet for Great Lakes DE-83R and DE83, viewed at http://www.greatlakes.com/common/msdspdf/00001.pdf on March 29, 2004.
[125] Amendment 24 to Council Directive 76/769/EEC. Available at http://europa.eu.int/comm/enterprise/chemicals/legislation/markrestr/amendments_en.htm, viewed October 12, 2005.

The Directive also states that the European Commission Joint Research Center (a research based policy support organization located within the European Commission) should evaluate applications for Deca-BDE to establish whether the Directive should be amended, i.e., certain applications of Deca-BDE should be exempted from the ban. The human health risk assessment was to be completed by France and the environmental risk assessment by the UK.

In February 2004, France completed the Human Health Draft of the Draft Update Risk Assessment for Deca-BDE within the framework of the Existing Substances Regulation (793/93 EEC). This portion of the risk assessment drew one conclusion on Deca-BDE, with regard to neurotoxicity. The Draft Update concluded that there is at present no need for further information and/or testing or for risk reduction measures beyond those which are being applied already.[126]

In May 2004, the United Kingdom completed the Final Environmental Draft of the Draft Update Risk Assessment for Deca-BDE. It concluded that there is need for further information and/or testing with regard to the assessment of Deca-BDE to be persistent, bioaccumulative, and toxic. The study also concluded that further information and testing are necessary to monitor the possible formation of more toxic and bioaccumulative products that may result from the degradation of Deca-BDE. However, the study concluded that further risk reduction measures are not currently necessary for Deca-BDE.[127]

In March 2005, the Scientific Committee on Health and Environmental Risks (SCHER), a committee of physicians and professors who serve an advisory role within the European Commission, released their opinion on the May 2004 Environmental Risk Assessment completed by the UK. Although the SCHER states that the update is well done, they disagree with the recommendation that risk reduction measures are not currently necessary. The SCHER concludes that,

> *Emissions of DeBDE [Deca-BDE] to the environment may constitute serious problems in the future. If formation of lower brominated, bioaccumulating substances take place this process can go on for a very long time and there are no possibilities to stop it. The previous scientific committee (CSTEE[128]) said that the uncertainties in the fate of Deca-BDE warrant risk reduction measure. Today there is further evidence for degradation of this substance to potentially harmful compounds and SCHER also strongly recommends risk reduction measures (conclusion iii).*[129]

Following the release of the SCHER opinion in March 2005, the European Commission Joint Research Center authored a second update to the May 2004 Environmental Risk Assessment.

[126] European Commission Joint Research Center, 2004. Update of the risk assessment of Bis(Pentabromophenyl) Ether (Decabromodiphenyl Ether): Human Health Draft of February 2004.
[127] European Commission Joint Research Center, 2004. Update of the risk assessment of Bis(Pentabromodiphenyl) Ether (Decabromodiphenyl Ether): Final Environmental Draft of May 2004.
[128] CSTEE: European Commission's Scientific Committee on Toxicity, Ecotoxicity, and the Environment
[129] SCHER, 2005. "Opinion on 'Update of the Risk Assessment of bis(pentabromophenyl) ether (decabromodiphenyl ether),' final environmental draft of May 2004." Adopted by the SCHER during the 4th plenary of 18 March 2005.

While disagreeing with the conclusion of the SCHER that further risk reduction measures are necessary, the report incorporates the SCHER's recommendations for a regular review of any new information relating to Deca-BDE.[130] The report does discuss the need for further study of Deca-BDE, particularly the debromination of Deca-BDE to lower PBDE congeners which it cites as of "high concern" and notes that, "many of these substances [lower PBDE congeners] are considered to be "persistent, bioaccumulative, and toxic (PBT) or very persistent and very bioaccumulative (vPvB)."[131]

On April 19, 2005, the Technical Adaptation Committee for the RoHS Directive (a committee formed to make decisions on unresolved issues of the RoHS) met to vote on a draft Decision by the European Commission to exempt Deca-BDE from the RoHS Directive. Prior to the vote, some member states questioned whether a vote was appropriate due to continuing doubts regarding the environmental and human health impacts of Deca-BDE.[132] Nevertheless the vote proceeded and the Draft Decision passed, although the vote fell short of a qualifying majority of 72.3% and was passed on to the European Parliament and Council for scrutiny on June 6, 2005.

The European Parliament, upon receiving the Draft Decision, questioned whether the Commission had exceeded its implementing powers, and charged the Commission with ignoring findings of the May 2004 Environmental Risk Assessment and the March 18, 2005 SCHER opinion. On June 21, 2005, Parliament's Committee on the Environment, Public Health and Food Safety then proceeded by voting in favor of a resolution calling for the European Council to oppose the Draft Decision unless the Commission reconsidered the exemption of Deca-BDE.[133] The European Parliament followed suit on July 6, 2005 with the same resolution.[134] Despite the objections of members of the European Parliament, the European Council voted in favor of the exemption on September 2, 2005[135]. The Draft Decision to exempt Deca-BDE was then forwarded back to the Commission, adopted, and published on October 13, 2005[136]. The exemption of Deca-BDE will remain in effect for 5 years. Because of the controversy surrounding Deca-BDE, members from the European Union continue to meet on a quarterly basis to review new data and studies on Deca-BDE and the Commission may rescind the exemption at any point in the future.

Departments of Ecology and Health Communication with the European Commission

[130] European Commission Joint Research Center, 2005. Addendum to the May 2004 Environmental Risk Assessment Report for Decabromodiphenyl Ether: Draft 2005.
[131] *Ibid., p. 41*.
[132] UK Department of Trade and Industry. Unofficial Note of the Technical Adaptation Committee on the WEEE and RoHS Directives, Brussels, 19 April 2005. Available at http://www.dti.gov/uk/sustainability/weee/TAC_Unofficial_Note_April05.pdf, viewed August 23, 2005.
[133] European Parliament, Committee on the Environment, Public Health and Food Safety. Motion for a Resolution, B6-0392/2005. Posted June 22, 2005.
[134] European Parliament. "Flame Retardants: MEPs Challenge the Commission." From the EP Daily Notebook July 6, 2005.
[135]European Brominated Flame Retardant Industry Panel. "Status of Proposed RoHS Exemption for Deca-BDE, 14 September, 2005. Available at http://www.ebfrip.org/publications.html, viewed October 13, 2005.
[136] European Commission Decision 2005/717/EC, 13 October 2005. Published in the Official Journal of the European Union, October 15, 2005.

Much of the proceedings of the European Union are closed sessions, meaning that official transcripts are unavailable to the public. As a result, interpretations vary in how different branches of EU government have responded to the exemption of Deca-BDE from the RoHS. Throughout this process, Ecology and Health has kept in contact with Robert Donkers, a delegate of the European Commission to the U.S. He has articulated that the Commission will continue to monitor Deca-BDE closely and may withdraw the exemption at any time in the future if new findings arise that show Deca-BDE, or its products, to be harmful to humans or the environment.

Australia

Australia published an assessment of PBDEs in June 2001, conducted under its National Industrial Chemicals Notification and Assessment Scheme (NICNAS). The assessment recommended that, due to identified health and environmental effects of concern with some PBDEs, the lack of adequate data on others and their wide use, a full risk assessment be considered when hazard data is available from international assessments. The assessment further recommended that, on the basis of known hazards for specific PBDEs, material safety data sheets and other hazard communication materials be revised to reflect the information on hazards already available.[137] In June 2005, NICNAS listed Deca-BDE as a Priority Existing Chemicals and will undergo a full risk assessment, including an assessment of the degradation products of Deca-BDE, in particular octa- and penta-BDE.[138] The government is also conducting risk assessments on a number of chemical alternatives to Deca-BDE.[139]

Canada

Deca-BDE is listed on the Domestic Substances List [140] which includes substances that were, between January 1, 1984, and December 31, 1986, in Canadian commerce, used for manufacturing purposes, or manufactured in or imported into Canada in a quantity of 100 kg or more in any calendar year. The purpose of the List was to define what was "New to Canada;" it currently contains about 23,000 substances.[141]

In February 2004, Environment Canada released a Draft "Environmental Screening Assessment Report on Polybrominated Diphenyl Ethers (PBDEs)" for Public Comment. The draft proposes that PBDEs, including tetra-BDE, penta-BDE, hexa-BDE, hepta-BDE, octa-BDE, nona-BDE and deca-BDE, be considered "toxic" under section 64 of the Canadian Environmental Protection Act of 1999 (CEPA 1999). It further proposes that consideration be given to adding tetra-BDE, penta-BDE, and hexa-BDE to the Virtual Elimination List under CEPA 1999 and that that PBDEs, including tetra-BDE, penta-BDE, hexa-BDE, hepta-BDE, octa-BDE, nona-BDE,

[137] "Polybrominated Flame Retardants (PBFRs): Priority Existing Chemical Assessment Report No. 20" National Industrial Chemicals Notification and Assessment Scheme, June 2001.
[138] Australian Government Department of Health and Ageing NICNAS. "Current Australian Use and Regulatory Activities on Polybrominated Flame Retardants." Existing Chemicals Information Sheet, June 2005.
[139] Chemicals with assessments can be found on the NICNAS website, at http://www.nicnas.gov.au/publications/CAR/NEW/CARSORT.ASP?infReq=30. Viewed November 22, 2005.
[140] Great Lakes Chemical Corporation, Material Safety Data Sheet for Great Lakes DE-83R and DE83, viewed at http://www.greatlakes.com/common/msdspdf/00001.pdf on March 29, 2004.
[141] Environment Canada, "Existing Substances Evaluation: Domestic Substances List Categorization and Screening Program," www.ec.gc.ca, viewed 26 May 2005.

and deca-BDE, be considered as "Track 1" substances under the Toxic Substances Management Policy.[142]

The Virtual Elimination List is compiled by the Canadian Ministers of Environment and Health. The Ministers must specify the level of quantification for each substance on the List and, having done so, must prescribe the quantity or concentration of the substance that may be released into the environment either alone or in combination with any other substance from any source or type of source.[143] A "Track 1" substance is one that has been determined to be persistent, bioaccumulative, toxic and primarily the result of human activity and subsequently targeted for virtual elimination from the environment. This objective will be achieved by addressing sources of release to the environment or by removing or managing the substance if it is already in the environment.[144]

In February 2004, Health Canada released a "Screening Assessment Report- Health: Polybrominated Diphenyl Ethers (PBDEs) [Tetra-, Penta-, Hexa-, Hepta-, Octa-, Nona- and Deca- Congeners]". The report also proposes that, principally on the basis of environmental considerations, PBDEs as a group be considered "toxic" as defined in Section 64 of CEPA 1999.[145]

China

In 2002 China's Ministry of Information began drafting regulations entitled the "Management Methods for the Prevention and Control of Pollution from Electronics Information Products" (Methods). Among other chemicals, the Methods ban PBDEs in electronic information products. The list of products covered is still under development, as are standards for maximum tolerated thresholds and labeling requirements.[146] The regulations are often referred to as the "China RoHS" because they incorporate the substance regulations of the European Union's RoHS Directive, including those for PBDEs.[147] China's draft regulations differ from the RoHS however, in a series of requirements for the labeling of the toxic-substance content, material-content, recyclability, "safe-use", and point-of-origin of products manufactured and imported into China.[148]

Denmark

[142] Environment Canada, "Draft for Public Comments: Canadian Environmental Protection Act 1999 Environmental Screening Assessment Report on Polybrominated Diphenyl Ethers (PBDEs)" February 2004, p. 14.
[143] Environment Canada, "CEPA Environmental Registry Substances Lists: Virtual Elimination List" http://www.ec.gc.ca/CEPARegistry/subs_list/VirtualEliminationList.cfm, viewed 12 July 2004.
[144] Environment Canada, "Management of Toxic Substances: Track 1", http://www.ec.gc.ca/toxics/TSMP/en/track1.cfm, viewed 12 July 2004.
[145] Health Canada, "Screening Assessment Report- Health: Polybrominated Diphenyl Ethers (PBDEs) [Tetra-, Penta-, Hexa-, Hepta-, Octa-, Nona- and Deca- Congeners]", February 2004, p. 6.
[146] American Electronics Association, "AeA Update: International Environmental Regulations affecting High-Tech Companies," www.aeanet.org, viewed 4 May 2004.
[147] "Global Regulatory Policy Development and Implementation: Focus on China." Presentation at the IEEE International Symposium on Electronics in the Environment, New Orleans, May 17, 2005. Available at http://www.iaer.org/summit/presentation2005/Ferris.ppt, viewed November 22, 2005.
[148] *Ibid.*

The Danish Environmental Protection Agency published an "Action Plan for Brominated Flame Retardants" in 2001 to serve as the foundation for future regulation of brominated flame retardants in Denmark. The action plan states as one of its short-term objectives the phase-out of PBDEs. The plan outlines seven areas of activity to accomplish its objectives, including international regulation, international cooperation, national initiatives, build-up of knowledge, standardization, information activities and the support of cleaner production.[149]

Germany

Deca-BDE is not used on a voluntary basis in Germany by association-bound companies in the plastics and textile industry.[150] In 1989, the Chemical Industry Association and the Association of the Plastics Producing Industry, in a statement to the Federal Government, voluntarily agreed to discontinue the production and further use of PBDEs.[151]

Sweden

In May 2004, Sweden commissioned the national chemicals inspectorate, KemI, to draft plans for banning Deca-BDE, in advance of EU actions on Deca-BDE. KemI is considering a national ban on all brominated flame retardants and is examining risks associated with a number of other substances.[152] The recent EU exemption of Deca-BDE from the RoHS Directive will affect the government's support of a national ban, although the Swedish Chemicals Inspectorate has spoken out in opposition of the exemption of Deca-BDE from the EU RoHS.[153]

United Kingdom

The UK Environment Agency is currently conducting national risk assessments for chemicals that are possible alternatives to Deca-BDE, or are used with chemical alternatives, but have not yet been investigated at the international level (such as an EU risk assessment). Assessments are pending for a number of chemicals including Triphenyl phosphate (TPP), Diphenyl cresyl phosphate (DCP), and Resorcinol bis-diphenyl phosphate (RDP). Assessments will be published as they are completed.[154] The UK is also coordinating with the Organization for Economic Cooperation and Development (OECD) on production of an Emission Scenario Document (ESD) for plastic additives, a major sector of the industry for PBDEs and other flame retardants. The ESD would describe the source, production, process, pathways, and use patterns of plastic

[149] "Action Plan for Brominated Flame Retardants" Danish Environmental Protection Agency, March 2001, p. 7.
[150] A. Leisewitz, H. Kruse, and E. Schramm, "Substituting Environmentally-Relevant Flame Retardants: Assessment Fundamentals" Environmental Research of the Federal Ministry of the Environment, Nature Conservation and Nuclear Safety, June 2001, p. 74.
[151] Carsten Lassen, Søren Løkke, Lina Ivar Andersen, Brominated Flame Retardants: Substance Flow Analysis and Assessment of Alternatives, Danish Environmental Protection Agency, 1999, p. 122.
[152] Environment Daily 1662, 06/05/04
[153] "Sweden Opposes Exemption of the Flame Retardant Deca-BDE in Electronic Products." Swedish Chemicals Inspectorate, Press Release July 7, 2005. Available at http://www.kemi.se/templates/Page____2645.aspx, viewed November 22, 2005.
[154] See the UK Environment Agency at http://www.environment-agency.gov.uk/business/444304/444362/368813/379069/575663/578111/?version=1&lang=_e, viewed November 22, 2005.

additivies with the aim of quantifying emissions and concentration of a particular chemical into the environment.[155][156]

OECD

The Organization for Economic Cooperation and Development (OECD) is made up of 30 member countries, including the U.S., and has active relationships with about 70 other countries.[157] As part of the OECD's Risk Reduction Programme, a risk assessment of PBDEs, along with two other flame retardants, polybrominated biphenyls and tetrabromobisphenol A, was published in 1994. This led producers of PBB and PBDE to enter into a voluntary agreement with the OECD in 1995 to minimize the risk of production spills and for the industry to refrain from producing other PBDEs than those already on the market. Joint meetings between OECD and the industry oversee industry's implementation of the commitments.[158]

OSPAR Commission

The OSPAR Commission is made up of the countries that have ratified or approved the Convention for the Protection of the Environment of the North-East Atlantic (the "OSPAR Convention"). As of 2001, Belgium, Denmark, Finland, France, Germany, Ireland, Iceland, Luxembourg, Netherlands, Norway, Portugal, Sweden, Switzerland, and the United Kingdom had ratified the Convention, and the European Union and Spain had approved it. In 1998, the OSPAR Commission placed PBDEs on its "List of Chemicals for Priority Action."[159] An OSPAR Commission background document on PBDEs was reviewed by Sweden in 2001. The next full review of this document is not planned before 2008.[160]

POPS Treaty

The Stockholm Convention on Persistent Organic Pollutants is a global treaty to protect human health and the environment from persistent organic pollutants (POPs). The Convention outlines measures to reduce or eliminate releases from the intentional production and use of 12 chemical substances to be taken by nation states that become members of the Convention. PBDEs are not included. The Convention was adopted by a Conference of Plenipotentiaries on May 22, 2001, and entered into force on May 17, 2004, following ratification by 50 nations.[161]

[155] "Agency Information on Emissions and Environmental Levels of Flame Retardants." UK Environment Agency. Available at http://www.environment-agency.gov.uk/business/444304/444362/368813/379069/575663/, viewed November 22, 2005.
[156] "Emission Scenario Documents." Organization for Economic Development and Cooperation, http://www.oecd.org/document/46/0,2340,en_2649_34373_2412462_1_1_1_1,00.htm, viewed November 22, 2005.
[157] "About OECD" Organization for Economic Development and Cooperation, http://www.oecd.org/about/0,2337,en_2649_201185_1_1_1_1_1,00.html, viewed 13 July 2004.
[158] "Action Plan for Brominated Flame Retardants," Ministry of Environment and Energy Danish Environmental Protection Agency, English Translation, March 2001, p. 22.
[159] OSPAR Commission, "Certain Brominated Flame Retardants- Polybrominated Diphenylethers, Polybrominated Biphenyls, Hexabromo Cyclododecane" 2001
[160] OECD, "Brominated Flame Retardants (BFRs): Hazard/Risk Information Sheets" February 2004, http://www.oecd.org/dataoecd/53/60/32021808.pdf, viewed 12 July 2004.
[161] United Nations Environment Programme, "Stockholm Convention on Persistent Organic Pollutants (POPs), www.pops.int, viewed May 17, 2004.

The U.S. has signed the Stockholm Convention, but has not yet ratified it. A bill to implement the Convention in the US, S. 1486, was introduced by Senators Chafee and Jeffords on July 29, 2003, and reported from the Committee on Environment and Public Works by Senator Inhofe with amendments on April 29, 2004. Under S. 1486, if the "Conference of Parties," the organization of nations that have signed the Stockholm Convention, decides to add a chemical substance to the 12 initially covered, the United States will not automatically adopt the change. Instead, the EPA administrator will follow an independent process to determine whether and how the chemical substance will be restricted in the United States. On April 29, 2004, the bill was placed on the Senate Legislative Calendar under General Orders.[162] Ratification of the treaty would likely require amendments to both the Toxic Substances Control Act and the Federal Insecticide, Fungicide, and Rodenticide Act to meet the treaty obligations.[163]

Jim Willis, the head of the United Nations Environment Programme chemicals division, told Reuters that "brominated flame retardants are a possibility (for addition to the list) as are many other chemicals."[164] The Nordic countries are working together to nominate Penta-BDE as a POP candidate.[165]

[162] US Senate, "S. 1486" 108th Congress, Second Session, Calendar No. 481, thomas.loc.gov, viewed 17 May 2004.
[163] "The Road to U.S. Ratification of the POPs Treaty." US POPs Watch, http://www.uspopswatch.org/ratification/index.htm, viewed November 22, 2005.
[164] Alistar Doyle, "'Dirty dozen' toxins are banned by UN pact," The Guardian, 17 May 2004.
[165] OECD, "Brominated Flame Retardants (BFRs): Hazard/Risk Information Sheets" February 2004, http://www.oecd.org/dataoecd/53/60/32021808.pdf, viewed 12 July 2004.

VI. Alternatives

Evaluation of the persistence, bioaccumulation potential and toxicity of Deca-BDE and Deca-BDE alternatives

Information on each alternative was compiled using a standard toxicity profile template. The template used for this report was developed based on several templates included in existing flame retardants reports (EPA, 2005; German report, 2000; Danish EPA reports, 2000). Draft Toxicity Profiles for each alternative and related chemicals are provided in Appendix F.

Toxicity, persistence and bioaccumulation data for each alternative is summarized in Table 12. Table 12 includes information on the name of the chemical alternative, any synonyms, its identifying Chemical Abstract Service (CAS) number and the names of commercial products which contain the alternative. Table 12 also includes information on the polymers in which these alternatives are used. This assessment focuses on use of these alternatives in polymers for electronic enclosures. It is important to note that many of these flame retardants have uses in other products and materials not listed here. Table 12 also lists whether the chemical is used as an additive or reactive flame retardant.

Information from toxicity studies is also summarized in Table 12. Different potential human health effects (cancer, non-cancer effects, and mutagenicity) are ranked as low, medium or high (L, M or H) concern. The ranking of human health effects are based mainly on toxicity studies in laboratory animals since there is very little information on health effects in human studies for either Deca-BDE or the alternatives. In cases where there are no available toxicity studies for a health effect, "no information" (NI) is indicated in Table 12 instead of the L, M, or H rank. Concern related to ecotoxicity (mainly aquatic toxicity) is also ranked as L, M, or H depending on the results of toxicity studies for each alternative. Table 12 also includes a ranking for the amount of information available relative to toxicity and potential for human exposures.

- TBC: note the error on table 12 in listing Deca-bde as bioaccumulative and as a PBT. The sceicne and criteria do not support these listings.

In addition, Table 12 lists if the alternatives meet Ecology's PBT criteria. Both the environmental persistence and the bioaccumulation potential of each alternative is evaluated. Categories include "Yes", " No" or " NI" is listed in Table 12 to indicate whether or not the alternative meets Ecology's PBT criteria or if information is lacking (NI). The final column of Table 12 indicates whether the alternative meets Ecology's PBT criteria, listed as either Yes, No or NI. See Appendix G for further definitions of the terms and ranking criteria used for Table 12.

Table 12. Summary of use, persistence, bioaccumulation potential and toxicity information for Deca-BDE and Deca-BDE alternatives.

					Human Health Effects			Eco-toxicity					
	Deca and Alternative	Product name	Use	Reactive or Additive	Cancer hazard	Non-cancer effects	Muta-genicity	Acute or chronic	Amt of tox. info	Informa-tion on potential routes of exposure	Persist-ence	Bioaccum Potential	PBT
Halogen-containing													
1	Decabromodiphenyl ether (Deca-BDE) (CAS# 1163-19-5)	SAYTEX 102E, DE-83R	HIPS	Additive	L	M	L	NI	M-H	Yes	Yes (PBDEs)	Yes (PBDEs)	Yes[1]
2	Bis(pentabromophenyl) ethane (CAS# 84852-53-9)	SAYTEX 8010, Firemaster 2100	HIPS,ABS, PC/ABS	Additive	L	L	L	NI	L	Yes	NI (likely)	No	No
3	1,2-bis(tetrabromophthalimido) ethane (CAS# 32588-76-4)	SAYTEX BT-93 and BT-93W	HIPS,ABS, PC/ABS	Additive	L	L	L	L	L	NI	NI (likely)	No	No
4	Tetrabromobisphenol A epichlorohydrin polymer (brominated epoxy resin) (CAS# 40039-93-8)	EPON Resin 1163, STAREX	HIPS, Polystyrene	?	NI	L (NI)	L (NI)	NI	L	NI	NI	NI	NI
5	Bis(tribromophenoxy)ethane (CAS# 37853-59-1)	FF-680	Mainly ABS	Additive	L	L	L	L	L	NI	Yes	Yes	No
6	Hexabromocyclododecane (HBCD) (CAS# 3194-55-6 and 25637-99-4)	SAYTEX HP-900, -9006L, SP-75, CD-75P	Polystyrene foam	Additive	L (NI)	NI	L	M	L	Yes	Yes	Yes	Yes[1]
7	Tetrabromobisphenol A (TBBPA) (CAS# 79-94-7)	SAYTEX CP-2000, BA-59P	ABS, HIPS	Additive in HIPS	L	M	L	H	M	Yes	Yes	Yes	Yes[1]
8	Tetrabromobisphenol A bis(2,3-dibromopropyl ether)(CAS# 21850-44-2)	SAYTEX HP-800A, -800AG, -800AGC, PE-68, 403AF	Polyprop-ylene	Additive	M	L	H	NI	L	NI	NI	Yes	NI
Non-halogen													
9	Resorcinol bis (diphenylphosphate) (RDP) (CAS# 57583-54-7)	FyrolflexRDP, Reofos RDP	HIPS/PPO, PC/ABS	Additive	NI	L	NI	M	L	NI	No	No	No
10	Bisphenol A diphosphate (BAPP, BPADP) or Bisphenol A bis(diphenyl phosphate) (BDP) (CAS# 181028-79-5 and 5945-33-5)	Reofos BAPP FyrolflexBDP, NcendX P-30	HIPS/PPO, PC/ABS	Additive	NI	L	L	L	L	NI	Yes	NI	NI
11	Diphenyl cresyl phosphate (DCP) (CAS# 26444-49-5)	?	Maybe HIPS/PPO	Additive	NI	M	L	M	L-M	Yes	Yes	Yes	Maybe (NI)
12	Triphenyl phosphate (TPP) (CAS# 115-86-6)	Used w/ RDP at ~5-6%	HIPS/PPO, PC/ABS	Additive	L	L-M	L	M-H	L-M	Yes	No	No	No
Related chemicals													
13	Zinc Borate (CAS# 1332-07-6)	Firebrake ZB-467, -112, -237, -100	Synergist for use in HIPS	Additive	NI	L	NI	M-H	L	Yes	NI	NI	NI (un-likely)
14	Polytetrafluoroethylene (PTFE) (CAS# 9002-84-0)		anti-drip agent	?	NI	H	NI	H	M	Yes (if heated)	NI	NI	NI
15	Antimony trioxide (CAS# 1309-64-4)	TMS/Timonox Red Star,	Synergist w/ BFRs	Additive	L-M	L	M-H	L	M-H	Yes	NI	Yes	Maybe (NI)

Results

DOH has identified a total of eleven possible alternatives to Deca-BDE for use in electronic enclosures, mainly to replace Deca-BDE use with HIPS. Of these eleven alternatives, seven contain bromine and four are halogen-free. DOH has also identified 3 related chemicals that are used in conjunction with different alternatives as either synergists or anti-drip agents.

The following is a brief description of the toxicity, persistence and bioaccumulation potential for each alternative and Deca-BDE. More detailed information can be found in Appendix F.
TBC: See scientific information provided by BSEF in letters mentioned in cover sheet to these comments. Deca-BDE does not qualify for toxicity or persistence and certainly not as a PBT. Potential to degrade is unsubstantiated as to risk levels posed in real environment. The following paragraph needs to be revised to reflect best available science derived risk analysis. Even the departments conclusions at the end of this section do not support the following statement.
1. Decabromodiphenyl ether (Deca-BDE) (CAS# 1163-19-5)

There are several animal toxicity studies of Deca-BDE evaluating its potential to cause cancer and other health effects including neurodevelopmental effects. Based on these studies, Deca-BDE represents a low – medium concern for human health and aquatic toxicity. Recent studies indicate that people can be exposed to Deca-BDE via food and indoor dust. Half-life information for Deca-BDE in water and other media indicate that it is persistent in the environment. Deca-BDE shows a moderate tendency to bioaccumulate into organisms. However, the main concern around Deca-BDE is its potential to breakdown to lower brominated forms of PBDEs that have greater toxicity and greater potential to bioaccumulate. Deca-BDE is classified as a PBT under Department of Ecology's PBT criteria.

2. Bis(pentabromophenyl) ethane (CAS# 84852-53-9) (SAYTEX 8010)

There are few toxicity studies available on bis(pentabromophenyl) ethane. Toxicity studies are reported by one of its manufacturers (Albemarle Corp.) but documentation for these has not yet been obtained for evaluation. Toxicity values provided by Albemarle Corp. indicates that this chemical has low toxicity concern. One study in Sweden indicated potential occupational exposures to this chemical. SAYTEX 8010 is expected to be persistent because it is a large halogenated compound, but there is no data on its half-life in water or other media with which to quantitatively evaluate its potential environmental persistence. Bis(pentabromophenyl) ethane shows a low tendency to bioaccumulate into organisms. This chemical does not meet Ecology's PBT criteria due to low bioaccumulation potential and low toxicity based on limited toxicity information.

3. 1,2-bis(tetrabromophthalimido) ethane (CAS# 32588-76-4) (SAYTEX BT-93)

There are few toxicity studies available on 1,2-bis(tetrabromophthalimido) ethane. Toxicity studies are reported by one of its manufacturers (Albemarle Corp.) but documentation for these has not yet been obtained for evaluation. Toxicity values provided by Albemarle Corp. indicates that this chemical has low toxicity concern. There is no information on potential human exposures to this chemical. SAYTEX BT-93 is expected to be persistent because it is a large halogenated compound, but there is no data on its half-life in water or other media with which to

quantitatively evaluate its potential environmental persistence. 1,2-bis(tetrabromophthalimido) ethane shows a low tendency to bioaccumulate into organisms. This chemical does not meet Ecology's PBT criteria due to low bioaccumulation potential and low toxicity based on limited toxicity information.

4. Tetrabromobisphenol A epichlorohydrin polymer (brominated epoxy resin) (CAS# 40039-93-8)

There are very few toxicity studies available on Tetrabromobisphenol A epichlorohydrin polymer. Toxicity values provided in an MSDS for this compound indicate low toxicity concern for mainly acute exposures. No information was found on several health impacts of interest including reproductive and developmental toxicity. No information on aquatic toxicity (eco-toxicity) was found. There is some indication of possible mutagenicity concern based on testing of a related compound, but more information is needed for the chemical itself. There is no information on potential human exposures to this chemical. There is no available information with which to evaluate this chemical's environmental persistence or bioaccumulation potential. This chemical lacks sufficient information for evaluating whether it meets Ecology's PBT criteria.

5. Bis(tribromophenoxy)ethane (CAS# 37853-59-1)

Toxicity testing for bis(tribromophenoxy)ethane has been conducted by Great Lakes Chemical Corp. Results from these tests are reported by Great Lakes Chemical Corporation in reports submitted to EPA's High Production Volume Challenge program. These reports provide summaries of the toxicity studies. Further documentation of these studies is not easily available. These toxicity studies indicate low toxicity concern for this chemical. There is no information on potential human exposures to this chemical. The chemical shows a tendency to persist in the environment and to bioaccumulate into organisms. This chemical meets Ecology's criteria for persistence and bioaccumulation, but does not meet Ecology's PBT criteria due to low toxicity based on limited toxicity information.

6. Hexabromocyclododecane (HBCD) (CAS# 3194-55-6 and 25637-99-4)

There is a moderate amount of information on HBCD available in the published medical literature and from companies that make it. HBCD is included on Ecology's draft PBT list indicating that it meets Ecology's criteria for environmental persistence, bioaccumulation potential and toxicity.[166]

7. Tetrabromobisphenol A (TBBPA) (CAS# 79-94-7)

There is a moderate amount of information on TBBPA available in the published medical literature and from companies that make it. TBBPA is included on Ecology's draft PBT list

[166] Ecology, 2005. Technical background information for proposed PBT list. October 2005. Available at: http://www.ecy.wa.gov/programs/eap/pbt/rule/docs/Summary-TechnicalBackgroundInformationforProposedPBTList(October2005-Bradley).doc .

indicating that it meets Ecology's criteria for environmental persistence, bioaccumulation potential and toxicity.[167]

8. Tetrabromobisphenol A bis(2,3-dibromopropyl ether)(CAS# 21850-44-2)

Tetrabromobisphenol A bis(2,3-dibromopropyl ether has few available toxicity studies. It is ranked as a medium – high concern for cancer and mutagenicity based on its structural similarity to a known carcinogen. There is no information on aquatic toxicity or potential human exposures. The chemical shows a tendency to bioaccumulate into organisms. There is no data on this chemical's half-life in water or other media with which to evaluate its potential environmental persistence. This chemical meets Ecology's PBT criteria for toxicity and bioaccumulation potential, but lacks information with which to evaluate persistence.

9. Resorcinol bis (diphenylphosphate) (RDP) (CAS# 57583-54-7)

Most of the available toxicity testing for RDP has been conducted by two of its manufacturers, Great Lakes Chemical Corp. and Albemarle Corp. Results of these toxicity studies indicate low toxicity concern for this chemical for humans and medium toxicity concern for aquatic organisms. There are no animal cancer studies available for this chemical and there is no information on potential human exposures. The chemical does not show a tendency to persist in the environment and does not indicate a tendency to bioaccumulate into organisms based on some limited data. This chemical does not meet Ecology's PBT criteria due to low bioaccumulation potential and low toxicity based on limited information.

10. Bisphenol A diphosphate (BAPP, BPADP) or Bisphenol A bis(diphenyl phosphate) (BDP) (CAS# 181028-79-5 and 5945-33-5)

All available toxicity testing for BAPP has been conducted by two of its manufacturers, Great Lakes Chemical Corp. and Albemarle Corp. Results from these tests are available in reports by the companies that provide only summaries of the toxicity studies. Results of these toxicity studies indicate low toxicity concern for this chemical for humans and aquatic organisms. There are no animal cancer studies available for this chemical and there is no information on potential human exposures. The chemical does show a tendency to persist in the environment. There is some conflicting information regarding its ability to bioaccumulate into organisms. This chemical lacks sufficient information for evaluating whether it meets Ecology's PBT criteria.

11. Diphenyl cresyl phosphate (DCP) (CAS# 26444-49-5)

Toxicity studies on DCP indicate a medium concern for human health and aquatic toxicity. There are no animal cancer studies available for this chemical. There is some information on human exposures, primarily in the workplace. The chemical shows a tendency to persist in the environment and to bioaccumulate into organisms. This chemical is on the borderline of meeting

[167] Ibid.

Ecology's criteria for bioaccumulation and toxicity based on limited toxicity and bioaccumulation information.

12. Triphenyl phosphate (TPP) (CAS# 115-86-6)

Toxicity studies on TPP indicate mostly low concern for non-cancer human health effects and medium to high concern for aquatic toxicity. This is some information on estimated human exposures from use of TPP. The chemical does not show a tendency to persist in the environment and does not indicate a tendency to bioaccumulate into organisms. This chemical does not meet Ecology's PBT criteria due to low persistence, low bioaccumulation potential and low toxicity based on limited toxicity information.

Conclusions

Based on a review of available information, there do not appear to be any obvious alternatives to Deca-BDE that are less toxic, persistent and bioaccumulative and have enough data available for making a robust assessment. It is clear from this exercise that there is much more data available on Deca-BDE than for any of the alternatives. Two of the alternatives with a moderate amount of data, hexabromocyclododecane and tetrabromobisphenol A, are currently on Ecology's draft PBT list, indicating that they present a hazard to the environment and human health. Other alternatives do not appear to meet Ecology's PBT criteria indicating that they are less of a concern, but it is difficult to draw definitive conclusions based on incomplete data sets for these chemicals. DOH will continue to collect information on alternatives to Deca-BDE and is pursuing the use of computer modeling to assess toxicity and environmental fate for two of the most promising alternatives, RDP and BAPP.

Additional Background Information on Alternatives

In addition to environmental fate and toxicity information on alternatives to Deca-BDE, DOH collected production information for each alternative and other information related to whether or not the alternative is currently part of an existing tracking or evaluation program (Table 13). This information was collected for the U.S. and other countries (mainly the EU) where available. The purpose of collecting and summarizing this type of information is to illustrate other data gaps in information about alternatives such as in their production, use and tracking mechanisms.

Table 13 shows that information on the total years of production for alternatives is unavailable. This appears to be mainly due to confidential proprietary information. It is also difficult to find estimates of the volume of production or estimated use for many of the alternatives. Table 13 also shows that there is little information on emissions data for these chemicals (TRI data) and that many alternatives are not included in EPA's High Production Volume program, which would be a source of toxicity and other information. Most alternatives identified are not included in existing U.S. environmental or biomonitoring programs for tracking their potential buildup in animal or human tissues. Table 13 also illustrates that there is limited tracking and evaluation information available for alternatives in Europe.

Table 13. Additional production and tracking information on Deca-BDE alternatives and related chemicals.

	Chemical	Year of initial production/ or total years of production	Volume of production/or estimated use	TRI reporting? Volume (most recent year available)	EPA HPV?	Subject to TSCA: Section 4? Section 8?	Part of a national biomonitoring program? i.e. CDC NHANES
1.	Deca-BDE (CAS# 1163-19-5)	1970's	24,500 metric tons (US-2001) (>1,000,000 lbs)	2003; 827,428 lbs total release	Yes	Yes / Yes	CDC, began in 2004
2.	Bis(pentabromophenyl) ethane (CAS# 84852-53-9)		Confidential[169]	No	No	No[170]	No
3.	1,2-bis(tetrabromophthalimido) ethane (CAS# 32588-76-4)		Confidential (>1,000,000 lbs-1994)	No	Yes	No / Yes Section 8	No
4.	Tetrabromobisphenol A epichlorohydrin polymer (CAS# 40039-93-8)		108,000 tons (World-2000)	No	No	No / No	No
5.	Bis(tribromophenoxy)ethane (CAS# 37853-59-1)		16,710 tonnes (World-2001) (>1,000,000 lbs)	No	Yes	Yes / Yes	No
6.	Hexabromocyclododecane (HBCD) (CAS# 3194-55-6 / 25637-99-4)		12,200 tons (2002) (>1,000,000 lbs)	No	Yes	No?	Nominated for 2004 CDC NHANES
7.	Tetrabromobisphenol A (TBBPA) (CAS# 79-94-7)		60,000 tonnes (World 1999) (>1,000,000 lbs)	2003; 643,250 lbs total release	Yes	Yes / Yes	Nominated for 2004 CDC NHANES
8.	Tetrabromobisphenol A bis(2,3-dibromopropyl ether) (CAS# 21850-44-2)			No	No	Yes / Yes	No
9.	Resorcinol bis (diphenylphosphate) (RDP) (CAS# 57583-54-7)			No	Yes (CAS# 125997-21-9)	No /No	No
10.	Bisphenol A diphosphate (BAPP, BPADP, BDP) (CAS# 181028-79-5 and 5945-33-5)			No	No	No / No	No
11.	Diphenyl cresyl phosphate (DCP) (CAS# 26444-49-5)		Confidential (>1,000,000 lbs)	No	No	No / Yes Section 8	No
12.	Triphenyl phosphate (TPP) (CAS# 115-86-6)		Confidential	No	Yes	Yes / Yes	No
	Related Chemicals						
13.	Zinc Borate (CAS# 1332-07-6)			No	No	No / No	No
14.	Polytetrafluoroethylene (PTFE) (CAS# 9002-84-0)		Confidential	No	No	No / No	No
15.	Antimony trioxide (CAS# 1309-64-4)		~4,720 metric tons (2003) (>1,000,000 lbs US)	2003; 13,157,168 (includes other antimony compounds)[171]	Yes	No / Yes Section 8	No

[168] In a search of: USGS Wildlife and Contaminants Online, USGS BEST, USGS Contaminant Hazards Review, USACE ERED, NOAA National Status and Trends Program (includes Mussel Watch)

[169] According to all records found, the manufacturers for this substance are keeping the production of this chemical confidential and, therefore, no numbers could be obtained.

[170] This chemical is not listed in EPA Substance Registry System

[171] Cumulative release data of antimony compounds listed in TRI 2003, individual data for antimony trioxide not available.

Table 13 (con't) Additional production and tracking information on Deca-BDE alternatives and related chemicals.

	Chemical	EU EINECS?	IUCLID Data Sheet? (year)/ OECD SIDS (year)	EU HPV?	European Priority List? EU Risk Assessment Status	Other Assessments / Risk Assessments?	I E
1.	Deca-BDE (CAS# 1163-19-5)	Yes	Yes, IUCLID (2000)	Yes	Yes/ Risk Assessment updates released May 2004, August 2005 (UK and France)		Y b
2.	Bis(pentabromophenyl) ethane (CAS# 84852-53-9)	Yes	No	No	No	UK Risk Assessment prending – expected 2006	
3.	1,2-bis(tetrabromophthalimido) ethane (CAS# 32588-76-4)	Yes	Yes, IUCLID (2000)	Yes	No	France - PBT Assessment	
4.	Tetrabromobisphenol A epichlorohydrin polymer (CAS# 40039-93-8)	No	No	No	Yes/ Currently underway (UK)		
5.	Bis(tribromophenoxy)ethane (CAS# 37853-59-1)	Yes	No	No	No		
6.	Hexabromocyclododecane (HBCD) (CAS# 3194-55-6 / 25637-99-4)	Yes	Yes, IUCLID (2005)	Yes	Yes/ Draft 2004, update pending (Sweden)		
7.	Tetrabromobisphenol A (TBBPA) (CAS# 79-94-7)	Yes	Yes, IUCLID (2000)	Yes	Yes/ Draft 2005 (UK)		
8.	Tetrabromobisphenol A bis(2,3-dibromopropyl ether) (CAS# 21850-44-2)	Yes	No	No	No	Netherlands Risk Assessment – expected 2006	
9.	Resorcinol bis (diphenylphosphate) (RDP) (CAS# 57583-54-7)	Yes	No	No	No	UK Risk Assessment pending – expected 2006	
10.	Bisphenol A diphosphate (BAPP, BPADP, BDP) (CAS# 181028-79-5 and 5945-33-5)	No	IUCLID (2004)/ OECD SIDS (2002, Japan)	No	No	Australia NICNAS (2005)	
11.	Diphenyl cresyl phosphate (DCP) (CAS# 26444-49-5)	Yes	Yes, IUCLID (2000)	Yes	No	UK Risk Assessment pending – expected 2006	
12.	Triphenyl phosphate (TPP) (CAS# 115-86-6)	Yes	Yes, IUCLID (2000)	Yes	No	UK Risk Assessment pending – expected 2006; EPA Penta alternatives assessment (2005)	
	Related Chemicals						
13.	Zinc Borate (CAS# 1332-07-6)	Yes	No	No	No	Norway -conducted data assessment	
14.	Polytetrafluoroethylene (PTFE) (CAS# 9002-84-0)	No	No	No	No		
15.	Antimony trioxide (CAS# 1309-64-4)	Yes	Yes, IUCLID (2000)	Yes	Yes/ Early stage in risk assessment (Sweden)	Sweden doing EU Health & Enviro. Review – expected 2006	

TRI = EPA's Toxic Release Inventory; EINECS = European Inventory of Existing Commercial Chemical Substances; HPV = High Production Volume programs (EPA and EU); OECD SIDS (Organization for Economic Cooperation and Development, Screening Information Data Set) – voluntary international testing program for developing base level test information on approximately 600 poorly characterized international HPV chemicals (SIDS available at: http://www.inchem.org/pages/sids.html). IUCLID = International Uniform Chemical Information Database. IUCLID data sets and other information under the EU available at: http://ecb.jrc.it/ ; NICNAS = National Industrial Chemicals Notification and Assessment Scheme, Australia Department of Health and Ageing. List of chemicals with information available at: http://www.nicnas.gov.au/publications/CAR/NEW/CARSORT.ASP?infReq=30

VI. Cost Benefit Analysis

TBC: As noted in second paragraph the uncertainty for these models is so high as to make them of limited utility. Recommend that other than a very brief summary of intent that the body of this section be moved to an appendix. This will shorten report body and help prevent confusion by reader that CBA has any meaning at this time.

IN BRIEF: Ecology used two approaches to evaluate the potential costs and benefits associated with a statewide ban on the use of deca-BDE in electronic casings. Under the first approach ("Business Model"), Ecology attempted to develop estimates of overall costs to Washington businesses and overall social benefits that might result from implementing a statewide ban. A key component of this approach was a survey questionnaire sent to Washington wholesalers and retailers. The limited response to the survey questionnaire (in addition to the e-mail survey, each non-responder was contacted at least twice by phone) prevented Ecology from developing estimates of overall costs to Washington businesses.

Under the second approach ("Individual Model"), Ecology attempted to estimate the average health benefits for individuals, comparing them to estimates of average lifetime expenditures for TVs and computer monitors. Ecology found that there is a high degree of uncertainty surrounding the estimates of potential health effects. When this uncertainty is combined with the fact that a safer, effective alternative to Deca-BDE has not yet been identified, Ecology concluded that the cost-benefit analysis has limited utility at this time, in terms of informing decisions on phasing-out uses of deca-BDE.

VIII. Policy Recommendations

IN BRIEF: This section lists the key findings, policy options, recommendations and rationale for each area of action proposed by Ecology and DOH.

Products Containing PBDEs at End-of-Life

Key Findings

PBDEs are found in a vast number of consumer products, with a correspondingly vast potential for continued human exposure. Under WAC 173-303, Dangerous Waste Regulations, Persistence Criteria, most products containing PBDEs would probably be considered hazardous waste at end-of-life. Currently, these products are handled by the solid waste system. Many products containing PBDEs, particularly electronics, are recycled or could be recycled, which conserves valuable resources. It is unknown whether the current system for disposing of and recycling products containing PBDEs adequately protects human health and the environment.

Policy Options

- Identify products containing PBDEs that may be entering the waste stream, along with the estimated percent of PBDEs in the product.

- Examine known information about potential pathways of PBDEs from products to the environment. Evaluate and recommend the most effective methods for preventing PBDEs from entering the environment.

- Create effective and practical methods to dispose of products containing PBDEs that is consistent in hazardous waste, solid waste, water quality, and toxic cleanup regulations.

- Create a "special waste" designation that is consistent in the hazardous waste, solid waste, water quality, and toxic cleanup regulations to isolate PBDEs and remove them from the waste stream. This could include chronic, sub-lethal criteria for designation.

- Remove foam and other materials with Penta-BDE and Octa-BDE from the recycling stream unless the recycling or processing activity safely handles and removes the PBDEs, and workers are adequately protected.

- Require separation of electronics containing brominated flame retardants during disposal.

- Ban the resale of designated products containing polyurethane foam, such as upholstered furniture.

- Establish a voluntary program with charities, reuse organizations, and businesses to minimize the resale of upholstered furniture containing polyurethane foam. Financing would be provided by the bromine industry to charities to properly dispose of foam containing items that are "dumped" on them, whether or not they are accepted by the charity.

- Restrict the disposal of products containing PBDEs to landfills that do not release leachate into the environment or to waste water treatment plants.

- If it is determined that disposal of existing PBDE containing materials are not safely handled in most available landfills or incineration facilities, require the bromine industry to establish and finance a collection, transportation and proper disposal system for the state.

- Require manufacturers that continue to use Penta-BDE and Octa-BDE in products sold to the general public (as opposed to specialty industries, such as aeronautics) to establish and finance a proper disposal system for their products.

- Place a tax on products sold in Washington State that contain PBDEs to fund a public information campaign and proper collection and disposal system. The tax should be adequate to cover all related costs to the public and private sector.

- No action.

Recommendations
Ecology should establish a process, to be completed by July 2006, to evaluate and determine appropriate disposal and recycling practices for products containing PBDEs, including potential financing options. Ecology will involve appropriate stakeholders in this process, including, but not limited to, local government, private waste haulers and landfill operators, recyclers, manufacturers, environmental advocates, and human health advocates. Ecology anticipates that this may require a rule revision of WAC 173-303, outlining recommended methods for recycling and disposal. If necessary, the rule revision will be complete by July 2007. As part of the evaluation, Ecology will:

1. Identify known information about potential pathways of PBDEs at end-of-life. Both PBDE releases to the environment and occupational exposure to workers would be examined at waste collection facilities, recycling facilities, waste disposal facilities, manufacturers using PBDEs and service industries such as carpet installers and upholsterers.
2. Through a literature search and limited product testing, characterize PBDE content of products along high-priority exposure pathways.
3. Establish where monitoring of PBDEs associated with end-of-life, including biosolids, leachate, and incinerator emissions, is warranted and, if so, for what purposes.

Rationale

Currently, not enough is known about the environmental and relative cost impacts of disposal practices for products containing PBDEs. In particular, the reuse and recycling of products containing PBDEs conserves valuable resources. Additional study is required before well-founded recommendations can be made. If special handling, recycling or disposal of products or wastes containing PBDE is required, adequate financing mechanisms will need to be identified.

Source Control

Penta-BDE and Octa-BDE

Key Findings

The only current manufacturer of Penta-BDE and Octa-BDE, Great Lakes Chemical Corporation (now Chemtura), phased out production of both products at the end of December 2004. Both Penta-BDE and Octa-BDE have a guaranteed shelf life of six months, so new products containing Penta-BDE and Octa-BDE theoretically will not be produced past June 2005.

On December 6, 2004, U.S. EPA issued a draft Significant New Use Rule (SNUR) for Penta-BDE and Octa-BDE. This proposed rule would require manufacturers and importers to notify EPA at least 90 days before commencing the manufacture or import of Penta-BDE or Octa-BDE on or after January 1, 2005. The required notice would provide EPA with the opportunity to evaluate any intended new use and associated activities and, if necessary, to prohibit or limit that

activity before it occurs. The proposed rule would not prohibit the import of products containing Penta-BDE or Octa-BDE (e.g., mattresses, upholstered furniture). The comment period for the SNUR closed February 4, 2005. EPA plans to finalize the SNUR by the end of 2005.

Policy Options

- Ban the import and use of Penta-BDE and Octa-BDE in Washington State.
- Ban the sale of new products containing Penta-BDE and Octa-BDE in Washington State with a phase-in period, allowing existing stock to be sold.
- Ban the sale of new products containing Penta-BDE and Octa-BDE in Washington State with a phase-in period, allowing existing stock to be sold. Allow recycled PBDE content of foam to be no more than 0.5% by mass, where the sole source of the PBDE can only be from recycled foam. This level of recycling might be permitted for a few years such as until 2010, after which content would be reduced to less than 0.1% by mass.
- Require labeling of new products containing Penta-BDE and Octa-BDE; the label should identify the PBDE formulation.
- Identify which Washington manufacturers use Penta-BDE and Octa-BDE in their products.
- No action.

Recommendation

The Washington State Legislature should ban the manufacture, distribution (but not transshipment) or sale of new products containing Penta-BDE and Octa-BDE in Washington State by July 2006. The ban may include an exemption for the use of recycled material containing Penta-BDE and Octa-BDE in new products, pending further review. The ban should include an exemption for products where no alternative for Penta-BDE or Octa-BDE is available. The ban would not include the reuse of products containing Penta-BDE or Octa-BDE (for example, the sale of used cars or upholstered furniture).

Rationale

Currently, there is no provision that would prevent a manufacturer, either domestic or foreign, from reintroducing Penta-BDE and Octa-BDE on the market. Penta-BDE and Octa-BDE are known persistent, bioaccumulative toxins, found in increasing concentrations in environmental media and humans. A ban on the manufacture, distribution, or sale of new products containing Penta-BDE and Octa-BDE would be consistent with similar laws in the European Union, California, Hawaii, Illinois, Maryland, Maine and New York. Such a ban also would provide a disincentive to manufacturers from reintroducing these products. This should have little or no impact on manufacturers since they are already using alternatives for these chemicals in order to comply with the EU ban and the discontinuation of supplies to the U.S. A temporary exemption

for the use of recycled material containing Penta-BDE and Octa-BDE in new products is recommended until it can be determined that disposal is preferable.

Deca-BDE

Key Findings

Globally, Deca-BDE has become the most used PBDE product and is the only PBDE product currently in production. Recent scientific evidence suggests that Deca-BDE breaks down into more bioaccumulative and potentially toxic compounds {TBC under laboratory conditions.} The amount of Deca-BDE in use, the expected increase in its use, and its expected breakdown in the environment ~~argue~~ TBC {raise concerns about the risks involved in allowing Deca-BDE use ~~should not be allowed~~ to increase ~~and should be decreased~~.

Consumer electronics (primarily televisions) currently account for approximately 45 to 80 percent of Deca-BDE use. In preparation for the European Union's Restriction on Hazardous Substances (RoHS) ban on Deca-BDE, ~~most major~~ some consumer electronics manufacturers announced that they had phased out or planned to phase out, the use of Deca-BDE. These manufacturers included: Apple, Brother, Daikin, Dell, Hewlett Packard, Matsushita, Panasonic, Samsung, Sharp, Sony, and Xerox. Since the EU exempted Deca-BDE from this ban in October, 2005, it is unknown how many of these firms will continue to use alternatives to Deca-BDE.

During 2005, Ecology and DOH pursued two lines of inquiry regarding Deca-BDE. An extensive survey of the available literature on Deca-BDE alternatives and an analysis of the costs and benefits were both inconclusive. A lack of data about the chemical alternatives and disclosure issues hampered the effort of the process. Few manufacturers would share their use of alternatives or cost data with the state, either due to concerns about confidentiality or because it was not in their best interest to do so.

At the same time, the market for Deca-BDE is expected to shift and grow in response to a national flammability standard for residential upholstered furniture under consideration by the Consumer Product Safety Commission (CPSC). (See Appendix I) Sixteen flame retardant chemicals or categories of chemicals – including Deca-BDE – have been identified by CPSC and industry as likely to be used to flame retard fabrics on furniture in order to comply with the standard. EPA is developing a rule to complement this standard, which would require notification to and review by EPA of flame retardants used by upholstery fabric manufacturers. With this rule, EPA may or may not restrict the use of Deca-BDE. If Deca-BDE is banned for these fabrics now, prompting manufacturers to choose another flame retardant from the start, it would eliminate a potential new source of Deca-BDE in the environment without forcing manufacturers to incur costs for redesign or retooling to replace Deca-BDE later. However, no other state in the U.S. has banned Deca-BDE.

Because Deca-BDE is present in so many products, it would be nearly impossible to capture or control it in all products. Therefore, it was necessary to evaluate the effectiveness of a potential ban by examining the types of Deca-BDE containing products individually. Ecology and DOH conducted an in-depth review of the literature concerning alternatives to Deca-BDE for electronic enclosures. This effort focused on alternatives that had been identified by other

investigations as feasible (i.e. the product could be manufactured AND could meet fire safety standards). To date, no clearly safer alternative (i.e. one that is less persistent, less bioaccumulative or less toxic) for these products has been identified, although there are several promising compounds currently in use.

Policy Options

- Ban the import and use of Deca-BDE and the sale of new products containing Deca-BDE in Washington State with a phase-in period, allowing existing stock to be sold.

- Ban the import and use of Deca-BDE and the sale of products containing Deca-BDE for applications where alternatives are available.

- Ban the import and use of Deca-BDE and the sale of products containing Deca-BDE for applications where known, safer alternatives are available.

- Examine the implications and logistics of a ban on products containing Deca-BDE to maximize benefits while minimizing negative impacts, including possible impacts on fire safety.

- Re-examine known information on the health and environmental impacts of Deca-BDE, along with the availability of safe alternatives, on a regular basis (e.g., annually) to determine if a ban, restricted use, or other actions are warranted.

- Identify which Washington manufacturers use Deca-BDE in their products.

- No action.

Recommendations

- The Washington State Legislature ~~should ban the manufacture, distribution (but not transshipment) or sale of new products containing Deca-BDE provided that safer alternatives are identified or upon the emergence of additional evidence of Deca-BDE harm~~. The legislature should also provide funding to TBC: {convene a independent science advisory board that will implement the policy option to*:*
  "Re-examine known information on the health and environmental impacts of Deca-BDE, along with the availability of safe alternatives, on a regular basis (e.g., annually) to determine if a ban, restricted use, or other actions are warranted."

Ecology and DOH ~~to continue to evaluate alternatives to Deca-BDE. If safer alternatives are not found in a reasonable time, Ecology and DOH should develop incentives/disincentives to encourage manufacturers to identify and develop safer alternatives or product design changes that eliminate the need for PBDEs~~. TBC {will periodicially evaluate the findings from the SAB to utlize in risk assessments and cost benefit studies.

Rationale

Ecology and DOH ~~believe that the benefits of~~ TBC {recognize that insufficient information is available to make any decisions on the need for reducing Deca-BDE use in Washington. Development of new information from an independent SAB will provide information that can be used to create defensible risk analysis on the significance of Deca-bde to both public health and the environment.
~~The most prudent course of action is to take steps~~ TBC: It is premature to make any recommendation now to reduce the use of Deca-BDE, due to the uncertainty of the data and inability to provide risk assessments or cost benefit analysis. . ~~However, at least two of the alternatives to Deca-BDE are included in the list of PBTs in the draft rule (WAC 173-333).~~ Care must be taken not to drive manufacturers to flame retardants that are as bad, if not worse, than Deca-BDE. ~~Ecology and DOH will continue to evaluate the toxicity, persistence and bioaccumulation characteristics of alternatives.~~

U.S. Chemical Policy

Background

The Toxic Substances Control Act (TSCA) is the key statute around which US chemical policy is formulated. It provides the framework by which EPA regulates new and existing chemicals to ensure the protection of human health and the environment. TSCA was signed into law by President Gerald Ford on October 11, 1976. Shortly after the law was signed, EPA Administrator Russel E. Train said that TSCA is "one of the most important pieces of preventative medicine legislation ever passed by Congress". Train went on to say that the current problem of toxic environmental contamination is that "we know so little - so abysmally little - about these chemicals".[172]

Under TSCA, EPA gathers information on the potential risks to human health and the environment posed by new and existing chemical substances and mixtures. EPA's TSCA Inventory currently contains over 82,000 existing chemicals; of which 3,000-4,000 are produced in excess of one million pounds per year and so are considered high-production volume (HPV) chemicals.[173,174]

TSCA requires testing information to be submitted in the form of Premanufacture Notices (Section 5) on all new chemicals, or proposed new uses of chemicals, prior to their introduction in to commerce. If the information is judged inadequate, EPA can require further testing, limit or prohibit manufacture. Such actions must be based on "an unreasonable risk of injury to health or the environment" or concern that the substance would "enter the environment in substantial quantities or there is or may be significant or substantial human exposure to the substance".

[172]

[173] Chemical Testing Overview at http://www.epa.gov/opptintr/chemtest/view.htm, Office of Prevention, Pesticides and Toxic Substances. US Environmental Protection Agency. Accessed November 2005.
[174] Chemical Regulation: Options Exist to Improve EPA's Ability to Assess Health Risks and Manage Its Chemical Review Program. United States Government Accountability Office. GAO-05-458 June 13, 2005.

Since 1979, approximately 150 Premanufacture Notices submitted for new flame retardant chemicals have been reviewed by EPA.

For chemicals already in commerce prior to TSCA implementation in 1979, such as PBDEs, EPA must promulgate a rule (Section 4) in order to obtain test data. The burden of using Section 4 to obtain data on the more than 60,000 chemicals that existed prior to TSCA has generally led EPA to rely on voluntary data submission as exemplified by the HPV Challenge Program. This program is a voluntary effort by industry to submit data on approximately 3,000 HPV chemicals. If such data suggests that an existing chemical poses "an unreasonable risk of injury to health or the environment", EPA can promulgate a rule under Section 6 to restrict production and use provided it is the least burdensome option that will adequately protect human health and the environment.

Criticism of TSCA implementation began almost immediately with a review by the General Accounting Office (GAO) in 1980 that noted EPAs slow response in beginning chemical review. Subsequent GOA reports from that time through the most recent review released in June 2005 have outlined numerous problems facing EPA in its implementations of TSCA.[6,175,176,177,178,179,180,181,182,183,184,185] Central to the theme of these reviews is the truly massive task that faces EPA in dealing with the more than 80,000 chemicals that are on the TSCA Inventory, the large majority of which were in commerce prior to TSCA. GOA's most recent report as well as other reviews have outlined important drawbacks in the statute and implementation by EPA.[6,186,187,188,189,190,191]

[175] EPA Is Slow To Carry Out Its Responsibility To Control Harmful Chemicals CED-81-1 United States Government Accountability Office. October 28, 1980.
[176] EPA's Efforts To Identify and Control Harmful Chemicals in Use. RCED-84-100. United States Government Accountability Office. June 13, 1984.
[177] Assessment of New Chemical Regulation Under the Toxic Substances Control Act RCED-84-84 United States Government Accountability Office. June 15, 1984.
[178] Toxic Substances: EPA's Chemical Testing Program Has Made Little Progress RCED-90-112 . United States Government Accountability Office. April 25, 1990.
[179] Toxic Substances: Effectiveness of Unreasonable Risk Standards Unclear RCED-90-189. United States Government Accountability Office. July 20, 1990.
[180] Toxic Substances: EPA's Chemical Testing Program Has Not Resolved Safety Concerns RCED-91-136. United States Government Accountability Office. June 19, 1991.
[181] Toxic Substances: Status of EPA's Reviews of Chemicals Under the Chemical Testing Program RCED-92-31FS. United States Government Accountability Office. October 31, 1991.
[182] EPA Toxic Substances Program: Long-standing Information Planning Problems Must Be Addressed AIMD-94-25. United States Government Accountability Office. November 17, 1993.
[183] Toxic Substances Control Act: EPA's Limited Progress in Regulating Toxic Chemicals T-RCED-94-212 United States Government Accountability Office. May 17, 1994.
[184] Toxic Substances Control Act: Preliminary Observations on Legislative Changes to Make TSCA More Effective. United States Government Accountability Office. T-RCED-94-263 July 13, 1994.
[185] Toxic Substances Control Act: Legislative Changes Could Make the Act More Effective RCED-94-103. United States Government Accountability Office. September 26, 1994.
[186] Framing a Futures Chemical Policy: A Working Forum for Stakeholders. Final Report. October 2005. Lowell Center for Sustainable Production. University of Massachusetts.
[187] Integrated Chemicals Policy: Seeking New Direction in Chemicals Management October, 2003. Lowell Center for Sustainable Production. University of Massachusetts.
[188] Goldman LR. Chemicals and children's environment: what we don't know about risks. Environ Health Perspect. 1998 Jun;106 Suppl 3:875-80.

The criticisms outlined in these recent examinations of TSCA focus around EPA's ability to get and use data. Efforts to evaluate alternatives to Deca-BDE by DOH support these criticisms. DOH considered only those chemical alternatives to Deca-BDE that had been previously evaluated for feasibility and cost. Some of these chemical alternatives looked promising based on very limited data, but DOH was not able to gather enough information to conclude that any such alternatives were better than Deca-BDE (see Chapter VI, Alternatives Assessment).

While comments on this finding from the Deca Alternatives Advisory Committee were varied, some acknowledgment was made that TSCA could be improved. Frustration was also noted from some members regarding the inability of Ecology and DOH to acknowledge a preference for those alternatives to which many companies have switched (e.g. resorcinol bis(diphenylphosphate). (Deca-Alternatives Advisory Committee meeting – Meeting Notes: October 25, 2005)

Key Findings

In exploring chemical alternatives to Deca-BDE, it became clear that little is known about the safety and potential impacts replacement which would be allowed for use as flame retardants under existing federal regulations. Permitted use of chemicals for which little data has been collected points to significant flaws in U.S. law for regulating existing chemicals. In addition, EPA's ability to provide public information on chemical production and risk is hindered by strict confidential business information (CBI) provisions of TSCA.

This dilemma is clearly illustrated in the struggle to identify alternatives to Deca-BDE that will have a minimal impact on the environment and human health. Because so few studies on each of the alternatives have been conducted and because much of the information collected is not readily available, an adequate evaluation of alternatives to Deca-BDE was made difficult. Even basic information about chemical alternatives, such as production volumes and the number of years the chemical has been in commerce were not publicly available.

TSCA creates a disadvantage for manufacturers who cannot make fully informed decisions about the products they use; retailers, who are unaware of environmental and health implications of the products they sell; consumers, who cannot make fully informed purchasing decisions; industries dependent on a healthy environment, such as fishing and whale watching, whose "products" may be adversely impacted by chemical contamination; and regulators, who lack necessary information on product safety. Local governments, primarily responsible for municipal waste disposal and recycling, bear increased costs when products discovered to be hazardous are disposed. Environmental protection agencies within state governments (e.g. Ecology) are spending considerable funds to clean up contaminated sites and sediments. State and local health

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[189] Goldman LR. Linking research and policy to ensure children's environmental health. Environ Health Perspect. 1998 Jun;106 Suppl 3:857-62.
[190] Goldman LR. Linking research and policy to ensure children's environmental health. Environ Health Perspect. 1998 Jun;106 Suppl 3:857-62.
[191] 23. Richard Dahl. Spheres of Influence. Can You Keep a Secret? Environmental Health Perspectives Volume 103, Number 10, October 1995.

departments must evaluate exposure pathways (e.g. fish consumption and indoor exposure) in order to provide advice on ways to reduce exposure.

Recommendations

Ecology and DOH will actively seek opportunities to work with other states and interested parties to contribute to the national dialogue regarding needed improvements to US chemical policy, with a goal of developing and advocating practical solutions. As a first step, Ecology participated as a member of the organizing committee for the Stakeholder Summit on Framing a Future Chemicals Policy, organized by the Lowell Center for Sustainable Production, to take place in April 2005.

Rationale
{TBC note: the following statement is correct that changes in chemical policy should occur at the national level. It is in this context that Washington State should follow the Federal lead in dealing with PBDE's as to there application in consumer and manufacturing. Thus, the departments own rational is in conflict with the recommendations for banning any particular chemical such as Deca-BDE.}
Change in national chemical policy must occur at the federal level. However, Ecology and DOH can work to facilitate and participate in a process to develop solutions.

Minimizing Human Exposure

State Purchasing

Key Findings

Executive Order 04-01 states that the Department of General Administration's Office of State Procurement shall make available for purchase and use by all state agencies equipment, supplies, and other products that do not contain persistent, toxic chemicals unless there is no feasible alternative. In circumstances where a product that does not contain persistent, toxic chemicals is not available, preference shall be given to the purchase of products that contain the least amount of persistent, toxic chemicals.

Policy Options

- Specify that goods purchased through state contracts should not contain PBDEs.
- Specify that bidders on state contracts should disclose which PBDE formulations, if any, are used in products.
- No action.

Recommendations

Consistent with Executive Order 04-01, restrict the state's purchase of PBDEs in appropriate contracts.

- General Administration should prefer products that do not contain Deca-BDE.

Rationale

Alternatives are available for many, but not all, applications of Deca-BDE. Alternatives are available for all applications of Penta and Octa-BDE, as neither product has been produced since December, 2004.

General Public

Key Findings

Human health risks are associated with exposure to PBDEs, though pathways and levels necessary to result in harm are not clearly understood.

Policy Options

- The DOH should develop recommendations for the general public to reduce PBDE exposure.

- Direct the bromine industry, at its expense, to provide best management practices and a public information campaign on how to reduce human and environmental exposure.

- No action.

Recommendation

DOH should develop methods and materials for health education about PBDEs. DOH should develop and implement a strategy to communicate with health care providers about PBDEs and provide guidance appropriate for both the general public and health care providers concerning reduction of exposure to contaminants in the environment, including PBDEs. This strategy will include information on the benefits of breastfeeding and the benefits of eating fish as part of a healthy diet.

Rationale

Levels of PBDEs measured in people in the U.S. vary widely but are consistently much higher than levels found in people outside of the U.S. and Canada. Several potential routes of exposure exist. Humans appear to be exposed primarily through eating PBDE contaminated foods and through indoor air and household dust. Though PBDEs are used in many consumer products, individuals cannot easily identify which products contains PBDEs. PBDEs differ from many other environmental pollutants because they are associated with several sources and because it is so difficult for individuals to identify how they might be exposed.

PBDEs accumulate in the body over time. Levels in women build up prior to conceiving a child and can be passed on to the child during fetal development and through breast milk. Because of this, public health education will focus on young women and their health care providers.

Currently, there are uncertainties about the relative contribution of different sources of PBDEs to total exposure and why some people have higher than average levels. Efforts to develop strategies to reduce human exposures will need to rely on continual monitoring of the research literature related to PBDEs. Public health recommendations for exposure reduction and educational strategies to communicate those recommendations will be revised to reflect new information as needed.

Occupational Exposure

Key Findings

Workers may be exposed to PBDEs in computers and electronics. A Swedish study showed that workers who dismantle and discard electronics at a recycling plant are exposed to PBDEs. PBDE exposure was also found in computer technicians, although at lower levels than for those in the recycling plant. The source of the exposure is thought to be dust from plastic components. Reducing the amount of PBDE-containing dust at the recycling plant led to reductions in workers' PBDE plasma levels. Another Swedish study found elevated PBDE levels in workers manufacturing or handling rubber. Occupational exposure to PBDEs has been implicated in a 2003-2004 study conducted in New York. Although appropriate occupational exposure studies have not yet been conducted, it is reasonable to assume that workers may also be exposed to PBDEs during the manufacture and recycling/disposal of polyurethane foams treated with these flame-retardants.

Policy Options

- To minimize occupational exposure to PBDEs, develop recommendations for employers and employees stating that exposure to PBDE-containing dusts should be controlled using standard industrial hygiene controls. *(At the time of this writing, L&I has already developed recommendations.)* Make employers and employees in potentially high exposure industries aware of the resources available from L&I to assist them in controlling exposure to PBDE containing dusts. L&I would focus on the most significant workplace exposures, which are likely associated with the manufacture and recycling/disposal of foams and plastics, rather than the office environment. There are no legally enforceable occupational exposure limits for PBDEs; however, L&I would apply the existing regulation for nuisance dust, i.e., particulates not otherwise regulated.

- No action.

Recommendation

- To minimize occupational exposure to PBDEs, develop recommendations for employers and employees stating that exposure to PBDE-containing dusts should be controlled using

standard industrial hygiene controls. *(At the time of this writing, L&I has already developed recommendations.)* Make employers and employees aware of the resources available from the L&I to assist them in controlling exposure to PBDE containing dust. There are no legally enforceable occupational exposure limits for PBDEs; however, apply the existing regulation for nuisance dust, i.e., particulates not otherwise regulated. This process should be informed by the proposed study to 1) identify industrial processes that generate high levels of PBDE-containing dust or fume and 2) conduct biological monitoring for PBDEs in high-exposure workers.

Rationale

In the Swedish electronics recycling plant, dust control had a significant impact on PBDE exposures. Exposure was reduced when the shredder was moved away from the workers, the ventilation system was upgraded and cleaning procedures were improved. Therefore, recommending standard industrial hygiene controls to reduce exposures is warranted.

Monitoring and Research

Key Findings

Current regulations do not require monitoring for PBDEs in Washington State. As a result, very little data exist on PBDEs specific to Washington. While sampling of human tissue and laboratory animal studies indicate a risk to human health, a lack of knowledge persists regarding exposure pathways. Additional information needs include:

- Environmental monitoring data to establish baselines and monitor trends.
- Biomonitoring to establish baselines and monitor trends.
- Public awareness and perspectives on PBDEs.
- Magnitude and pathways for potential occupational exposure.
- Levels of occupational exposure to establish baselines and monitor trends.
- Deca-BDE debromination in various environments.
- The fate of PBDEs in the landfill environment.
- Alternative, non-brominated flame retardants, including their current presence in the environment and biological organisms, including people, to establish a baseline for future studies.
- Product design and other solutions to chemical fire retardants.

Research and monitoring efforts are typically conducted in coordination with other government agencies and research institutions to maximize efficient use of resources.

Policy Options

- Bring together regional government agencies and research institutions involved in environmental monitoring and research to develop a multi-media monitoring program for PBDEs.

- Establish a biomonitoring program that includes examination of PBDEs in blood and breast milk to monitor trends and identify at-risk populations.

- Devise a sampling strategy to determine the relative contributions of PBDEs from various products and processes. This would include an evaluation of environmental releases from manufacturing processes (e.g., foams) in addition to recycling and disposal operations. This study could be funded via legislative request – similar to the study conducted on metals in fertilizers.

- A two-phase workplace exposure study in collaboration with CDC. This study could be funded jointly by Ecology, CDC, and potentially NIOSH, with some logistical support provided by L&I. Once Washington State workplaces with the greatest potential for PBDE exposures have been identified, the following study could be conducted in a two-phased approach.

    - Phase 1 - Air and surface sampling for PBDEs to determine the magnitude of potential exposures via the inhalation, dermal, and ingestion routes. If this evaluation suggests that there is a potential for exposure, proceed to Phase 2.
    - Phase 2 – Biomonitoring of workers who are potentially exposed to PBDEs in the workplace.

- Test biosolids, leachate and incinerator emissions for PBDEs. Top priorities may include biosolids used for food production and leachate from the LRI landfill, which uses auto fluff for daily cover.

- Require the bromine industry or manufacturers of products containing PBDEs to finance monitoring and research through direct financing or a tax on products containing PBDEs.

- In collaboration with other government agencies and research institutions, conduct research on the following issues:

    - The fate of PBDEs in the landfill environment, with particular attention to Deca-BDE debromination.

    - Deca-BDE debromination in various environments as a result of UV light exposure and metabolic processes, with particular attention to biosolids.

    - Alternative, non-brominated flame retardants, including current presence in the environment and biological organisms, including people, to establish a baseline for future studies.

- Product design and other solutions to fire retardant needs.

Recommendations

Human Health Monitoring

- DOH should coordinate with federal agencies on existing national biomonitoring of PBDEs.

- DOH should explore whether additional regional biomonitoring is needed. Additional funding to support this effort would be required.

- DOH should research public awareness and perspectives to assure correct message development and environmental health communications strategy. This research is necessary to minimize unintended consequences of information delivery.

- DOH and L&I should implement a two-phase workplace exposure study in collaboration with CDC. Once Washington State workplaces with the greatest potential for PBDE exposures have been identified, the following study could be conducted in a two-phased approach.

    - Phase 1 - Air and surface sampling for PBDEs to determine the magnitude of potential exposures via the inhalation, dermal, and ingestion routes. If this evaluation suggests that there is a potential for exposure, proceed to Phase 2.

    - Phase 2 – Biomonitoring of workers who are potentially exposed to PBDEs in the workplace.

Environmental Monitoring

- Ecology has developed a monitoring program for PBDEs in the environment. Ecology should evaluate whether further sampling for Deca-BDE alternatives is needed.
- Ecology should determine whether additional sampling for PBDEs at landfills, recycling facilities, sewage treatment facilities or other areas is needed.

Research

Encourage other government agencies and research institutions to conduct research on the following issues:

- Deca-BDE debromination in various environments.

- The fate of PBDEs in the landfill environment.

- Alternative, non-brominated flame retardants, including their presence in the environment and biological organisms, including people, to establish a baseline for future studies.

- Product design and other solutions to chemical fire retardants.

- A better characterization of how people in the U.S. are being exposed to PBDEs. This should include further monitoring of PBDEs in U.S. foods, identifying sources and levels of PBDEs in homes and other buildings, and identifying behaviors that contribute to PBDE levels in human tissues.

Mike Gallagher, PBT Coordinator
Washington State Department of Ecology

Dear Mike Gallagher,

Thank you for the opportunity to comment on the Washington State Polybrominated Diphenyl Ether (PBDE) Chemical Action Plan: Draft Final Plan, dated December 1, 2005, which is available at http://www.ecy.wa.gov/biblio/0507048.html.

1. **State Leadership in Promoting Safer Alternatives to PBDEs is Nationally Significant**

Your work is important not only for Washington State but also for the seven other states that have already enacted laws that begin to restrict the use of PBDEs and several additional states that are considering such policy action. Your leadership on Deca-BDE is especially important since many other states, including Maine, New York, Illinois, Oregon and Maryland are moving in the same direction and are closely monitoring the analysis and development of policy recommendations in the state of Washington.

2. **Deca-BDE Should be Phased Out in Favor of Safer Alternatives**

We strongly support your findings and recommendation that the manufacture and sale of products containing Deca-BDE be banned in favor of safer alternatives (page 94). We strongly agree with the rationale for such policy action as provided in your report:

"Ecology and DOH believe that the benefits of reducing Deca-BDE use in Washington are likely to be significant to both public health and the environment. The most prudent course of action is to take steps now to reduce the use of Deca-BDE, despite the uncertainty of the data." (page 94)

3. **A Safer Alternative to Deca-BDE is Nationally Available and is Already in Widespread Use**

On page 75 of your report, the language in the "Conclusions" section should be modified to explicitly state the conclusion that a safer alternative to deca-BDE is nationally available, namely the flame retardant chemical known as resorcinol bis (diphenylphosphate) or RDP.

As reported in a report by Tim Greiner prepared by the University of Massachusetts-Lowell and summarized in your report, RDP is a widely used alternative flame retardant chemical that has replaced Deca-BDE in many electronic enclosures used for computers and televisions.

According to your analysis on page 74 and in Table 12 (on page 71), RDP does not meet the Washington state criteria for being designated as a persistent bioaccumulative toxic chemical (PBT). Specifically. RDP is neither persistent not bioaccumulative according to your own criteria. For example, your report concludes that:

"Results of these toxicity studies indicate low toxicity concern for this chemical for humans and medium toxicity concern for aquatic organisms. … The chemical does not show a tendency to persist in the environment and does not indicate a tendency to bioaccumulate into organisms based on some limited data. This chemical does not meet Ecology's PBT criteria due to low bioaccumulation potential and low toxicity …. (page 74)

However, deca-BBE has been formally designated as a PBT by the State of Washington. Chemicals that are not PBTs are inherently safer than PBTs. Therefore, your conclusion should be direct and unambiguous – a safer alternative to deca-BDE is widely available and in use.

Thank you for your good work in promoting safer alternatives to PBTs such as PBDEs.

Sincerely,

Michael Belliveau

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"Preventing harm where we live, work and play"

Dear Mr. Gallagher,

I am writing on behalf of the WA Chapter American Academy of Pediatrics in support
of your recommendations in the draft plan related to PBDEs. The WCAAP supported
legislation in the 2005 session to ban Deca-PBDE, particularly in light of the
growing concerns about the impact such chemicals could have on infants and children.

Specifically, we support the following recommendations and ask you to include them in the final plan:

* Ban all three forms of PBDEs, especially deca, in consumer products. Because deca is used in massive quantities and has shown to break down into even more problematic forms of the chemical, it is prudent to eliminate its use to prevent future harm. Many companies have eliminated deca, including market leaders such as Sony, Dell, and HP.

* Require state agencies to give preference to PBDE-free products when making purchasing decisions. The government should lead by example and purchase products that do not contain these chemicals.

* Improve U.S. chemical policy so that chemicals such as PBDEs don't wind up in products used in our homes, offices, and schools. A key component of this federal reform starts at the state level. The state should start by preventing the use of toxic chemicals in consumer products.

Thank you.

Sincerely,

Laurie Lippold

Sincerely

Sincerely

Laurie Lippold
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Seattle, WA 98115

December 30, 2005

Mike Gallagher, PBT Coordinator
Department of Ecology
PO Box 46700
Olympia, WA 98504-7600

Dear Mr. Gallagher:

I am writing to submit comments on the Washington State Chemical Action Plan on Polybrominated Diphenyl Ethers.

As your report has identified, PBDEs are in widespread use in consumer products, including many types of electronics, furniture, and building materials. PBDE levels have been rapidly increasing in both wildlife and human tissues. In the US human tissue levels are 10-100 times greater than levels measured in Europe and Japan. Whereas a clear path of exposure has not been identified, it is presumed that the majority of human exposure is via food and house dust exposure. For infants, the major route of exposure is via breast milk. Because PBDEs have been identified as reproductive and neuro- toxins by animal studies, exposure to developing fetuses and infants is of greatest concern.

1. Levels of PBDEs that pose a threat to human health.

> In the executive summary and on p. 9, it is stated that "although PBDEs are present in people and many foods, these levels have not yet reached those shown to be toxic in lab animals and do not pose an immediate human health threat." And also in the executive summary it is stated "While levels of PBDEs found in breast milk in the US are not yet at a level of concern,…"

On the contrary, I believe levels in breast milk are currently at a level of concern and for the most highly exposed populations, at levels that pose immediate health threats.

The median level of PBDEs in breast milk in the US is approximately 40 ng/g. However, 5% of U.S. women have total PBDEs breast milk concentrations greater than 300 ng/g lipid weight and levels of some individual congeners (such as the penta-BDE congeners BDE-47 and BDE-99) exceed 100 ng/g lipid weight (*1-3*). These levels are less than 10 times the amount found in animal studies to cause adverse neurodevelopmental effects (800 ng/g). Furthermore, animal studies have shown uptake of PBDEs from breast milk and human studies have confirmed that PBDEs are transferred across the placenta (*4*). Therefore, fetuses and infants are exposed to PBDEs during critical times of development and for at least 5% of the population these exposures are occurring at an uncomfortably small margin of safety (*2*).

As levels of PBDEs appear to continuing a trend of rapid increase, a larger percentage of the population will be within the range found to cause harm in animal studies. A recent study measured the highest levels of PBDEs to date in humans (*5*). This study found total PBDEs concentrations of 9630 ng/g in a 32-year-old man and 4060 ng/g in a 23-year-old

woman. These PBDE levels are greater than the levels found to cause harm in animal studies.

2. Reproductive outcomes, p. 23-24.

PBDE-99 has been shown to result in male reproductive toxicity. A more recent report than the one cited in this document demonstrated a one-time, low dose penta-BDE (BDE-99) exposure *in utero* resulted in decreased sperm counts (*6*). Although the rats in this study remained fertile, the observed decrease in sperm counts is concerning because the exposure dose was very small and similar to levels found in the mostly highly exposed humans (60 ng/g). With current evidence for an overall decrease in sperm counts in the male population, PBDEs could be an important contributor to this phenomenon.

3. Occupational studies and degradation.

In addition to the occupational studies described on pg. 19-20, there is another more recent occupational study of Deca-PBDE exposure in rubber manufacturers (*7*). In this study, workers manufacturing or handling rubber flame retarded with DecaBDE had a median concentration of BDE-209 of 35 ng/g. By comparison a non-exposed referent group, had a median BDE-209 concentration of 2.4 ng/g. In addition, rubber workers were found to have elevated levels of all nonabromodiphenyl ethers (nonaBDEs) and several octabromodiphenyl ethers (octaBDEs) congeners, including BDE-203. These levels were 2.5- to 11-fold higher compared to the referents. These results confirm a significant uptake of BDE-209 in the workers exposed to DecaBDE and indicate a potential for degradation of BDE-209 to lower brominated BDEs in humans.

Based on your agency's PBDE review and these additional studies, I fully support the Washington State phase-out plan for PBDEs. Furthermore:

- All 3 forms of commercial PBDE mixtures (Penta-, Octa-, and Deca-) should be banned in consumer products. As Penta- and Octa- are already no longer in production, an emphasis should be placed on the phase-out of Deca- products. Many companies have begun to eliminate Deca-from their products. As more and more businesses begin asking for PBDE-free products, industry will be forced respond to this market pressure.

- As your agency has acknowledged, we should not replace one toxic chemical for another in this phase-out. The use of other brominated or chlorinated flame retardants should not replace the use of PBDEs. Purchasing policies should reflect this preference.

- Disposal and/or recycling of PBDE containing products is a major hurdle that WA state can take a lead on forming policy. There are thousands of products currently in use that contain all 3 of the commercial forms of PBDEs. As these products age, they will be more likely to release PBDEs into the environment, continuing to contaminate groundwater and expose wildlife and humans. Proper disposal of these products must ensure that continued exposure does

not occur. Part of the consumer education should be that exposed foam and deteriorating fabrics are a major source of PBDEs.

I appreciate the opportunity to comment on this plan and want to recognize the hard work that has gone into producing it.

Sincerely,

Sarah Janssen, MD, PhD, MPH
University of California, San Francisco
Occupational and Environmental Medicine Fellow.

References:

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Dear Mr Gallagher:

As the chair of the Illinois House Environmental Health Committee, I am concerned about the impacts of deca PBDE on our health and environment. We legislators are looking to Washington state to lead the efforts in banning deca PBDE in consumer products.

While we in Illinois had success in banning penta and octa PBDE, we have asked our EPA to study the effect of deca PBDE, which is widespread and especially toxic. Your state's actions on deca will greatly impact our efforts in our respective states to eliminate deca and all other forms of PBDEs. We urge you to recommend a ban on all three forms of PBDEs in consumer products, especially deca.

Thank you so much for your consideration of my views.

Karen May

State Representative
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www.karenmay.org

Dear Mr. Gallagher,

The Lands Council has over 1000 members in Washington State and works on water and toxic issues in eastern Washington is supportive of a ban on flame retardents. We currently work with the Department of Ecology on educating Spokane citizens about lead and PCB's and are quite concerned about the effects of persistent toxic chemicals on the public's health, especially children. We appreciate your efforts to take action on the critical issue of toxic flame retardants (PBDEs). We also note that a test last year indicated that the Spokane River had very high levels of PBDE's from an unknown source and this is troublesome.

We support your current recommendations in the draft plan and ask you to remain strong in including them in the final plan. We support a ban all three forms of PBDEs, especially the deca form, in consumer products. Because deca is used in massive quantities and has shown to break down into even more problematic forms of the chemical, it is precautionary to eliminate its use to prevent future harm.

A ban should include a provision that requires state agencies to choose PBDE-free products when making purchasing decisions. We encourgage Ecology to become a leader nationally and put efforts into changing U.S. chemical policy so that chemicals such as PBDEs don't wind up in products used in our homes, offices, and schools.

Thank you for your efforts to eliminate toxics from our envirnoment.

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December 30, 2005

Mike Gallagher
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Dear Mike:

We appreciate the opportunity to comment on the draft final PBDE chemical action plan and would like to thank the Departments for their extensive work on this plan. The final PBDE plan comes at a critical time as the Washington State Legislature will consider legislation on PBDEs in 2006. This plan strongly supports immediate legislative action to phase out all forms of PBDEs, particularly deca-BDE.

The leadership of the Department of Ecology and Health on deca-BDE is extremely important as many other states, including Maine, New York, Illinois, Oregon and Maryland are moving in the same direction and are closely monitoring the scientific information and development of policy recommendations in the state of Washington.

We ask that the final plan remain strong on phasing out deca-BDE in favor of safer substitutes; that the section on alternatives be strengthened; and, that the section on Europe be updated and made clearer. Finally, we fully support your call for reform of federal chemical policy.

1. **Phasing out deca-BDE will help protect children's health, is consistent with the state's PBT rule, and follows the direction of corporate leaders in the marketplace.**

We support Ecology's recommendation to ban the manufacture, distribution and sale of new products containing deca-BDE in favor of safer alternatives. We also agree with your rationale stated in the report:

> "Ecology and DOH believe that the benefits of reducing deca-BDE use in Washington are likely to be significant to both public health and the environment. The most prudent course of action is to take steps now to reduce the use of deca-BDE, despite the uncertainty of the data." (p. 94)

As stated in Ecology's PBT rule (September 27th, 2005), "persistent bioaccumulative toxins (PBTs) are chemicals that pose a *unique threat* to human health and the environment in Washington state…Because of the unique threat that these PBTs pose, special attention is necessary to identify actions that will reduce and eliminate threats to human health and the environment." Deca-BDE is listed on Ecology's PBT list because it breaks down into chemicals that meet the PBT criteria in WAC 173-333-320 (2). Taking action to prevent contamination, health impacts, and the costs associated with the use of deca-BDE and other PBTs is the common sense approach that the PBT rule is based on. The recommendation is consistent with the rule and necessary.

This recommendation is also crucial for protecting our children from the potential negative effects of exposure to PBDEs. What we know is that children are pelted continuously with toxic chemicals from the moment of conception. Deca-BDE in particular has been found in cord blood, breastmilk, and house dust. Breastmilk and house dust in particular have been identified as significant exposure routes for infants and toddlers. The plan cites one study in particular that found 90% of a toddler's daily intake of PBDEs comes from incidental ingestion of dust (PBDE CAP p. 13). While this is disturbing, it is a problem that can be solved by substituting these chemicals in products with safer alternatives. As we have experienced with PCBs, DDT and other persistent chemicals, levels in people will decline when bans are put in place.

Phasing out deca-BDE is also consistent with the direction of the marketplace. Market leaders such as Ikea, Dell, HP and Sony have abandoned PBDEs due to concerns over the potential impacts to public health and the environment. In fact, HP recently announced a goal to eliminate the brominated flame retardant tetrabromobisphenol A, another PBT chemical on Ecology's list and alternative to deca used by some companies (HP Press Release http://www.hp.com/go/environment). In addition, Dell recently unveiled its new chemical policy that is grounded on taking precautionary measures to prevent harm. It states:

> *"Dell believes that if reasonable scientific grounds indicate a substance (or group of substances) could pose significant environmental or human health risks, even if the full extent of harm has not yet been definitively established, precautionary measures should be taken to avoid use of the substance(s) in products unless there is convincing evidence that the risks are small and are outweighed by the benefits."*

As part of the policy, "Dell is striving to eliminate all remaining uses of brominated flame retardants by 2015." (Note: Dell has already phased out deca-

BDE and is working on eliminating other brominated flame retardants)(http://www1.us.dell.com/content/topics/global.aspx/corp/environment/en/prod_design?c=us&l=en&s=corp&~section=016)

Finally, the largest remaining use of deca-BDE is in plastic TV enclosures. However, Sony, Panasonic, and others have already phased it out. Sony's commitment goes beyond PBDEs as the company is working to replace all brominated flame retardants with safer alternatives. This has led them to advance the flame retardancy properties of biobased plastics, so that they can be used to replace petroleum based plastics.

2. **A safer alternative to Deca-BDE is available and already in widespread use.**

According to your analysis on page 74 and in Table 12 (on p. 71), Resorcinol Diphenyl Phosphate (RDP) does not meet the Washington state criteria for being designated as a PBT. RDP is neither persistent nor bioaccumulative according to your own criteria. Furthermore, a chemical must meet all criteria—P and B and T— for it to be on the Washington state list and the report concludes:

> "Results of these toxicity studies indicate low toxicity concern for this chemical for humans and medium toxicity concern for aquatic organisms. … The chemical does not show a tendency to persist in the environment and does not indicate a tendency to bioaccumulate into organisms based on some limited data. This chemical does not meet Ecology's PBT criteria due to low bioaccumulation potential and low toxicity …. (p. 74)

Deca-BBE on the other hand is on the PBT list as explained above. Chemicals that are not PBTs are inherently safer than PBTs. Therefore, your key findings (p. 93) and your recommendation (p. 75) should be clear– there is a safer alternative to deca-BDE.

Furthermore, we know that RDP already in widespread use. According to recent report by the Lowell Center for Sustainable Production (2005), Europe used about 20,000 metric tons of RDP in televisions. Phosphate based alternatives are already a significant piece of the market.

Deca-BDE is considered a PBT by the state of Washington. We agree that companies should not be substituting other PBTs for deca-BDE and that the state should help identify and support companies switching to safer substitutes. The state can do this in part by sticking to their recommendation on phasing out deca-BDE and by carrying out the PBT program with additional chemical action plans on other brominated flame retardants.

3) Clarify and update information on Europe situation.

At the final PBDE advisory committee meeting in December, Rob Duff of the Department of Health clearly stated that after reviewing the risk assessments and other information from Europe, Washington state disagreed with the conclusions of the European risk assessment that no further risk reduction measures are necessary for deca-BDE. Instead, the state did agree with the European Scientific Committee on Health and Environmental Risks (SCHER) that recommended strongly that risk reduction measures are necessary. We request that the final plan clearly state the position of the state of Washington related to Europe.

In addition, **t**here is a clarification and several updates from Europe that should be included in the final PBDE plan.

- On p. 55, the plan states that the European Council voted in favor of the deca-BDE exemption on September 2, 2005 and that the Commission then adopted the exemption. The statement should more clearly explain that at the Council level, the exemption failed again to receive the qualifying majority for immediate adoption. Despite the two failing votes and the overwhelming opposition from Parliament, the Commission moved forward and adopted the exemption in October 2005.
- The Danish Government has decided to challenge the European deca-BDE exemption based on the Commission failing to show that alternatives to deca-BDE do not exist. If they win the case, the exemption will be null and void.
- Switzerland and Norway should be included in the list of European countries that are acting on Deca-BDE. After July 1, 2006, the use of deca-BDE in new electronic equipment is not allowed in Switzerland unless there are no alternatives. Norway is also moving forward with a ban.

4) Reform of national chemicals policy is necessary and urgent.

Our experience at the state level on PBDEs is a glaring example of the failure of the nation's chemical policy. The state deserves a great deal of credit for stepping in where the federal government has failed our environment and our children. Allowing PCB-like chemicals into consumer products so that they now contaminate our homes, our bodies and our food supply is appalling. What is even more appalling is that when our state decided to take action to protect our water bodies, food supply and residents from PBDEs,

basic information was not readily available on the chemical or its alternatives. Federal reform is not only necessary but it is urgent.

We strongly support the recommendation to reform federal chemical policy and for the state to actively work to make this happen. We ask that the state adopt the following principles with respect to reforming national chemicals policy as part of the PBDE plan:

a) Require Safer Substitutes and Solutions -- seek to eliminate hazardous chemical use and emissions by altering production processes, substituting safer chemicals, redesigning products and systems, and rewarding innovation. Safer substitution includes an obligation on the part of the public and private sectors to invest in research and development for sustainable chemicals, products, materials, and processes.

b) Phase-out Persistent, Bioaccumulative, or Highly Toxic Chemicals -- prioritize for elimination chemicals that are slow to degrade, accumulate in fatty tissues, **or** are highly hazardous to humans or the environment.

c) Give the Public and Workers the Full Right-To-Know -- label products that contain hazardous chemicals, list quantities of hazardous chemicals used in agriculture and in manufacturing facilities, and provide public access to safety data on chemicals. Also require manufacturers to report the amount of hazardous chemicals they use each year.

d) Act on Early Warnings -- act to prevent harm when credible evidence exists that harm is occurring or is likely to occur, even when some uncertainty remains regarding the exact nature and magnitude of the harm.

e) Require Comprehensive Safety Data for All Chemicals -- assume that a chemical is highly hazardous unless comprehensive safety data are available for the chemical and require manufacturers to provide this data by 2015 for a chemical to remain on the market -- this is the principle of "No Data, No Market."

f) Take Immediate Action to Protect Communities and Workers -- when communities and workers are exposed to levels of chemicals that pose an immediate health hazard, immediate action is necessary to eliminate these exposures.

Conclusion

We greatly appreciate the hard work and thought that have gone into this PBDE phaseout plan. As we have stated, it provides a strong case for the phase out of all forms of PBDEs. We urge Ecology and Health to strengthen the plan by including our suggestions.

Thank you again for this opportunity to provide input. We look forward to the final plan.

Sincerely,

Laurie Valeriano
Policy Director

Lynn Sainsbury
916 Missoula Ave
Helena, MT 59601

Mike Gallagher, PBT Coordinator
Department of Ecology
PO Box 46700
Olympia, WA 98504-7600

December 28, 2005

Dear Mr. Gallagher:

I am quite excited that the state of Washington is considering taking bold steps to reduce the amount of toxic flame retardant chemicals in the world. It is so wonderful that a state like Washington has taken the time and energy to thoroughly research the issue.

I support the PBDE Chemical Action Plan and strongly recommend that the plan:
... Ban all three forms of PBDEs in consumer products, especially deca. Safer alternatives to deca do exist and these viable alternatives should be acknowledged in the plan.
... Require state agencies to give preference to PBDE-free products when making purchasing decisions.

A friend of mine recently became a mother and her breast milk was tested for chemicals. Though she takes great measures to reduce her exposure to chemicals in general, she must have been inadvertently exposed to PBDE's, as the concentration was very high.

Though I am not a resident of your state, The Washington State PBDE Chemical Action plan will not only help residents of your state, but will serve as a beacon for other states as well as for the nation as a whole.

Thank you for the opportunity to comment on this plan.

Sincerely,

Lynn Sainsbury

Subject: WA Toxics Alert: Help Our State Take a Step Closer in Protecting Kids

Help Our State Take A Step Closer in Protecting Kids

Tell State Agencies to Stand Up to Chemical Industry

Washington Toxics Coalition Action Alert 12/16/05

In just a few months, the Washington State Legislature will have a second chance to protect kids and the environment by passing a bill to end the use of toxic flame retardants (or PBDEs) in consumer products. A draft plan released last week by the departments of Ecology and Health will help passage of this bill because it recommends a ban on all forms of PBDEs, including the most widely used form called deca.

Ask Ecology and Health to remain strong on their recommendations calling for a ban on PBDEs.

Out-of-state chemical manufacturers are putting a tremendous amount of pressure on Ecology and Health to weaken the plan. The bromine industry, based in the Southeast and Midwest, flies representatives into all stakeholder meetings and pays for several lobbyists in Olympia to fight against the legislation.

Ask Ecology and Health not to yield to the chemical industry. Please send in comments today.

The Department of Ecology is accepting public comments on the draft PBDE Action Plan until Friday, December 30, 2005. For more information on this issue, please visit our website.

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**The Washington Toxics Coalition is a non-profit membership-based organization dedicated to protecting human health by preventing pollution in industry, agriculture, schools, and the home. If you are not already a member, please consider joining! Dues are $35 per year. Members receive our quarterly newsletter and periodic action alerts.

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Dear Mr. Gallagher,

I am very concerned about the effects of persistent toxic chemicals on the public's health, and especially our children's health. I thank the departments of Ecology and Health for taking action on the critical issue of toxic flame retardants known as polybrominated diphenyl ethers (PBDEs).

I fully support your current recommendations in the draft plan and ask you to remain strong in including them in the final plan:

* Ban all three forms of PBDEs, especially deca, in consumer products. Because deca is used in massive quantities and has shown to break down into even more problematic forms of the chemical, it is prudent to eliminate its use to prevent future harm. Many companies have eliminated deca, including market leaders such as Sony, Dell, and HP.

* Require state agencies to give preference to PBDE-free products when making purchasing decisions. The government should lead by example and purchase products that do not contain these chemicals.

* Improve U.S. chemical policy so that chemicals such as PBDEs don't wind up in products used in our homes, offices, and schools. A key component of this federal reform starts at the state level. The state should start by preventing the use of toxic chemicals in consumer products.

We need leadership and policies from the state that will stem the tide of toxic chemicals that we, and especially our children, are exposed to on a daily basis. Please do everything within your power to protect the citizens of Washington state by continuing your efforts to eliminate our exposure to PBDEs.

Thank you.

Sincerely

Ann Blake
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December 29, 2005

Mike Gallagher, PBT Coordinator
Department of Ecology
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Olympia, WA 98504-7600

Dear Mr. Gallagher:

We are writing as members and supporters of the Toxic-Free Legacy Coalition—a broad-based alliance of environmental, health, and professional organizations working to eliminate persistent toxic chemicals in Washington State—to urge your agency to issue a final PBDE chemical action plan that takes strong action to phase out all forms of PBDEs, especially deca.

Strong action on PBDEs is needed because they belong to a class of chemicals called persistent toxic chemicals (or PBTs). These chemicals do not break down, but instead remain in the environment for long periods of time, build up in the food chain and our bodies, and are toxic in very small amounts. Scientific studies have shown that exposure to PBDEs, like the long-banned PCBs, can result in neurological and thyroid problems. These chemicals are found in numerous consumer products, such as electronics and furniture, and can leach out to contaminate our homes, offices, schools, and bodies.

We are especially concerned about the health and environmental impacts of the deca form of PBDEs for these reasons:

- **Deca is the most heavily used form of PBDEs in the United States.** Approximately 24,500 tons of deca is put into consumer products in the United States each year, four times as much as is used in Europe. This amount is expected to rise nearly 14% per year, primarily due to increased use in residential upholstered furniture and mattresses.
- **Deca is building up in our bodies and environment.** Deca is building up in people, wildlife, and our homes and work places. Studies have found deca in women's breast milk, our bodies, house dust, food, peregrine falcons, polar bears, and gulls in polar regions.
- **Deca breaks down into other toxic forms of PBDEs.** Studies show that deca readily breaks down into the already-banned penta and octa forms of PBDEs and into other harmful chemicals.
- **Deca and its breakdown products pose a threat to children's health.** Recent scientific studies link deca and its breakdown products to many of the same health effects that may result from exposure to the penta form of PBDE, which has been banned in numerous states. These health effects include thyroid problems and neurodevelopmental problems such as learning and behavior problems.
- **We are exposed to deca and its breakdown products on a daily basis.** Because deca is so prevalent in the consumer products we use everyday, like televisions and furniture, our families are exposed to deca on a daily basis. An estimated 500 million pounds of deca is already in consumer products in our homes, offices, schools, and landfills.

Many cost-effective alternatives to deca exist that do not compromise fire safety. Numerous companies have already announced plans to phase out of deca in favor of several alternatives, including using less problematic chemicals or switching to more inherently fire resistant materials. Sony, Philips, Electrolux, Dell, Intel, Apple, Ikea, Hewlett Packard, Panasonic, and Sharp are just a few of the companies that have switched, or will be switching, to deca-free alternatives.

PCBs, the chemical cousins of PBDEs, provide a cautionary example of the health, environmental, and economic impacts caused by persistent toxic chemicals. Banned thirty years ago after being

linked to many of the same health effects as PBDEs, including cancer, endocrine system problems, and thyroid problems, we are still dealing with their toxic legacy. PCBs can still be found in salmon, orca whales, and humans. Businesses and taxpayers continue to pay millions of dollars each year to clean up PCB-contaminated sites. Clearly, we cannot afford another PCB tragedy. Unfortunately without swift state action, we are headed down a similar road.

We fully support the PBDE phase out plan and specifically urge you to recommend the following:

- **Ban all three forms of PBDEs in consumer products, especially deca.** Because deca is used in massive quantities and has been shown to break down into even more problematic forms of the chemical, it is prudent to eliminate its use to prevent future harm. Many companies have eliminated deca, including market leaders such as Sony, Dell, and HP.
- **Require state agencies to give preference to PBDE-free products when making purchasing decisions.** The government should lead by example and purchase products that do not contain these chemicals.
- **Improve U.S. chemical policy so that chemicals like PBDEs don't end up in products used in our homes, offices, and schools.** A key component of this federal reform starts at the state level. The state should start by preventing the use of toxic chemicals in consumer products.

Finally, we would like the plan to recognize that safer alternatives to deca exist today. Ecology's and Health's own data shows that one widely used phosphate-based flame retardant does not qualify as a persistent toxic chemical under Ecology's PBT criteria. If a chemical is not a PBT, it is safer from an environmental and health perspective than PBDEs, which Ecology has classified as PBTs. Also, Ecology should recognize that safer materials, like bio-based plastics, currently are available and that several companies have already started using them.

By putting forward a strong state plan to eliminate PBDEs, Ecology can help make sure our environment is not contaminated with PBDEs and that Washington state remains a healthy and safe place for our children to grow, play, and learn. We urge you to keep the plan recommendations strong.

We appreciate the time and resources your agency has put into developing the phase out plan.

Sincerely,

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