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COMMENTS FROM THE NATURAL RESOURCES DEFENSE COUNCIL ON "FLAME RETARDANTS USED IN FLEXIBLE POLYURETHANE FOAM: AN ALTERNATIVES ASSESSMENT UPDATE- DRAFT" FROM U.S. EPA DESIGN FOR THE ENVIRONMENT

We appreciate this opportunity to submit comments on behalf of the Natural Resources Defense Council (NRDC), a non-profit organization with over 1.3 million members and activists. NRDC has no financial interest in any of the chemicals or products that may be the subject of these comments.

We generally support DfE's program and its efforts to identify safer replacements for hazardous chemicals. However, we are concerned that the Program has some fundamental flaws that need to be addressed, which are evident in the updated assessment. Significant amongst these are: the failure to consider and endorse non-chemical approaches, the identification of substances with major data gaps as potentially preferable, the reliance on models that are inadequate for identifying potential harm, and the reliance on non-evidence based assumptions regarding bioavailability and hazard.

As described in the report, DfE alternatives assessments only consider chemical replacements that could be used with minimal changes to manufacturing and supply chain processes ("drop-in" chemical replacements). This narrow approach excludes other methods with the potential to completely eliminate hazards from flame retardants (such as removal of flame retardants from foam).

For both upholstered furniture and children's products, an outdated California standard drove the use of flame retardants in foam.[1,2] Recent updates by the state have implemented improved fire safety standards that can be achieved without the use chemical flame retardants and also established that since a number of children's products do not pose a fire hazard, they are exempted from the flammability standard.[3] Thus, in meeting the new standard, manufacturers can remove flame retardants from the foam of upholstered furniture and children's products and maintain safety while eliminating the hazards associated with these chemicals.

That being said, we still commend the agency for this timely Alternatives Assessment update to include flame retardants currently used for upholstered consumer products containing flexible polyurethane foam. Through a transparent and well-documented process, this report finds that the majority of chemicals assessed pose an unacceptably high hazard to human health and the environment and

[1] Stapleton HM, Klosterhaus S, Keller A, Ferguson PL, van Bergen S, Cooper E, et al. Identification of flame retardants in polyurethane foam collected from baby products. Environmental Science & Technology. 2011 Jun;45(12):5323–31.

[2] Stapleton HM, Sharma S, Getzinger G, Ferguson PL, Gabriel M, Webster TF, et al. Novel and High Volume Use Flame Retardants in US Couches Reflective of the 2005 PentaBDE Phase Out. Environmental Science & Technology [Internet]. 2012 Nov; Available from: http://dx.doi.org/10.1021/es303471d

[3] http://www.bhfti.ca.gov/about/laws/propregs.shtml

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therefore should not be used in consumer goods. The halogenated, non-halogenated aromatic phosphates, melamine and proprietary mixture flame retardants were all identified as having undesirable hazard profiles.

Unfortunately, for the chemicals identified as potentially safer alternatives, this report provides only a screening-level assessment, with significant further efforts required to fill data gaps and diminish uncertainty to positively establish lower hazard.

As outlined in our comments below, the Update Draft has several valuable components, but there are also important deficiencies that must be addressed before the report is finalized. Our comments will highlight both the strengths and weaknesses of the Update Draft, and focus on nine specific topics outlined below:

Strengths

1. The scope of the report is appropriately expanded to cover all upholstered consumer products containing flexible polyurethane foam that could contribute to harmful flame retardant exposures.
2. Individual flame retardant chemicals known to be used as a mixture are evaluated separately and together, with the highest-hazard mixture component determining the hazard ratings for the mixture.
3. Some hazards associated with the preparation of flame retardants for use in flexible polyurethane foam are evaluated.

Weaknesses

4. Not using any chemical flame retardants in foam needs to be described and encouraged, since this is the only approach which will eliminate all of the chemical-associated hazards.
5. The report should clearly indicate which flame retardants do NOT have preferable profiles based on the hazard assessment.
6. The report should highlight previous DfE findings that flame retardants can contribute to the formation of toxic combustion by-products.
7. Aquatic toxicity models are insufficient for evaluating poorly soluble substances and hazard designations should not be assigned for acute or chronic aquatic toxicity when a chemical's solubility or other physicochemical parameters fall outside of the model's range.
8. "Potentially preferable" chemicals have significant data gaps for health hazard and endocrine disruption endpoints and should be described as "needing more study".
9. A molecular weight above 1,000 (MW>1,000) is not the appropriate cut off for bioavailability and needs to be re-evaluated. Moreover, low bioavailability should <u>not be used</u> to dismiss hazards without solid evidence.

DETAILED COMMENTS

STRENGTHS

1. **The scope of the report is appropriately expanded to cover all upholstered consumer products containing flexible polyurethane foam that could contribute to harmful flame retardant exposures.**

We commend DfE for expanding the scope of the report to include flame retardants that have been identified in all upholstered consumer products containing flexible polyurethane foam. The updated report now considers flame retardants identified in children's products such as car seats and nursing pillows in addition to furniture flame retardants. It is appropriate for DfE to include these products, as indicated in the report, because flame retardants are often added in the manufacturing of foam, and even products with small amounts of foam will contain additive chemical flame retardants. Flame retardant uses in non-furniture products have the same potential to contribute to human exposure as furniture uses, and thus should also be scrutinized for hazard reduction opportunities.

2. **Individual flame retardant chemicals known to be used as a mixture are evaluated separately and together, with the highest-hazard mixture component determining the hazard ratings for the mixture.**

In the case of flame retardant products that are mixtures of individual flame retardant chemicals, DfE's approach to apply the highest hazard designation for any one component of the mixture as the hazard designation for the whole mixture is scientifically sound. This approach is especially appropriate for instances in which the mixture product has little or no empirical data available for toxicity of the mixture.

3. **Some hazards associated with the preparation of flame retardants for use in flexible polyurethane foam are evaluated.**

Although this report is not a full life-cycle assessment, it is appropriate that DfE includes the hazards associated with the chemical washes used to prepare expandable graphite for commercial use. Though the exact composition of the chemical wash varies between manufacturers, the fact remains that workers do not have a choice when it comes to what chemicals they work with, and they are already vulnerable to a variety of other potentially harmful occupational exposures. These hazards should and must be taken into account. In the future, DfE should characterize similar potential hazards from the manufacturing and production processes associated with other chemicals, not just expandable graphite, in its assessments.

It is unclear whether residuals from the chemical washes might be present as an additive along with the graphite flame retardant in the foam. This point should be clarified.

WEAKNESSES

4. **Not using any chemical flame retardants in foam needs to be described and encouraged, since this is the only approach which will eliminate all of the chemical-associated hazards.**

For both upholstered furniture and children's products, simply eliminating the use of all chemical flame retardants from the foam is the best option to eliminate health hazards associated with flame retardants. California recently updated[4] the TB-117 flammability standard that drove the use of flame retardants in the foam of upholstered furniture and children's products. For upholstered furniture, the new standard, TB-117-2013, can be met through the use of smolder-resistant fabrics and barrier materials, without the use of any chemical flame retardant additives in foam. In addition to the three juvenile products that were exempted from meeting the standard in 2010, more than a dozen other juvenile products are now exempted from meeting TB-117-2013. These juvenile products are not subject to any other flammability standard. Under the California Safer Consumer Products Program, the Department of Toxic Substances Control recognized that removing flame retardants from the foam of certain children's products was likely the best and safest alternative available to manufacturers[5]. The chapter on "Alternative Solutions Not Assessed in this Report" should include information on flame retardant removal.

5. The report should clearly indicate which flame retardants do NOT have preferable profiles based on the hazard assessment.

Section 2.2, "Hazard and Fate Results by Chemical Group," describes the findings of the assessment for various endpoints by chemical group, but only presents conclusions for the flame retardants that are evaluated to have potentially preferable profiles. For example, the hazard profiles for APP and expandable graphite are stated to "indicate lower levels of concern than the other profiles in this report." No such conclusions are presented for the halogenated flame retardants, melamine, aromatic non-halogenated phosphates, or proprietary mixtures. The report should clearly identify the chemicals that do not have preferable profiles based on the hazard assessment, and explicitly state that the high hazard chemicals are not recommended as alternatives.

6. The report should highlight previous DfE findings that flame retardants can contribute to the formation of toxic combustion by-products.

DfE's report, "Flame Retardant Alternatives for Hexabromocyclododecane," [6] gives some general information about flame retardants and notes that some flame retardants "…contribute to hazardous by-products from a smoldering or fully engaged fire (e.g., carbon monoxide and smoke (Nelson 1998; Peck 2011)) when inhibiting combustion. Some halogenated flame retardants will yield additional hazardous by-products (e.g., halogenated dioxins and furans) during incomplete combustion (Sidhu, Morgan et al. 2013)." New studies add to the body of evidence that halogenated flame retardants, including polymerics, can increase fire toxicity.[7] In its current evaluation of flame retardants in flexible polyurethane foam, DfE should acknowledge that the toxic, combustion-related by-products associated with flame retardants are also a health concern for upholstered consumer product uses, even if the hazards of combustion by-products are not evaluated.

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[4] http://www.bhfti.ca.gov/about/laws/propregs.shtml

[5] California Department of Toxic Substances Control. "Priority Product Profile: Children's Foam Padded Sleeping Products Containing TDCPP." March 2014. Available at: http://www.dtsc.ca.gov/SCP/upload/ProfileTDCCP.pdf

[6] US EPA. Flame Retardant Alternatives for Hexabromocyclododecane (HBCD) [Internet]. Design for the Environment; 2014. Report No.: 740R14001. Available from: http://www.epa.gov/dfe/pubs/projects/hbcd/index.htm

[7] Molyneux S, Stec AA, Hull TR. The effect of gas phase flame retardants on fire effluent toxicity. Polymer Degradation and Stability. 2014 Aug;106:36–46.

7. **Aquatic toxicity models are insufficient for evaluating poorly soluble substances and hazard designations should not be assigned for acute or chronic aquatic toxicity when a chemical's solubility or other physicochemical parameters fall outside of the model's range.**

The inadequacy of the aquatic toxicity models for evaluating the poorly soluble flame retardants (TBB, TBPH, APP, and expandable graphite) is noted, yet low hazard designations are still assigned for these endpoints. The model deficiencies are serious enough to make the predictions unreliable, requiring that hazard ratings not be assigned for the acute or chronic aquatic toxicity endpoints for these particular chemicals.

As DfE has done for the respiratory sensitization endpoints, these endpoints should be left blank when data are not available and an appropriate model is not available. A "Low" rating should only be assigned when adequate data indicate a lack of aquatic toxicity, either empirical data or output from a validated model. Designation of a "Low" aquatic toxicity in the absence of such data and with chemicals known to fall outside of the model's predictive range is misleading.

DfE should further develop its models to be able to account for and predict aquatic toxicity associated with poorly soluble substances.

8. **"Potentially preferable" chemicals have significant data gaps for health hazard and endocrine disruption endpoints and should be described as "needing more study."**

Rather than concluding that the chemicals with significant data gaps indicate lower levels of concern than the other profiles in the report, the conclusion should more appropriately be that adequate data are needed to address these gaps. Only once these data are available can a hazard determination be established with any confidence.

Only one of the "potentially preferable" chemicals (diethyl bis(2-hydroxyethyl)aminomethylphosphonate) has existing empirical data regarding its environmental fate, and these data lead to a "High" hazard rating for persistence.

All of the chemicals indicated as "potentially preferable" are missing empirical data for at least half of the human health hazard endpoints, and none have any data available on potential endocrine disruption activity:

"Potentially preferable" flame retardant	**Human health hazard endpoints <u>without</u> empirical data**	**Endocrine activity**
APP	63% (7/11)	Limited bioavailability expected (see next point below about MW>1,000 and bioavailability)
Expandable graphite	63% (7/11) "Low confidence in hazard profile due to lack of empirical data"	No data located
Diethyl bis(2-hydroxyethyl)aminomethylphosphonate	45% (5/11)	No data located
Oligomeric ethyl ethylene phosphate	72% (8/11)	Limited bioavailability expected (see next point below about MW>1,000 and bioavailability)
Oligomeric phosphonate polyol	72% (8/11)	No data located

We are very concerned that there are no data available for endocrine disruption for the entire category of flame retardants assigned lower levels of hazard in the other human health endpoints. While DfE's approach to summarizing data on endocrine activity was appropriate, the lack of any empirical data on the interaction of the chemicals listed above with the estrogen, androgen or thyroid hormonal pathways is a serious data gap that again calls into question the designation of the above chemicals as "potentially preferable."

For example, in the 2005 report,[8] several of the Firemaster 550 components lacked empirical data for health endpoints, and were assigned Low or Moderate ratings, resulting in a potentially preferable hazard profile. In the current update report, with more empirical data now available, many of the hazard ratings have risen from Low to Moderate or Moderate to High, with a resulting profile that is not preferable. This experience indicates that when there are significant data gaps associated with a chemical, caution is warranted and more study is needed before indicating that the chemical may be preferable.

9. A molecular weight above 1,000 (MW>1,000) is not the appropriate cut off for bioavailability and needs to be re-evaluated. Moreover, low bioavailability should <u>not be used</u> to dismiss hazards without solid evidence.

Throughout the report, higher molecular weight components (MW>1,000) are assumed to not contribute to toxicity because such components are expected to have limited bioavailability. However, DfE should consult with other EPA scientists on the appropriateness of this metric, given that other polymeric flame retardants with MW>1,000 have been found to contaminate biological specimens such as gull's eggs. These findings reveal that substances with higher molecular weights can exhibit bioavailability, indicating that the MW cut off for bioavailability needs to be raised.

Furthermore, low bioavailability in of itself is not sufficient to establish low hazard. Unless there are specific data to the contrary, it is inappropriate to assume that low expected bioavailability results in low hazard. The flame retardant DecaBDE was long thought to have low bioavailability, and thus to be "inert." We now know that this prediction was quite wrong.[9] DfE would be well served by creating more extensive guidance about how to consider bioavailability in combination with various hazards, as good guidance is not available from EPA or other sources and this is a resource that assessors need.

CONCLUSION

While this report provides some useful information on a number of chemical flame retardant additives, without further scientific study, these flame retardants cannot be deemed safe for human health or the

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[8] US EPA. Furniture flame retardancy partnership: environmental profiles of chemical flame-retardant alternatives for low-density polyurethane foam [Internet]. U.S. Environmental Protection Agency; 2005. Available from: http://www.epa.gov/dfe/pubs/flameret/ffr-alt.htm

[9] Betts KS. Research challenges assumptions about flame retardant. Environmental Science & Technology. 2004 Jan;38(1):8A–9A.

environment. DfE should not dismiss hazards without solid evidence, and data gaps should be clearly identified as such.

DfE should indicate that removal of all chemical flame retardants from foam where possible is the preferred alternative that presents the least hazard for human health and the environment.

A number of the chemicals analyzed in this report are also identified for assessment under the TSCA Work Plan (e.g., TBB, TBPH and TCEP). We trust that the flame retardant use information compiled for this report, as well as the weaknesses pointed out here, will be used to inform and develop the TSCA assessments so that they are robust and scientifically sound.

Thank you for your consideration of these comments. Please feel free to contact me with any questions.

Respectfully,

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