SILENT SPRING INSTITUTE
Researching the Environment and Women's Health

320 Nevada Street, Suite 302, Newton, MA 02460 / 617.332.4288 / www.silentspring.org

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Carcinogen Identification Committee
c/o Tyler Saechao
Office of Environmental Health Hazard Assessment
1001 I Street
P. O. Box 4010, MS-12B
Sacramento, California 95812-4010

Comments submitted electronically via https://oehha.ca.gov/comments

RE: Consideration of perfluorooctane sulfonic acid (PFOS) and its salts and transformation and degradation precursors for possible listing under Proposition 65 based on carcinogenicity

Dear Office of Environmental Health Hazard Assessment,

We are writing to comment in support of listing perfluorooctane sulfonic acid (PFOS) and its salts and transformation and degradation precursors under the Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65). We are scientists at Silent Spring Institute, an independent research organization that investigates links between the environment and women's health, with a focus on breast cancer. Silent Spring was founded as a collaboration of scientists, clinicians, and families affected by breast cancer, with a mission to conduct environmental health research that can inform disease prevention. We have studied PFAS in drinking water,[1,2] consumer products,[3] and blood.[4] Silent Spring currently has four federally funded research studies on PFAS, including 1) Massachusetts PFAS and Your Health Study, part of a larger study funded by CDC/ATSDR to study health effects of PFAS exposures from drinking water, 2) PFAS-REACH, based in Massachusetts and New Hampshire, which is assessing the relationship between PFAS and pediatric immunotoxicity, 3) STEEP, led by the University of Rhode Island, which is investigating the environmental transport of PFAS and health effects related to exposure, and 4) a newly funded National Science Foundation study to investigate policy responses to PFAS at multiple levels of governance. We also have a study supported by the state-funded California Breast Cancer Research Program to investigate the impact of California's Proposition 65 on exposure to breast carcinogens and endocrine disrupting chemicals.

[1] Schaider, L. A., Rudel, R. A., Ackerman, J. M., Dunagan, S. C., & Brody, J. G. (2014). Pharmaceuticals, perfluorosurfactants, and other organic wastewater compounds in public drinking water wells in a shallow sand and gravel aquifer. *Science of the Total Environment*, *468*, 384-393.
[2] Hu, X. C., Andrews, D. Q., Lindstrom, A. B., Bruton, T. A., Schaider, L. A., Grandjean, P., ... & Sunderland, E. M. (2016). Detection of poly-and perfluoroalkyl substances (PFASs) in US drinking water linked to industrial sites, military fire training areas, and wastewater treatment plants. *Environmental science & technology letters*, *3*(10), 344-350.
[3] Schaider, L. A., Balan, S. A., Blum, A., Andrews, D. Q., Strynar, M. J., Dickinson, M. E., ... & Peaslee, G. F. (2017). Fluorinated compounds in US fast food packaging. *Environmental science & technology letters*, *4*(3), 105-111.
[4] Boronow, K. E., Brody, J. G., Schaider, L. A., Peaslee, G. F., Havas, L., & Cohn, B. A. (2019). Serum concentrations of PFASs and exposure-related behaviors in African American and non-Hispanic white women. *Journal of exposure science & environmental epidemiology*, *29*(2), 206-217.

Chemicals in the PFAS family are of concern for many health endpoints relevant to a Proposition 65 listing, including cancer, reproductive toxicity, and developmental effects on the mammary gland.[5] Our own research has documented ubiquitous exposures to PFAS, including PFOS. For example, as work conducted as part of the California-based Women Firefighters Biomonitoring Collaborative, we detected PFOS in 100% of study participants; we also found that firefighters deployed in fire events had higher serum levels of PFOS compared to drivers, signaling this is an occupationally-relevant exposure.[6,7]

We support listing PFOS and its salts and precursors under Proposition 65 given their impacts on health, and frequent detection in consumer products. We also urge future listings to expand to other compounds in the PFAS class given shared hazard traits. We discuss these points in great detail below.

It is critical to include precursors in this listing, as they are frequently detected in consumer products

PFAS precursors released from products can be transformed in humans or the environment into highly stable terminal perfluoroalkyl sulfonic acids (e.g., PFOS) and perfluoroalkyl carboxylates.[8,9] Our research and that of others has demonstrated that PFAS precursors are detected frequently in consumer products. In a recent study, we screened 61 children's products for 36 extractable PFAS and measured PFAS precursors in a subset of 30 products using the Total Oxidizable Precursor assay. We found that many products frequently used by children and adolescents contained PFAS precursors (i.e., precursors were detected in 19 of 30 products analyzed), and precursor concentrations and detection frequencies often exceeded target analyte concentrations and detection frequencies.[10] For example, PFPeA was detected in 4.9% of products and its precursors were detected in 57% of the products when the TOP assay was used. This finding is consistent with other studies.[11,12,13] For example, while PFOS was one of the more infrequently detected PFAS compounds in our study, Ye et al. (2015) found that PFOS precursors (e.g., N-methyl

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[5] Agency for Toxic Substances & Disease Registry (ATSDR). (2019). *Toxicological Profile for Perfluoroalkyls*. https://www.atsdr.cdc.gov/toxprofiles/tp.asp?id=1117&tid=237

[6] Clarity C, Trowbridge J, Gerona R, Ona K, McMaster M, Bessonneau V, et al. 2020. Associations between polyfluoroalkyl substance and organophosphate flame retardant exposures and telomere length in a cohort of women firefighters and office workers in San Francisco. medRxiv : the preprint server for health sciences.

[7] Trowbridge, J., Gerona, R. R., Lin, T., Rudel, R. A., Bessonneau, V., Buren, H., & Morello-Frosch, R. (2020). Exposure to perfluoroalkyl substances in a cohort of women firefighters and office workers in San Francisco. *Environmental science & technology*, *54*(6), 3363-3374.

[8] D'eon, J. C., & Mabury, S. A. (2011). Exploring indirect sources of human exposure to perfluoroalkyl carboxylates (PFCAs): evaluating uptake, elimination, and biotransformation of polyfluoroalkyl phosphate esters (PAPs) in the rat. *Environmental health perspectives*, *119*(3), 344-350.

[9] D'eon, J. C., & Mabury, S. A. (2007). Production of perfluorinated carboxylic acids (PFCAs) from the biotransformation of polyfluoroalkyl phosphate surfactants (PAPS): exploring routes of human contamination. *Environmental science & technology*, *41*(13), 4799-4805.

[10] Rodgers, K., Swartz, C., Occhialini, J., Bassignani, P., McCurdy, M., & Schaider, L. (2021, October 3-7). *Do Product Labels Predict the Presence of PFAS in Consumer Items Used by Children and Adolescents?* FLUOROS Global 2021 Meeting, Virtual.

[11] Robel, A. E., Marshall, K., Dickinson, M., Lunderberg, D., Butt, C., Peaslee, G., ... & Field, J. A. (2017). Closing the mass balance on fluorine on papers and textiles. *Environmental science & technology*, *51*(16), 9022-9032.

[12] Ye, F., Zushi, Y., & Masunaga, S. (2015). Survey of perfluoroalkyl acids (PFAAs) and their precursors present in Japanese consumer products. *Chemosphere*, *127*, 262-268.

[13] Zhu, H., & Kannan, K. (2020). Total oxidizable precursor assay in the determination of perfluoroalkyl acids in textiles collected from the United States. *Environmental Pollution*, *265*, 114940.

perfluorooctane sulfonamidoethanol) had higher detection frequencies and concentrations than PFOS in their study of a variety of consumer products. Given these findings, it is critical that any Proposition 65 listing also include PFOS precursors that can be transformed into highly stable terminal PFOS in the body and environment.

A class-based approach to PFAS regulation is necessary

We commend OEHHA for proposing to not only list PFOS but also include its salts and precursors. OEHHA's document "Evidence on the Carcinogenicity of Perfluorooctane Sulfonic Acid (PFOS) and Its Salts and Transformation and Degradation Precursors," it includes a "non-exhaustive" list of 169 PFOS precursors. While this is a step in the right direction, we hope that future proposals for new Proposition 65 listings will consider the entire class of PFAS compounds. EPA's Comptox Database now indicates that there are over 9,000 PFAS[14] and over 1,400 individual PFAS have been associated with industrial uses and consumer products[15], meaning it would be impossible to study each one individually and inadvisable to regulate just a subset of PFAS. Newer generation PFAS—including those used to replace the long-chain compounds —are also highly extremely persistent and mobile in the environment[16], and recent studies raise concern about their potential toxicity. For example, animal studies have shown reproductive and developmental toxicity associated with perfluorobutane sulfonic acid (PFBS)[17,18] and perfluorohexanoic acid (PFHxA)[19], two common replacements for PFOS and PFOA.

Listing PFAS as class would be consistent with other regulatory approaches, including those adopted by other California-based agencies, and expert advice. For example, California's Department of Toxic Substances Control is regulating PFAS as a chemical class, citing this approach as "logical" and "necessary" given that all studied PFAS, or their degradation, reaction, or metabolism products, display common hazardous traits.[20] In 2019, the European Union recommended an action plan to eliminate all non-essential uses of PFAS.[21] In Massachusetts, the Administrative Council on Toxics Use Reduction recently moved to amend the Toxic Use Reduction Act (TURA) List so that PFAS is regulated as a class for their reporting rule for those PFAS that contain a perfluoroalkyl moiety with three or more carbons or a perfluoroalkylether moiety with two or more. The Scientific Advisory Board concurred that it was important to consider the entire lifecycle and include transformation and degradation precursors, which is consistent with OEHHA's proposal to list PFAS precursors as well. The American Public Health Association and a number of expert scientists including Dr. Linda Birnbaum, former head of the National Institute for

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14 PFAS Master List of PFAS Substances (Version 2), EPA, https://comptox.epa.gov/dashboard/chemical_lists/pfasmaster

15 Glüge, J., Scheringer, M., Cousins, I. T., DeWitt, J. C., Goldenman, G., Herzke, D., ... & Wang, Z. (2020). An overview of the uses of per-and polyfluoroalkyl substances (PFAS). *Environmental Science: Processes & Impacts*, *22*(12), 2345-2373.

16 Wang, Z., Cousins, I. T., Scheringer, M., & Hungerbuehler, K. (2015). Hazard assessment of fluorinated alternatives to long-chain perfluoroalkyl acids (PFAAs) and their precursors: status quo, ongoing challenges and possible solutions. *Environment international*, *75*, 172-179.

17 Feng, X., Cao, X., Zhao, S., Wang, X., Hua, X., Chen, L., & Chen, L. (2017). Exposure of pregnant mice to perfluorobutanesulfonate causes hypothyroxinemia and developmental abnormalities in female offspring. *Toxicological Sciences*, *155*(2), 409-419.

18 Das, K. P., Grey, B. E., Zehr, R. D., Wood, C. R., Butenhoff, J. L., Chang, S. C., ... & Lau, C. (2008). Effects of perfluorobutyrate exposure during pregnancy in the mouse. *Toxicological sciences*, *105*(1), 173-181.

19 Iwai, H., & Hoberman, A. M. (2014). Oral (gavage) combined developmental and perinatal/postnatal reproduction toxicity study of ammonium salt of perfluorinated hexanoic acid in mice. *International journal of toxicology*, *33*(3), 219-237.

20 Bălan, S. A., Mathrani, V. C., Guo, D. F., & Algazi, A. M. (2021). Regulating PFAS as a chemical class under the California Safer Consumer Products Program. *Environmental Health Perspectives*, *129*(2), 025001.

21 Council of the European Union, *Towards a Sustainable Chemicals Policy Strategy of the Union*. 2019: Brussels, Belgium.

Environmental Health Sciences, have recommended approaching PFAS as a class based on their shared chemical properties.[22,23]

While we recommend regulating the entire PFAS class as the most scientifically sound approach, listing PFOS and its salts and precursors is a step in the right direction and consistent with other regulatory approaches. It is critical to take this approach given that research, including our own, frequently detects precursors in consumer products and these can account for a high percentage of total PFAS concentrations. Thank you for the opportunity to provide comments.

Sincerely,

Jennifer Liss Ohayon, PhD
Research Scientist

Robin Dodson, ScD
Research Scientist

[22] American Public Health Association, *Reducing Human Exposure to Highly Fluorinated Chemicals to Protect Public Health.* 2016.

[23] Birnbaum, L., Southerland, B., & Sussman, R. (2021, July 30). EPA must protect public health by regulating PFAS as a class. The Hill. https://thehill.com/opinion/energy-environment/565528-epa-must-protect-public-health-by-regulating-pfas-as-a-class