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I, the undersigned, am writing this statement in support of the Petition to the CPSC to regulate four categories of household products containing non-polymeric additive organohalogen flame retardants.

1. I, Terrence James Collins, am the Teresa Heinz Professor of Green Chemistry in the Department of Chemistry, and the Director of the Institute for Green Science at the Carnegie Mellon University.

My collaboration with environmental health scientists (EHS) has focused on developing appropriate tests to identify chemical properties that give rise to adverse human health effects at low doses through endocrine disruption. Our work has aimed to underpin the development of safe chemicals in general, including safe alternatives to organohalogen chemicals. I have attached a copy of my curriculum vitae and a list of my publications.

In a privately funded collaborative effort spanning five years, my EHS colleagues and I produced and published the Tiered Protocol for Endocrine Disruption (TiPED). This allows green chemists, for the first time, to design with state of the art scientific authority against endocrine disruptors. I am best known for inventing the first small molecule mimics of any of the great families of oxidizing enzymes. My TAML® activators are extensively patented and have been commercialized so I am a friend to the commercial development of chemicals. TAML® activators were TiPED tested in design to ensure no new endocrine disruptor would be commercially produced and those in development have passed all assays as not being endocrine active thus far.

2. Organohalogens used as flame retardants as a class have specific chemical properties that give them a high potential for causing adverse human health effects via multiple mechanisms. Organohalogens tend to bioaccumulate in human and animal tissues. This occurs because halogens, particularly bromine and chlorine, which are broadly used in flame retardants, often cause the organic chemicals to which they are attached to partition from environmental media (particularly water) into living tissues, where they bioaccumulate. This bioaccumulation is driven by the differential solubility of chemicals in fats, oils, lipids (such as what cell walls are made of) and other similar solvents compared with water and aqueous-like media. As organohalogens tend to be more lipophilic (fat-loving) than their non-halogenated analogues, they will bioaccumulate more readily.

3. Depending on the structure of the organic parent compound, the addition of halogen elements can either increase or decrease the compound's reactivity. Either change can impact the compound's toxicological profile leading to an increased risk of adverse health effects in humans. For alkylorganohalogens (such as most chlorinated organophosphate flame retardants), halogens tend to increase reactivity toward the chemical modification of key biomolecules, including DNA and the histone proteins around which DNA is wrapped. These modifications are likely to interfere with gene expression and to increase the likelihood of cancer. For

arylhydrocarbons (carbon ring-like structures with halogens appended, such as most brominated flame retardants), halogens tend to decrease reactivity, impeding the cell's ability to enzymatically break down the arylhydrocarbons thus increasing their lifetime in the cell.

4. Some organohalogen flame retardants are known to be potent endocrine disruptors, so their bioaccumulation leads to additional likelihood of harm to organisms via developmental damage associated with disruption of the endocrine hormone control of cellular development. Arylhydrocarbon organohalogens can mimic natural hormones that at very low concentrations regulate expression of proteins involved in cellular development. This developmental disruption, which appears to occur via disruption of hormone action, is a major cause of human health harm. The adverse health effects are often manifested at very low concentrations (in the range to which people are exposed) and can disrupt development starting *in utero*. Endocrine disruptors can activate gene expression resulting in abnormally high protein production (agonist), or suppress gene expression resulting in abnormal protein deprivation (antagonist). This disruption of the normal expression of control proteins can lead to cells that do not develop and multiply, are less healthy, have altered fates, and are more likely to develop cancer later in the life of the organism. This is one mechanism by which arylhydrocarbon organohalogens such as dioxins function to produce birth defects and cancer. In my professional opinion, such adverse effects should also be anticipated for arylhydrocarbon organohalogen flame retardants.

5. Organohalogen flame retardants can also disrupt DNA function. Arylhydrocarbon organohalogen flame retardants share chemical similarities with compounds that are known to stick to DNA by inserting into the DNA base pair structures. This intercalation can alter the normal function of DNA and can serve as a mechanism for initiating carcinogenesis.

6. When they burn, organohalogen flame retardants produce halogenated dioxins and furans, which are extremely persistent and extremely toxic to humans. This fundamental and thus far inescapable factor in the full life cycle of the entire class of organohalogen flame retardants is a large cause of harm to human health currently and out into the distant future.

7. To summarize, organohalogen flame retardants have highly persistent and toxic combustion by-products, readily bioaccumulate and can resist breakdown inside cells, can modify the DNA or disrupt its function, and can act as endocrine disruptors. To the best of my knowledge, there is no sound evidence showing a lack of health harm for any organohalogen flame retardants studied to date.

8. Based on the above arguments, I would urge the Consumer Product Safety Commission to regulate the use in consumer products of the entire class of non-polymeric additive organohalogen flame retardant chemicals.

Yours sincerely,