EEB
European
Environmental
Bureau

EEB submission to the REACH restriction on the use of per- and polyfluoroalkyl substances (PFASs) in firefighting foams

24/05/2022

General comments

The European Environmental Bureau (EEB) would like to provide comments to strengthen the restriction proposal on the following topics:

- **SCOPE**: we support a grouping approach for PFAS as they share common characteristics of concern, including persistence, mobility, bioaccumulation, and/or toxicity. Moreover, PFAS-containing fire-fighting foams contain many known and unknown individual PFAS chemicals that are released into the environment. Consequently, such restrictions would eliminate these releases. However, we are very concerned with the proposed derogations as this restriction addresses the same uses in FFF as the C6 restriction, while proposing more derogations and vastly longer transition times without a technical justification, therefore, reducing the higher level of protection already supported by RAC and SEAC in their opinions on the C6 restriction.
- **HAZARD ASSESSMENT**: while we agree that a common hazard property of the vast majority of PFAS is persistence, those that have been studied share also concerns of mobility, bioaccumulation, and/or toxicity. Although all PFAS have not been evaluated for all of these criteria, the ones that have been studied share one or more of these characteristics, making it unlikely that understudied/unstudied PFAS do not also share one or more of these characteristics. Hence, we believe a grouping by the "P-sufficient" approach is needed.
- **EXPOSURE ASSESSMENT**: many PFAS are used in different products, for this reason the suggested values underestimate the amount of PFAS in the water, air, and soil. In real life events the PFAS are carried across larger distances via the air into water and soil, this is at least relevant at a scale of a couple kilometres – on top of the known long-range transport effects. If, additionally to this, we consider the longer transitional periods and broader derogations proposed in this dossier, compared to the ones under the PFHxA restriction, we estimate that 2800 tons of PFAS would be emitted additionally.
- **RISK ASSESSMENT**: The present risk assessment follows a case-by-case approach, similar as earlier restriction proposals on microplastics and PFHxA. The planetary boundaries and the irreversibility of the pollution, or the practical impossibility to reverse it; The already existing ubiquitous presence of PFAS and the numerous adverse effects known, are further arguments, as well as the unknown but strongly expected multitude of adverse effects still to be discovered. These arguments are indisputable and inescapable physical realities.
- **ALTERNATIVES**: technically feasible and safer non fluorinated FFF are available and in use for different levels of performance, including for managing fire risks at Seveso sites.

- **TRANSITIONAL PERIODS**: The present restriction dossier proposed transition periods for many sectors, which go well beyond those agreed in their final opinion by the RAC and SEAC in the PFHxA restriction process.

1. Scope

The EEB welcomes the approach to grouping PFAS based on structural similarity (in accordance with OECD definition) and rationale that they have as a common concern their high persistence, together with one or several additional hazardous properties such as mobility, bioaccumulation, and/or toxicity.
However, we are very concerned with the scope of this proposal. The PFAS fire-fighting foam restriction addresses the same uses in FFF as the C6 restriction, while proposing, without a convincing technical justification, more derogations and vastly longer transition times (see overview table below) than those already supported by RAC and SEAC in their recent opinions on the restrictions of PFHxA.

Restrictions	C6			FFF		
Substance scope:	PFHxA and related substances			any substance that contains at least one fully fluorinated methyl (CF_3) or methylene (CF_2) carbon atom		
Fire-fighting applications	*Revised SEAC DO 19/11/2021* [7] EiF=2022 (assumed)			*Pre-publication of Annex XV report* [6] EiF=2026 (assumed)		
	Timeline		Reference	Timeline		Reference
	Stated	Expected		Stated	Expected	
Scope	Manufacturing, placing on the market, use. Substance, mixtures and articles.			any substance that contains at least one fully fluorinated methyl (CF_3) or methylene (CF_2) carbon atom		
Manufacture of substance	EiF+3y	2025	Art. 2+3	EiF+10y(8)	2036	Art. 1
Manufacture of mixture						
General	EiF+3y	2025	Art. 2+3	EiF+10y(8)	2036	Art. 1
Exemption mixtures from mixtures	EiF+5y	2027	Art. 5(c)	NA		
Uses						
Training Testing	EiF+5y[1]	2027	Art. 5(c)	EiF+1.5y[2]	2027	Art. 3(a)
Municipal Civilian ships Portable extinguishers Seveso establishments	(EiF+3y)[4]	2025	(Art. 2(b))	EiF+1.5y	2027	Art. 3(b)
				EiF+3y	2029	Art. 3(c)
				EiF+5y	2031	Art. 3(d)
				EiF+10y	2036	Art. 3(e)
Exemption: large tanks	EiF+12y	2034	Art. 7(a)	NA		
Others	EiF+5y	2027	Art. 5(c)	EiF+5y	2031	Art. 3(f)

2. Hazard assessment

Classical hazards

We agree that a common hazard property of PFAS is persistence, however those that have been studied share also concerns of mobility, bioaccumulation, and/or toxicity. Although all PFAS have not been evaluated for all of these criteria, the ones that have been studied share one or more of these characteristics, making it unlikely that understudied/unstudied PFAS do not also share one or more of these characteristics. The persistence of PFAS is a sufficient basis to warrant regulation regardless of the chemicals' bioaccumulation potential or toxicity, hence, we advocate for grouping according to the **"P-sufficient" approach** (Cousins et al. 2019, Cousins et al. 2020).

Regarding the environmental impacts, we should consider the effect of all PFAS, including **fluoropolymers,** during their life-cycle, from manufacture ("beginning of life") and waste management ("end of life"). Specifically: (i) some fluorinated polymers (e.g. PTFE fine powder) are still manufactured using processing aids containing hazardous long-chain PFAAs (e.g. PFOA), which are widely distributed in the environment and can undergo long-range global transport, (ii) a wide range of potentially hazardous byproducts have been observed in the environment near fluoropolymer manufacturing sites (SWD(2020) 249 final, Environ. Sci. Technol. 2020, 54, 12820−12828), (iii) environmental emissions of these persistent polymers during use and at end of life are problematic given the current concern regarding persistent microplastics in the environment, and (iv) the best available technology for treatment of solid wastes is currently incineration, from which emissions of harmful chemicals including certain PFAS could occur if incineration is not operated according to international guidelines (Environ. Sci.: Processes Impacts, 2020, 22, 1444) and European legislation.[1] Therefore, impacts of all PFAS (including fluorinated polymers), should be considered in the risk assessment process during their whole lifecycle.

We agree that the PFAS that have been studied for toxicity produce toxicity in living organisms across a range of doses and endpoints, but an assertion that the hazards differ between individual substances and between groupings of different chemical structure is somewhat vague and fails to address that a major concern of PFAS-containing fire-fighting foams is that the predominant PFAS contained in them are the well-studied PFAS.[2] It is therefore likely that the toxicity of PFAS in PFAS-containing fire-fighting foams will be at least as great as predominant PFAS (C8 or C6).

While we support the **arrowhead concept**, it is important to consider that not all PFAS are arrowhead substances or precursors. A study by McDonough et al., 2020 identified that some of the PFAS in the formulation they used were likely biologically degraded into PFAS which they did not expect to find and these PFAS bioaccumulated more strongly than the arrowhead substance in the experimental animals. **This means that it may not be possible to accurately predict the number and type of PFAS in the environment and/or living organisms based on chemical evaluation of precursors and putative arrowheads in PFAS-containing fire-fighting foams**. Consequently, a restriction on PFAS in fire-fighting foams **must also include these potential environmental and biological novel degradation products that may yet not even be identified**, especially in the formulations themselves.

While we agree that chain length can affect **mobility** (in water), release into and movement through air is not limited to short-chain PFAAs. For example, a paper published by Galloway et al. in 2020 in Environmental Science and Technology demonstrated that both PFOA (a longer-chain PFCA) and HFPO dimer acid (a six carbon perfluoroalkyl ether carboxylic acid) were both detected 40+ km away from a point of emission and were transported via atmospheric transport. In fact, PFOA was detected at points more distant from the point of emission than HFPO-DA, which may suggest longer range atmospheric transport for PFOA than its shorter chain counterpart. PFOA travels just as far as a shorter chain compound, so mobility in water is not the only concern, but it would also be the transport in air which is not thoroughly considered in this proposal. When PFAS are emitted into the air, they can be transported to Arctic and high

[1] Art. 50 (2) of the Industrial Emissions Directive 2010/75 sets a minimum temperature of 1100 °C for hazardous waste containing more than 1% of halogenated organic substances, such as PFAS.

[2] In our contribution to the public consultation on the PFHxA restriction (contribution #3107, original text reproduced in section 12), we provided a full identification of all surfactants used in fire-fighting foams currently being legally sold at scale on the European market. According to stakeholders, registration data and logic, these substances are: CAS 34455-29-3 and 80475-32-7, jointly totalling 98% of the market. Another five identified substances are used below 1 t/y. All of these substances are C6-based, i.e. in the scope of the restriction on PFHxA and related substances, and certainly well-studied.

mountain regions (Joerss H. et al. 2020, Joerss H. et al. 2021). They are also transported over long distances when dissolved in water. In Hesse, 364 groundwater monitoring point inspections for 21 different PFAS were carried out annually from 2009 to 2016. PFAS could be detected at about 90 % of the measuring points (Gassmann M. et al. 2021).

Many PFAS are used in different products, PFAS (such as the side-chain fluorinated polymers) are released in the water, air, and soil. In real life fire events, the PFAS are carried across larger distances via the air into water and soil, just because the flames carry them away. This is at least relevant at a scale of a couple kilometres - on top of the known long-range transport effects. The additional emissions that these releases produce, are further explained in the exposure assessment section below.

Distribution modelling has not been assessed in this dossier, as opposed to the PFHxA dossier. However, such modelling could reinforce the mobility assessment in this dossier and inform the RAC and SEAC's opinion. Likewise, long-range transport is mentioned in section B.4.2.5, however it does not have a full analysis like in the case of PFHxA and the PFOA dossiers.

In order to ensure coherence among the different RAC opinions on PFAS we recommend to include all hazards that have been identified in previous opinions, (e.g. immunotoxicity, cholesterolemia, etc.), e.g. from the restriction processes on PFOA and PFHxS.

Hazards from waste incineration

The Annex XV dossier assumes emissions of 1% of the PFAS during incineration (p. 87), assuming disposal in "hazardous waste incinerator[s] and cement kilns" - reportedly "best available techniques" (p. 65).

It should first be clarified that the Waste Incineration BREF,[3] the relevant document setting *Best Available Techniques* (or BATs, as defined by the IED 2010/75, Art. 2 (10)) does not identify any BAT on the incineration of PFAS-containing waste. The correct legal reference is IED Art. 50 (2), which sets a minimum temperature of 1100 °C for the incineration of hazardous waste containing more than 1% of halogenated (i.e. also fluorinated) organic substances. The legislation provides no possibilities to derogate from this requirement.

On p. 69, the dossier submitter states that emissions from incineration are *not well known* in nature and quantity, and that *the impact of greenhouse gases has not been calculated*.

However, there is conclusive evidence that incineration of PFAS at lower temperatures (e.g. the typical 850 °C of household waste incinerators) leads to quasi-quantitative formation of extraordinarily potent greenhouse gases.[4] As these are well-known peer-reviewed studies, we suggest using them as a baseline for the estimation of emissions from incineration - instead of assuming zero or near-zero emissions!

In the meantime, public authorities have also become increasingly aware of this issue and engaged in work to derive more precise knowledge.[5] We urge the dossier submitter to take into account these references and to update estimations with reasonable best-case and worst-case scenarios.

It can be assumed that 1100 °C is indeed an appropriate temperature to break down PFAS into inorganic fluoride - provided waste gas cleaning under basic conditions is carried out, as otherwise highly corrosive and toxic hydrofluoric acid is released. However, the dossier submitter should under no circumstances assume that these 1100 °C are universally respected in the EU just because they are a legal obligation. In

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[3] Available here, and Commission Implementing Decision 2019/2010.

[4] S. Huber *et al.* (2009): Emissions from incineration of fluoropolymer materials, OR 12/2009, Norwegian Institute for Air Research (NILU), available here, and references therein.

[5] e.g. RIVM's 2021 study "PFAS in waste incinerator flue gases", available here. The US EPA issued a draft guidance in 2020 with a wealth of explanations and references, available here.

blatant disregard of EU law, Antwerp-based hazardous waste incinerator Indaver was issued a permit allowing them to burn halogenated waste at temperatures down to 950 °C.[6] The company explicitly applies this to PFAS at "temperatures above 800 °C" (!) according to a newspaper article.[7] Currently, investigations are ongoing to determine the nature of the gases emitted - one should certainly expect substantial presence of potent and long-lived greenhouse gases. Fragments of other PFAS would not come as a surprise either.

The fact that a permit was issued and that the company publicly admits to low temperatures in use hints that the European law is likely not broadly known, and in any case probably poorly implemented.

Therefore we urge the **dossier submitter to update their assumptions**, for example possibly based on temperature data from compliance reports[8] by relevant incineration facilities.

Additionally, we would like to highlight that the results (page 55) from the recent EU wide biomonitoring project HB4EU show that over 14% of the European teenagers analysed had levels of several PFAS (PFOS + PFHxS + PFOA + PFNA) in their bodies that, when combined, exceeded assumed safe levels set by the European Food Safety Authority). This means that their health may be harmed by these chemicals. The HBM4EU results on PFAS demonstrate the urgent need to reduce human exposure levels. This is only the tip of the iceberg as very few PFAS have been included in biomonitoring programs.

3. Exposure assessment

The Annex XV dossier assumes (table 2, p. 35) that annual emissions of PFAS amount to ca. 470 t/y in the EU.[9] This figure appears plausible based on the stated columns of foams and concentrates used in this dossier. The dossier submitter also assumes p. 34 that in real fire events, water collection is less effective than in training - this appears reasonable: photographs of real-life fires show that foam is applied well beyond the object in flames; and it is well-known that flames and hot air carry the PFAS across a distance, largely leading to contamination of soil and water.

On the other hand, these data also allow us to calculate the amount of additional, and avoidable emissions from the long transition periods and broad derogations of this restriction proposal. This calculation is detailed in the table below.

Sector	PFHxA restriction end date for use[10]	Foams restriction end date for use[11]	Delay (y)	Annual volume (t/y)	Total volume (t)[12]
Municipal	2025	2027	2	50	100

[6] Permit available here, see paragraph 7 on p. 24.

[7] Gazet van Antwerpen, 24th June 2021, article available here.

[8] Based on IED Art. 55.

[9] This table contains a remarkable oversight, equating "oil/(petro-)chemical sites" to Seveso sites, overlooking that only a tiny minority, namely 135, of the 11378 Seveso sites are registered as "petrochemical / oil refineries". Another 653 Seveso sites are "chemical installations" (see also our input on specific question 3).

[10] Based on transition periods in the final opinion, the date of the agreement of the final opinion (December 2021) and the legal deadlines in REACH Art. 72 and 73.

[11] Based on the transition periods in the Annex XV dossier and an assumed entry into force in 2026.

[12] Assuming that phase-out at individual sites is driven by legal deadlines.

Civilian ships	2025	2029	4	50	200
Portable extinguishers	2025	2031	6	10	60
Defence	2027	2031	4	20	120
Civil aviation	2027	2031	4	40	240
SUB-TOTAL					600
Seveso sites (except large tanks)	2025	2036	11	200	2200[13]
Large tanks	2034	2036			
GRAND TOTAL					2800

This calculation shows that 2800 tons of PFAS would be emitted additionally because of the present restriction's longer transition periods and broader derogations than under the PFHxA restriction. The biggest driver for the additional emissions is doubtlessly the broadening of the restriction from tanks > 400 m^2 (in the final opinion of the PFHxA restriction) to all Seveso sites.
As these deviations are hardly technically justified by the present dossier (notably regarding Seveso sites, on p. 76 of the dossier), and taking into account the faster phase-out in progressive American States[14], it can be assumed that these emissions are not only additional, but also unnecessary.

4. Risk assessment

The present Annex XV dossier's risk assessment follows a case-by-case approach, very much like earlier restriction proposals on microplastics and PFHxA. This approach appears justified by this analogy (PFHxA being a PFAS), as well as by the nature of the general and specific hazards of PFAS.
The dossier submitter bases the argument on planetary boundaries and the irreversibility of the pollution, or the practical impossibility to reverse it. The already existing ubiquitous presence of PFAS and the numerous adverse effects known are further arguments, as well as the unknown but strongly expected multitude of adverse effects still to be discovered. These arguments are not classical (eco)toxicological arguments, but they are indisputable and inescapable physical realities.

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[13] Given that no granularity is available on how many fires on large tanks (> 400 m^2) can be assumed with respect to fire in all Seveso sites, this figure is a worst-case scenario. However, this worst-case scenario appears plausible for the following reason: very likely under the PFHxA restriction, very few operators would have stayed with fluorinated foams for their large tanks despite the exemption, as there is no demonstrated technical or safety advantage.
[14] Notably, but not only: Washington State (end of transition period (TP) 1/1/2024, no derogations possible), Illinois (end of TP 1/1/2025, possibilities for notification-based derogations until 1/1/2027) and Connecticut (see also section 7) end of TP 1/10/2021, case-by-case extensions possible until 1/10/2023), see the summary by the Fire Fighting Foam Coalition, AFFF Update June 2021, available here.

Further aspects not mentioned in the conclusion, but which could make the conclusion even stronger, could be:

- the limitation of the arrowhead approach: degradation pathways are multifarious, and in many cases, the arrowhead substance is not the one with the weakest hazards.
- the fate of PFAS under incineration conditions, in fire events or in controlled incineration under insufficiently high temperatures: emission of largely unidentified degradation products, whereby potential formation of long-lived and potent greenhouse gases has been identified.
- inappropriate disposal methods of PFAS by users unaware of the presence of PFAS, due to insufficient awareness and labelling requirements (or the implementation of existing ones).

5. Alternatives Assessment

Information on alternatives for Seveso plants in the Annex XV dossier

The Annex XV dossier proposes a derogation for all Seveso sites. However, the dossier is internally inconsistent as it does not analyse the availability of alternatives for Seveso sites, and it also contradicts itself in several occasions:

- The dossier's summary (p. 3) acknowledges that "alternative [...] foams are available and have been successfully used in the sectors identified above". The "sectors identified above" include the "oil/(petro-)chemical sector". This not only means that a general, indiscriminate derogation to all oil and (petro-)chemical activities is not justified. It also means that the even broader derogation to all Seveso sites (see also our answer on specific question 3) is even less justified.
- Section E.2.5 of the annex, supposed to explain the dossier submitter's choice of a broad derogation for all Seveso sites, contains no analysis of alternatives regarding Seveso sites. It only deals (in subsection E.2.5.7) with the smaller sector (see also our answer on specific question 3) of "petrochemical processing and large tank farms". Note that the formulation "large tank farms" is also different, and broader than the formulation in the final opinion to the PFHxA restriction, which is closer to "large tanks in tank farms".
- In section E.2.6.2, the dossier mentions five onshore facilities (including an oil refinery) being in the process of converting to fluorine-free foams. The fact that a refinery is converting to fluorine-free foams indicates that they are not waiting for further demonstration of performance. It is worth noting that the Mongstad refinery, the only refinery in the Equinor group, boasts tanks of a surface in excess of 1600 m^2, i.e. four times larger than the threshold for the derogation in the final opinion of the PFHxA restriction - logically obviating the need of such a derogation.

It is worth noting that none of the following authoritative documents signal a non-availability of fluorine-free foams for Seveso sites in general:

- The 2019 Wood report, used as the basis for the alternatives assessment of this restriction report, only mentions the number of Seveso sites and states that they present a fire hazard (p. 64 and 389). The question of the efficacy of fluorinated or fluorine-free foams is not addressed.
- Information in annex section E.2.5.7 details results of various very large tests. These tests showed "satisfactory results" and "appropriate performance" and it is acknowledged that results from tanks

of 60 m diameter[15] can be extrapolated "no reason to doubt" to tanks larger than 80 m in diameter. Quite obviously, the settings of the technical equipment and the application rates have to be adapted - as they generally have to be with changes in foam characteristics (not only when switching to fluorine-free foams). Determining these parameters is exactly the purpose of such tests!

- The Annex XV dossier of the PFHxA restriction does not address Seveso sites. It proposed a derogation only for certain defence uses (later dropped) and for large fuel tanks > 500 m^2.

Information on alternatives for Seveso plants in the Wood 2020 report

The Wood report, purportedly the basis of this Annex XV dossier, does not provide any justification on suitability of fluorine-containing or fluorine-free foams for Seveso sites.
Its Appendix 7, the "pre-annex XV dossier", which is admittedly and understandably less specific about potential derogations, does not provide any basis for an extension to Seveso plants.

Information on alternatives for Seveso plants from the PFHxA restriction process

- The Annex XV dossier of the PFHxA restriction states on p. 54, that according to experts [at the 2019 Commission workshop], "it is likely that solutions for the derogated uses in the petrochemical industry will be available within the next years". With the confirmed conversion process at the Mongstad, Norway refinery, this 2019 statement has confirmed its truth in 2022. Consequently, the Annex XV dossier for the present restriction should be updated accordingly, to take into account current knowledge.
- The final opinion of the PFHxA restriction dropped the initially proposed derogation for defence uses, thereby limiting the transition time to 2027 (paragraph 5 of the conditions) supposing formalisation of the final opinion according to REACH Art. 72 and 73).
- More importantly, the final opinion of the PFHxA restriction states in its justification (paragraph 7(a), p. 11 of the revised draft final opinion) "it was confirmed that experience shows that fluorine free fire-fighting foams are able to extinguish fires up to 400 m^2."
- Interestingly, the final opinion states (ibid.) that the SEAC "expects [the fire-fighting foams restriction dossier" to contain clarifying information on [the justification of a derogation based on the Seveso status][16]." Unfortunately the present dossier does not provide any information on this relevant question.

Criteria for being considered an alternative

Performance standards, notably EN 1568 parts 3 and 4 were regarded as good (at least sufficiently good) proxies for performance in real life events. As an example, the Wood report links (p. 109, step 2) technical feasibility to "compliance with performance standards, differences in volumes and frequency of use

[15] Note that the PFHxA restriction's limit for "large tanks" is 400 m^2 in surface area, which corresponds to 22 m in diameter only! Tanks of 60 m diameter are consequently truly huge.
[16] Requested by two industry lobby groups in contributions to the public consultations (#889 by Eurofeu and #935 by the Fire Fighting Foam Coalition), also mentioned in the final opinion.

required”[17]. Its market survey collected extensive data on the performance standards met by fluorinated and fluorine-free foams, which are copied into section E.2.4 of the annex to the Annex XV report. However, the Annex XV dossier does not mention those standards, nor the significance of the different performance ratings foams can achieve. Consequently, no conclusions are drawn from those performance tests, generally used by foam producers to advertise and describe their products. In many cases, fluorinated foams achieve lower ratings than fluorine-free foams; however also those lower performing fluorine-containing foams are successful on the market. Consequently, it appears to us that there is no rationale to assume that fluorine-free foams cannot cover the same area of applications as PFAS-containing foams.

6. Transitional periods

As mentioned in our comments on the scope, the present restriction dossier proposed transition periods for many sectors, go well beyond those agreed in their final opinion by the RAC and SEAC in the PFHxA restriction process.

Restrictions	C6			FFF		
Substance scope:	PFHxA and related substances			any substance that contains at least one fully fluorinated methyl (CF_3) or methylene (CF_2) carbon atom		
Fire-fighting applications	*Revised SEAC DO 19/11/2021* [7] EiF=2022 (assumed)			*Pre-publication of Annex XV report* [6] EiF=2026 (assumed)		
	Timeline		Reference	Timeline		Reference
	Stated	Expected		Stated	Expected	
Scope	Manufacturing, placing on the market, use. Substance, mixtures and articles.			any substance that contains at least one fully fluorinated methyl (CF_3) or methylene (CF_2) carbon atom		
Manufacture of substance	EiF+3y	2025	Art. 2+3	EiF+10y(8)	2036	Art. 1
Manufacture of mixture						
General	EiF+3y	2025	Art. 2+3	EiF+10y(8)	2036	Art. 1
Exemption mixtures from mixtures	EiF+5y	2027	Art. 5(c)	NA		
Uses						
Training Testing	EiF+5y[1]	2027	Art. 5(c)	EiF+1.5y[2]	2027	Art. 3(a)
Municipal	(EiF+3y)[4]	2025	(Art. 2(b))	EiF+1.5y	2027	Art. 3(b)
Civilian ships				EiF+3y	2029	Art. 3(c)
Portable extinguishers				EiF+5y	2031	Art. 3(d)
Seveso establishments				EiF+10y	2036	Art. 3(e)
Exemption: large tanks	EiF+12y	2034	Art. 7(a)	NA		
Others	EiF+5y	2027	Art. 5(c)	EiF+5y	2031	Art. 3(f)

Among these, especially the length of the derogation on Seveso plants (irrespective of the breadth of the derogation) is not justified (section 2.8.2 of the dossier). The dossier submitter mentions that a transition period of 10 to 12 years is “broadly consistent with the reported duration of the transition by the Norwegian oil and gas company Equinor”, and refers to the case study in Annex E.2.6.

However, that case study reveals that this conversion started with a product development and approval period of 4 years (2010-2014), and a joint development by then Statoil and Solberg. This is a completely normal process for a first mover, but the knowledge gained in this process can be directly transposed to other sites. In a further 2 years after the product approval, 30 of Equinor’s 31 sites had been converted successfully!

[17] It is unclear to us what property “frequency of use” refers to; another reference to the term on p. A15 does not clarify the issue.

In this sense, a 2-year transition period would certainly be ambitious, but not impossible.[18] The 3-year conversion period allowed by the PFHxA restriction would be substantially more realistic.

One should not forget that risk-averse operators, or those anticipating a slow conversion, can start or will have started their conversions already. Not least since the dossier publication of the PFHxA restriction dossier in 2019, most companies will have been aware of the upcoming changes - providing good communication via their associations. As of that moment, any operator could have started a conversion process.

Long derogation periods are mainly convenient for late adopters. Innovative and can-do approaches are needed more broadly for the rapid changes necessary to transition away from fossil fuels. Shorter transition periods, as exemplified in the forward moving American states,[19] should rather be the norm.

7. Case study: best regulatory practice

Finally, we would like to bring to the committees' attention the situation in the State of Connecticut, US. As mentioned earlier, Connecticut signed in July 2021 a law[20] banning fluorinated fire-fighting foams as of October 2021. Case-by-case extensions from this deadline can be granted for a maximum of two years (i.e. expiring on 1st October 2023) for operators of a "chemical plant, oil refinery, or terminal, storage or distribution facility for flammable liquids".[21]

The state runs a user-friendly website informing operators and the public about the ban (not least using an easy-to-understand infographic), about operators having been granted extensions as well as about alternatives.[22] Furthermore, the state established a take-back scheme to help municipal fire brigades to replace their stocks and dispose of the PFAS-containing foams according to best management practices.

One noteworthy aspect of Connecticut's ban is the conditionality of its legal validity upon the identification of an alternative foam. Subdivision (2) of section (1.b) of the bill ties the applicability of the ban to the condition that the Commissioner of Energy and Environmental Protection identifies an alternative. Indeed, the said commissioner identified such a valid alternative[23] in a working group involving "fire service leaders from around the state, as well as personnel from the Department of Energy and Environmental Protection's Emergency Response Unit and Remediation Division".

This process is a good example of an independent and expert-led decision: none of the people involved had financial stakes in the use of one or the other commercial product. Experts regarding the only relevant aspects, namely safety in use and environmental risks, were the decision makers. Foam providers were not directly involved but were in a healthy competition to get their product identified.

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[18] It should be noted that Connecticut's ban (see also section 7) on PFAS in fire-fighting foams was signed in July 2021; it provides for a transition period of less than 6 months, with possibilities for an extension of a maximum of 2 years, until 01/01/2023.

[19] e.g. of the order of two years (including all possibilities for extension) in the case of Connecticut. See also section 7.

[20] Public Act No. 21-191, Substitute Senate Bill No. 837, available here.

[21] It should be noted that this description is substantially narrower than that of "Seveso plants".

[22] Available here.

[23] Official order available here, the identified alternative is "National Universal[(R)]F3 Green", which was independently confirmed to be "PFAS- and halogen-free".

Specific Information Requests

8. Question 3: Definitions of industrial installations

QUESTION: Paragraph 3b and 3e of the proposed restriction (see section 2.2.5) details a transitional period of 10 years after entry into force for establishments covered by Directive 2012/18/EU (Seveso III Directive; both upper and lower tiers). Are the definitions in this Directive appropriate to identify the industrial installations that require 10 years to transition to alternative (PFAS-free) firefighting foams? If not, how else could such a distinction be practically made at a European level?

In the restriction process on PFHxA, regarding the use in fire-fighting foams, the dossier submitter proposed

- (5.c)[24] a transition period of 5 years for fire-fighting foams in class B fires
  - with a derogation for training and testing where emissions are minimised and effluents collected and safely disposed of
  - (6) and a derogation for defence applications as long as substitutes are not available for sea-going units, air traffic facilities and storage of fuel,
- (8) a transition period of 12 years for tanks with a surface area above 500 m^2.

After consideration of the dossier and the information submitted into the public consultations, the RAC and SEAC's final opinion, agreed in December 2021, settled on a mostly more restrictive regime:

- (5.c)[25] a transition period of 5 years for fire-fighting foams in class B fires
  - with a derogation for training and testing where emissions are minimised and effluents collected and safely disposed of
  - [derogation on defence applications deleted]
- (7.a) a transition period of 12 years for tanks with a surface area above **400** m^2 [emphasis added] and the bunded areas they are in.

The dossier on PFAS in fire-fighting foams proposes to substantially relax these conditions, by proposing broader and longer derogations, most strongly, but not exclusively[26] by derogating the use of fluorinated fire-fighting foams in Seveso facilities. The broadening to all Seveso installations constitutes substantial backtracking, which is neither consistent with information submitted and conclusions drawn under the PFHxA restriction, nor with trends and developments in other parts of the world, notably with bans in places such as Washington State, Connecticut or Illinois – which boast many types of Seveso facilities.[27]
At least three aspects illustrate that the extension to all Seveso facilities equates to substantial broadening, going well beyond demonstrable needs for a derogation:

- Broadening in Seveso hazard classes: the PFHxA restriction derogation only applies to facilities storing fuel (which would correspond to Seveso type P5c); the fire-fighting foams restriction broadens this to all Seveso types. Consequently, the derogation would apply to all 11378 Seveso

[24] Numbering in the Annex XV dossier proposal.
[25] Numbering in the RAC and SEAC final opinion proposal.
[26] An comparative overview of the transition periods and derogations under both restriction proposals can be downloaded here: https://drive.google.com/file/d/1ylqPSJEwqMLO5jGXBPox3D6u3GY23yqU/view?usp=sharing.
[27] a useful summary is provided by the Fire Fighting Foam Coalition, AFFF Update June 2021, available from: www.fffc.org, also from: https://drive.google.com/file/d/1ylqPSJEwqMLO5jGXBPox3D6u3GY23yqU/view?usp=sharing. This information has already been submitted into the public consultation on PFHxA, comment 929 in the ORCOM document.

facilities currently registered, instead of less than 900 facilities storing fuel, as under the PFHxA restriction.[28]

- Broadening in types of fires: the PFHxA restriction only covers class B fires (i.e. burning liquids), whereas the fire-fighting foams restriction covers essentially all types of fires.
- Broadening in facility size: the PFHxA restriction covered only parts of facilities with storage tanks above 400 m^2. Each such tank will hold at least several thousands of cubic metres, or several thousand tonnes of combustible materials. As most facilities have tens or hundreds of tanks (many of which likely smaller in volume), the size of most relevant facilities can be assumed to be of the order of $5 \cdot 10^4$ to $5 \cdot 10^6$ tonnes of storage capacity. In those facilities, fluorinated foams may only be used on the largest tanks and their bunded areas, not on other parts of the plant.[29] As a contrast, the lower-tier threshold under the Seveso directive (Annex I, category P5c) is a mere 5 000 tons (roughly the size of a single tank under the PFHxA restriction derogation), and the fluorinated foams may be used on any part of the installation.

Because of these three effects with respect to the final opinion of the PFHxA restriction, the conflicts between both restrictions may lead to a substantial increase of facilities continuing to use fluorinated substances for no safety benefit, but with substantially increased risks to the environment and human health.
We would also like to highlight that it is entirely unclear what the rationale or the driving force behind broadening the derogation (with respect to the PFHxA restriction) to all Seveso sites could be:

- The often-cited Wood report of 2020,[30] purportedly the conceptual basis for the present restriction proposal, does not explain nor justify this derogation. The text only informs about the number of Seveso sites and their propensity for fire accidents (on p. 64, and subsequently, wit identical text on p. 389). It does not inform about any suitability of fluorine-containing or fluorine-free foams for Seveso sites in general.
- The industrial player's workshop slides, an integral part of this report, does not mention Seveso sites either. On p. 273, Eurofeu's presentation calls for continued use of fluorinated foams for "high-risk areas (e.g. chemical/petrochemical industry, airports, fuel depots) until combined measures allow for use of Fluorine Free Foams (F3) <u>*without sacrificing the level of fire safety*</u>." In other words, Eurofeu does not request such a broad derogation, nor such an indiscriminate one: the sane fire safety can be demonstrably achieved in virtually all situations with fluorine-free foams, as established by RAC and SEAC in the PFHxA opinion development.
- Seveso sites also include those with acutely toxic or environmentally toxic (but not especially flammable) substances at quantities of the order of 100 kg. It is obvious that this represents no particular fire hazard. It is less obvious why such facilities (categories H and E of Annex I of the Severso III directive) should be allowed to use fluorinated fire-fighting foams.

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[28] eSPIRS database, May 2022. Facility counts for categories "fuel storage" and "refineries" were selected; the number 900 is likely an overestimation as many facilities will not have tanks larger than 400 m2 in size.
[29] It may sound impractical to have two different foam systems on the same facility. However, it should be borne in mind that the derogation equates to a right, not to an obligation to use fluorinated foams. There is no necessity either to use them, and legal bans are coming into place in more progressive parts of the world (see EEB's contribution #929 to the public consultations on the PFHxA restriction, question 7, or section 11).
[30] Wood/Ramboll/Cowi Final Report: The use of PFAS and fluorine-free alternatives in fire-fighting foams.

- The present Annex XV does not appear to provide any justification for the extension to Seveso sites. To the contrary on p. 4, it states that the derogation is justified, yet it omits to provide the justification.
- Lastly, only two documents have been found that hints to a source of the extension to Seveso sites: Eurofeu's contribution to the restriction on PFHxA, document #889 in the ORCOM document, and in the Fire Fighting Foam Coalition's (FFFC) contribution #935. In section 1.2, the Eurofeu contribution states "[...] asking a derogation to the Seveso-status of a site [...] would be more flexible and practicable. This is clearly a somewhat altered version of Eurofeu's 2019 position mentioned earlier. However, even this document does not hint at any justification why such a derogation would be necessary or justified.

9. Question 6: PFAS removal costs

QUESTION: Any specific information on the costs of treatment (e.g. reverse osmosis) that is effective at removing PFASs from drinking water?

EurEau estimates that reverse osmosis treatment would raise the price of water treatment by more than 1 €/m^3, resulting in circa 200 €/year additional cost for the average household.[31] Additionally, reverse osmosis and nanofiltration do not destroy the removed chemicals, but the waste created (which could represent 25% of the treated water) has to be treated separately.

Treatment cost depends on the threshold value for PFAS in drinking water and increases with stringency of this value.[32]

The treatment cost to secure safe drinking water, however, outweighs the environmental and health costs resulting from the negative health effects of PFAS pollution. As an example, in Sweden the cost to treat PFAS-contaminated raw water to a drinking water standard of 4 ng/L is estimated to 1 billion SEK (ca 95 million euro) per year, while the societal costs of PFAS pollution (linked to infections, low birthweight and premature death) is estimated to 10-17 billion SEK (ca 950 – 162 million euro) annually.[33]

10. Question 10: Enforcement

QUESTION: The conditions of the proposed restriction include a clause on the labelling of firefighting foam concentrates containing non-PFAS organofluorine substances (column 2, paragraph 7 of the proposed restriction) to enable enforcement without requiring targeted analysis of all potential PFASs. Would this requirement facilitate enforcement? Could it be improved?

The dossier does not give any examples of practically or hypothetically existing substances that would be fluorinated surfactants but not PFAS, i.e. the ones requiring labelling. The reference of "non-PFAS organochlorine" on p. 71 of the Annex XV dossier does not clarify what substances could potentially be meant.

The parallel to restriction #75 on tattoo inks (referred to in the footnote) does not appear meaningful: whereas conditions (6) and (7) in that restriction make immediate sense to us, the present labelling proposal is more of an intellectual curiosity. In our opinion, labelling cannot do any harm, but this is a non-issue.

[31] EurEau Briefing Note: Moving Forward on PMT and vPvM Substances (2019), available here: https://www.eureau.org/resources/briefing-notes/3934-briefing-note-on-moving-forward-on-pmt-and-vpvm-substances/file

[32] Franke et al, ACS EST Water 2021, 1, 4, 782–795 https://doi.org/10.1021/acsestwater.0c00141

[33] Swedish Nature Conservation Society (2022) Minst 2 miljoner svenskar har för mycket PFAS i dricksvattnet (in Swedish), available here: https://www.naturskyddsforeningen.se/artiklar/minst-2-miljoner-svenskar-har-for-mycket-pfas-i-dricksvattnet/

We would like to point out an inconsistency in ECHA's approach: in the restriction process on PFHxA and related substances, EEB proposed labelling of PFAS-containing of relevant articles and mixtures for derogated uses and during transition periods.[34] In that process (see p. 64 of the final opinion of the SEAC), the SEAC concluded that *SEAC has no information on the costs associated with a labelling requirement, nor on how purchasers would react to such labels and their effectiveness in promoting awareness and proper waste management. Therefore, SEAC cannot evaluate whether costs and benefits of such requirement would be well balanced*.

It is surprising that an Annex XV dossier published a mere three months later does not provide any learnings from this process and leaves the cost question unassessed.

[34] In contributions #3021 and #3077 to the public consultation; acknowledged but discarded in the RAC and SEAC's draft final opinion.

Annexes

11. Contribution to PFHxA restriction, question 7

Text copied from our contribution to the public consultations on the PFHxA restriction, entry ORCOM #929

The performance of a foam can actually be linked to three parameters:

a. spreading: This is the foam's ability to cover a surface uniformly by flowing freely over the surface of the fuel; this is mostly relevant for gentle application (i.e. where a foam is projected onto a wall or vertical surface) since there is no forward momentum when the foam meets the fuel. Where fixed deluge and spray systems are used, minor differences in spreading rates can be accommodated by adapting the design of such equipment which is tightly regulated in standards such as EN 13565 and NFPA 11. Where forceful application is used, spreading rates have limited relevance as the foam is projected directly onto the fuel's surface with an inherent forward momentum. This momentum pushes the foam across the fuel surface, smothering the fire, irrespective of inherent spreading capacity.

b. extinguishment, i.e. the propensity to quench the fire. This property is assessed in a routine and standardised manner according to EN 1568 (specifically parts 3 and 4). The rapid control and extinguishment of a fire is a key element to all international standards, such as the ones by the International Civil Aviation Organisation (ICAO), Underwriters Laboratories (UL), Factory Mutual (FM) and Lastfire.

c. burnback resistance (i.e. avoiding that a fire can start again after being extinguished). Once a fire has been extinguished, the foam layer is required to hold back any vapours which may reignite above the foam surface. EN 1568 requires a foam to resist flames for a set period of time in order to achieve an acceptable rating. This is also required in all of the listed standards, mentioned above.

A foam's performance on parameters (b) and (c) are usually indicated on technical data sheets, a IA rating (EN 1568 part 3 and 4) being a top rating. High-quality fluorine-free foams routinely meet those specifications; it should be kept in mind that many lower-quality AFFFs also exist and are used. A few examples:

- fluorine-free foams with a top IA rating include Solberg's Versagard AS-100, Angus Fire's Respondol ATF and Bioex' Ecopol Premium;[35]
- C6-based foams with a IIIB or IIIC rating (EN 1568 part 3) include Dr. Sthamer's Moussol®-FF 3/6 F-5 and 3F's Chemex.[[2]]

These are merely a few examples to illustrate that both types of foam exist in many different grades and qualities and therefore it is not correct to state that fluorinated foams perform better than fluorine-free ones, although regrettable substitution should be avoided.

What's more, European Standards such as EN 13565, require lower performing foams to be applied at higher rates in order to compensate for the lower performance, but they do not preclude or limit their use. These ratings and associated fire performance are especially important in extinguishing fires for large storage tanks, as site operators may rely on other sites' supplies of foams (and equipment) in their disaster management plans – this means they will have to work with many different qualities of foam in practice.

[35] Technical data sheets available from https://www.perimeter-solutions.com/wp-content/uploads/2021/02/SOLBERG-VERSAGARD-AS-100_datasheet-VF.pdf, https://angusfire.co.uk/wp-content/uploads/6833-Respondol-ATF3-3-1.pdf and https://www.bio-ex.com/en/our-products/product/ecopol-premium/, respectively

Finally, it should be noted that not all fires can or should be extinguished; in the aftermath of the Buncefield fire (see also part 3 of this response), the UK's Health and Safety Executive issued a final report regarding fuel storage sites.[36]

Recommendations 18 and 19 in part 2 of this report provide high-level summaries on cases where a controlled burn strategy is better than extinguishing the fire. This should be kept in mind against any impression that AFFFs can extinguish any type of fire.

1. Practice does not justify this size limit either. Existing legislation (e.g. in the US) banning the use of fluorinated foams usually only grants case-by-case exemptions, and the general ban does not contain any reference to surface areas. Many states in the US have recently passed such legislation;[37] time limits to exemptions are often much shorter than in the DO: California 2032, Washington State 2028, Illinois 2027, Vermont 2025, Connecticut 2023. Tank farms in the scope of these bans are, among many others, Motiva's site in New Haven, Connecticut and the Exxon refinery in Joliet, Illinois, which both host numerous tanks in excess of 400 m^2, and even up to 2000 m^2.[38] The DO remains below the ambition and technical possibilities demonstrated by legislation elsewhere.

Regarding ECHA's request on the possibility to fully contain AFFFs in the event of an accident, we provide the following information:

2. <u>Containment by the bunded area:</u> In a best-case scenario, bunded areas are built to retain leaks of fuel or chemicals until the leak can be dealt with, but their resistance to fires has proven to be insufficient. The Buncefield Fire in the UK in 2005, one of the major fire events in tank farms, showed failures in the bunded areas, releasing large quantities of fluorinated foams (actually still C8-based) to the environment. Due to the fire burning for several days in bunded areas of three different construction types, leakages were observed because of heat damage to the concrete walls, movements of concrete slabs, and joints and sealants damaged by the heat. The attached expert report[39] summarises the lessons learnt; we have highlighted relevant passages for the readers' convenience.

In a worst-case scenario, bunded areas are not even protected by an impermeable layer in the soil. Although bunds can be retrofitted,[40] many bunded areas in the EU have probably not been equipped with such linings, allowing fuel and foam to seep through the ground after the event. In addition, some tanks may even not be equipped with concrete or brick-and-mortar bunds, but only rely on earth dikes.

A long-term derogation for use of fluorinated foams may therefore not rest on the assumption that bunded areas can reliably retain foams. Controlling the risk of such releases would entail independent detailed checks of the installations, as a minimum against all failure modes described by Tarada and Robery.

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[36] HSE 2009, Safety and environmental standards for fuel storage sites, Process Safety Leadership Group, Final report, available at: https://www.hse.gov.uk/comah/buncefield/fuel-storage-sites.pdf

[37] a useful summary is provided by the Fire Fighting Foam Coalition, AFFF Update June 2021, available from: www.fffc.org, also attached.

[38] Aerial views of relevant sites attached as .pdf files.

[39] F. Tarada, P. Robery (2014) Containment for petroleum products - lessons learnt from Buncefield, UK, Civil Engineering, 167 (CE4), 167-175, dx.doi.org/10.1680/cien.14.00016, attached with highlights of relevant passages.

[40] See e.g. the materials and services offered by Rawell: https://www.rawell.co.uk/sectors/?i=1

Another major fire incident, currently still under investigation, took place at ITC in Deer Park, Texas, US in March 2019. In this event, major environmental pollution was caused by foam being discharged outside of the bunded area[41], by the failure of secondary (i.e. bunds) and of tertiary physical barriers (a dike)[42] designed to contain fuel and foam.[43] Subsequent environmental monitoring[44] documented high concentrations of 6:2 FTS (i.e. PFHxA-related substances) in the waterways around the site.

3. Containment for atmospheric losses: Whoever has seen a smoke plume from a major fire incident knows of the forceful upwards movements of hot air, and knows that soot can be deposited many kilometres away. A sizeable fraction of the foam projected by monitors onto fire will not end up in the bunded areas (even if they withstand the fire), and more will be dragged into the smoke plumes and deposited elsewhere. The fire itself may not be supposed to break up the PFAS from the foam to inorganic fluoride: even dedicated (but certainly insufficiently effective) incinerators fail to destroy PFAS effectively[45], let alone a fire burning at lower temperatures in most parts of the fire. Effective minimisation of releases through the air can in practice only be achieved by using fluorine-free foams.

12. Identification of active substances in AFFFs

Copied from EEB's contribution #3107 to the PFHxA restriction, footnote 18

[EC 252-046-8/CAS 34455-29-3 is] the only substance registered 100-1000 t/y under REACH mentioned in table 4.2, p. 59 in the DG ENVI/ECHA report. Table 4.2 contains three substances of unrevealed identity, most importantly "unknown 1" and "unknown 2" tonnages (of fluorosurfactant, not concentrate) of 138.6 t/y each. These substances can legally and logically only be 34455-29-3 as no other fluorosurfactant (necessarily non-polymeric) was or is registered at >100 t/y. Based on the Eurofeu data, it can thus be safely assumed that 88% of the total market or 298.3 t/y of fluorosurfactants correspond to this substance.

[41] Aerial views illustrating the failures can be found here: https://www.youtube.com/watch?v=dTiTrUNE61E

[42] https://www.chron.com/neighborhood/deerpark/article/Spill-from-ITC-Deer-Park-plant-fire-threatening-13723602.php and https://www.icis.com/explore/resources/news/2019/03/22/10338392/dike-at-fire-hit-itc-chemical-tanks-in-us-la-porte-partially-collapses/

[43] News Release on 23rd March 2019 by the Texas Commission on Environmental Quality, attached

[44] N.A. Aly et al. (2020) Temporal and spatial analysis of per and polyfluoroalkyl substances in surface waters of Houston ship channel following a large-scale industrial fire incident, Environmental Pollution, 265, 115009, doi.org/10.1016/j.envpol.2020.115009

[45] An example of such incorrect disposal is described here: https://theintercept.com/2020/04/28/toxic-pfas-afff-upstate-new-york/