OIL TECHNICS, UK

Response to SEAC Draft Opinion on Proposed PFAS Restrictions in Firefighting Foams: Relating to <u>Offshore sector</u>

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Executive Summary

Oil Technics appreciates this opportunity to make a submission to ECHA, regarding the SEAC (Socio-Economic Assessment Committee) draft opinion on the proposed restrictions of PFAS in firefighting foams. This submission provides detailed evidence for an extension to the proposed transition period for Offshore Installations to 10 years with review, since it is at least if not more onerous than fires on Seveso III sites, because they are:

- Congested and confined multi-level hazardous facilities.
- accommodation adjacent to hazardous areas.
- limited personnel escape options with little separation distances from safe and hazardous areas.
- fires spread quickly offshore (aided by wind) requiring the most effective agents to prevent rapid escalation and life loss.
- Fluorine Free Foam (F3) alternatives cannot deliver required fire performance functionality when seawater (only available water supply offshore) and non-aspirated or very low expansion delivery devices have to be used (necessary to combat adverse effects of wind).
- Disproportionate shut-down, re-engineering, clean-out costs while compromising designed life safety and infrastructure protections.
- Limited remaining operational life of offshore installations as society increasingly transitions to a fossil free energy future.

SEAC is requested to re-consider the evidence provided to justify increasing its transition period to match the 10years with review given to SEVESO III sites, as the risks to lives under these challenging operating conditions are at least as severe as Seveso III sites, possibly more so, due to the congested and constrained limitations for escape to safe areas and the speed with which fires can escalate in constant wind conditions prevalent offshore. Only seawater is available for firefighting operations in winter temperatures that often drop to -18°C in North Sea and Baltic areas. There are no known F3s available which are UL162 listed for approval under such onerous operating conditions.

A. Background

Much work has been done by foam users and the fire industry to control, restrict and prevent legacy C8-PFAS foam use and prevent any foam discharges to the environment. This is focused on collection and containment wherever possible, with firefighter training principally using PFAS-free or Fluorine Free Foams (F3s)[1,2]. Where not possible, only alternative more benign high purity short-chain C6-PFAS foams are used which are collected, contained and disposed of safely according to Jurisdictional requirements. C6-foams are categorised not bioaccumulative nor toxic[3,4], with a short average 32day half-life in humans excreted in urine[5] (compared to 3.8, 5,4 and 8.5 years for PFOA, PFOS and PFHxS respectively[6]). Very different from legacy C8 foams - breaking down to PFOS, PFHxS and PFOA which ceased manufacture by 2002-3[7], are POP listed under the Stockholm Convention, and have already been widely replaced across EU, preventing this historic problem from being perpetuated. Legacy fluorotelomer foams breaking down to small amounts of PFOA also ceased production in 2015 under the US EPA PFOA Stewardship program[8].

Body loadings of legacy C8-PFAS can increase to levels of concern with increasing exposure, hence their earlier tight restrictions on use in most places and banning from use across EU, which is not the case with short-chain C6-PFAS. The US Centre for Disease Control's (CDC) latest 2017-18 PFAS in blood serum survey[9] of the whole US population confirmed that PFOS and PFOA concentrations had declined by 32% compared to the 2011-12 survey results[9] covering all age groups and demographics across the US population. CDC found the main C6 breakdown product PFHxA was not detected within blood serum from any age group or demographic in the US population[9], despite inevitable exposure from the plethora of consumer items containing them from medicines, cosmetics, furnishings, clothing, electronics, computers, food packaging, glossy magazines, mobile phones, even dental floss[10]. Presumably due to short human half-life before excretion in urine[5].

Since early 2016 all leading fluorinated firefighting foams contain only high purity C6-PFAS fluorochemicals (earlier in some cases - which fully comply with EU regulation 2017/1000[11].

Component	Amount allowable under EU regulations EU 2017/1000	1% AFFF LF-C6 concentrate Performance against EU2017
>PFOA or its salts	<u><</u>25ppb	<u><10ppb</u>
>PFOA related substances	<u><</u>1000ppb	<u><1000ppb</u>

This allows their continued use, especially offshore where no known equivalent functionality can be provided by any leading F3s, which as Swedish research shows[21], usually struggle with impaired fire performance using seawater. UL162 listing[12] and our own testing evidence confirms F3s are usually too viscous to be accurately proportioned at 1% under operating conditions of -18ºC, required offshore in both North and Baltic Seas, during winter.

The offshore industry relies on these C6-foams continuing to be accepted for use during emergency fire incidents in EU, as they are in most places. Unless that changes, if the existing transition restriction in SEAC's draft opinion on PFAS in Firefighting Foams becomes implemented, it would prevent the rapid fire control relied upon offshore to retain current low rates of fire impacts.

SEAC recognises these issues as very valid concerns in its draft opinion (p49)[13] stating ***"****However, as explained in Table 9, there is a concern that the transition times proposed by the Dossier Submitter might not be sufficient to ensure the development, full testing and adoption of alternatives suitable for the most challenging types of fires.* ***Given the potential very high impacts of even a single catastrophic fire on human health and the environment, the proportionality of the proposal is uncertain if risks of such catastrophic fires are not kept as low as they are currently. SEAC recommends in this context to adopt a no-regret strategy; that is, a restriction option that remains justifiable whether catastrophic fires take place or not."***

SEAC's draft opinion[13] also clearly confirms (Section 1.2, p9-10) that "*Regarding the transition periods proposed by the dossier submitter,* ***SEAC considers that some transition periods may need to be extended, however, SEAC lacks detailed enough information to recommend a specific length."*** This submission's evidence provides such detail.

The accompanying Information Note[14] specifically confirms information requests considered relevant to this proposal's evaluation includes:

"*1.* ***SEAC would welcome further information on the availability, technical feasibility and implementability of alternative PFAS-free firefighting foams in the following sectors****/activities:*

a. ***<u>offshore exploration and exploitation,</u>***
b. ***transport of flammable liquids in pipelines****,*
c. ***(bulk) transport of flammable liquids on rail and road****,*

d. ***Temporary storage directly related to transportation of dangerous substances****,*

e. ***"Neighbouring establishments" as defined by Seveso Directive*** *(an establishment that is located in such proximity to another establishment so as to increase the risk or consequences of a major accident).*

This submission provides the clear evidence to justify a transition extension to at least 10 years (with review) is necessary, to avoid jeopardising existing life safety and critical infrastructure protections offshore, while maintaining the current reduced risk of catastrophic fires occurring.

B. Activity: <u>Offshore installations</u>
Transitional Period: extension to 10-years - as equivalently challenging hazards to Seveso III sites.

We are encouraged by SEAC's draft opinion[13] confirming **"*SEAC considers that for some applications in industrial facilities*** *and in the defence sector* ***an appropriate performance level of fluorine-free alternatives at the end of the transition periods proposed by the Dossier Submitter <u>has not been fully demonstrated</u>*."** We welcome this acceptance and consider that the sector of Offshore Oil and Gas Installations (ie. including: offshore drilling/jack-up rigs and drilling barges; fixed/semi-submersible offshore oil/gas production and accommodation platforms; spar platforms; associated helidecks; FPSOs [Floating Production, Storage and Offloading vessels]; drill ships; tug boats; offshore supply vessels; associated pipelines; storage etc.) is a key area of industrial facilities where an appropriate F3 performance level cannot be demonstrated (particularly low temperature use in seawater with non-aspirated delivery devices), thereby placing lives under increased risk unless a transition extension is granted. This should be equivalent to Seveso III sites (ie. 10 years transition with review), as offshore operations are at least equally challenging to Seveso III (upper and lower tiers). The evidence justifying this extension follows in this submission.

This offshore sector suffers from the following hazards and obstacles not currently addressed by F3 alternatives:

- space and weight limitations.
- inadequacy of approval testing.
- lack of existing relevant approvals.
- lack of verified fire performance during realistic challenging major fires within specific sectors.
- complexity, cost and 'down-time' required during system transition.
- inability of re-design to meet fire protection requirements because of:
    a. seawater use.
    b. high winds.
    c. extreme operating temperatures.
    d. higher application rates.
    e. extra concentrate storage.
    f. forceful, non-aspirated applications.
    g. risk of overflowing containments.
    h. excessive costs of clean-out, re-design, retro-fits which still do not meet existing life safety protections.
    i. significant Installation decommissioning by 2030.

C. **10-year extension justified for the following reasons:**

1. **The draft opinion**[13] **cautions that "*SEAC has some concerns*** *that other industry/economy sectors than Seveso installations* ***could represent a challenge for fighting fires without PFAS foams (transportation of hazardous chemicals/goods; non-Seveso sites in the vicinity of Seveso sites, etc.).****"*

   SEAC is correct. This concern should include Offshore installations which arguably have at least as challenging an application as Seveso III sites, perhaps more so since they are confined spaces with limited opportunity for personnel to move away from fires, which could spread rapidly, given the usually multi-level, highly congested nature of these platforms where escalation occurs rapidly, often driven by high winds, requiring forceful application of non-aspirated foam spray (at typically 3-4:1 expansion) to reach the target areas for protection.

2. **Offshore installations predominantly use C6 AFFF LF (Low Freeze version)** and C6 AR-AFFF LF firefighting foams for the range of hydrocarbons (Crude Oil, Condensate, Jet A1, Diesel, Asphaltine etc.) and polar solvent fuels (mostly Methanol) found on offshore platforms, and proven effective under testing standard UL162[22,12] (Underwriters Laboratories) verifying acceptability, because the foam is tested under critical application rates at low temperatures and using saltwater (representative of operational seawater) with specific non-aspirated/low expansion delivery devices (≤5:1 expansion) representative of conditions and devices used offshore. NFPA Research Foundation's 2022 Fire Service Roadmap report[15] confirmed "***The research conducted to date suggests that FFFs tend to lose effectiveness when discharged through non-air-aspirating nozzles that produce lower aspirated/aerated foam with expansion ratios less that 4-5*** *(generally speaking)."* We understand there is no F3 alternative which currently meets the existing C6 AFFF LF capability requirements at 1% (required for space/weight saving) and 3% foam concentrates, nor has passed the existing UL162 seawater accreditation[12] under necessary operating conditions down to -18°C widely experienced in EU, UK and Norway during winter.

3. **The US Department of Defense (DoD) in Jan. 2023 issued a new Fluorine Free Foams (F3s) fire performance test standard MIL-PRF-32725**[16] for, but this is specifically designed for **land-based use using freshwater only**, and is not accepted for Naval use, clearly indicating that F3s meeting this specification are not suitable for application in sea water because they are significantly less effective i.e. UNSUITABLE. Any such MilSpec qualified F3 will also have to carry a warning label "**This product is not authorised for US Navy Ship Board Use.**" This standard also seems considerably weakened by:

   - **Single 50ft^2 (4.64m^2) fire test uses 3gpm nozzle [50% higher application rate] on Jet A1** and freshwater (*not seawater and 2gpm nozzle on gasoline as AFFF MilSpec– a much harder test*) - ***potentially placing lives at increased risk.***
   - **Allows 2 passes from 3 attempts** (only 66% success) per test - ***eroding safety factor from 100% pass rate currently.***
   - **28ft^2 (2.6m^2) fire tests use Jet A1 with 10sec preburn - *unrealistically short, avoiding heat build-up*** (*not gasoline with 10sec preburn - tougher*)
   - **Only one 28ft^2 (2.6m^2) fire test with gasoline**, 2gpm nozzle, 60sec preburn, **60sec extinction**, 240sec burnback – **freshwater only** (***not gasolin****e, 2gpm nozzle, 10sec preburn,* ***30sec extinction*** *and 360sec burnback with fresh and seawater*). *Probably not tough enough?*
   - **Burnbacks start after 30secs** (*not within 60 secs implying 55-58secs for AFFF spec.*) *– easier to pass.*
   - **Dry Chemical compatibility uses JetA and freshwater (*not gasoline and SEAwater*) -** *also easier to pass*.
   - **ALL fire tests conducted between 5 and 32°C ambient temps**, making it much easier to pass at 5°C - *unrepresentative of year-round conditions!*
   - **Wind speed reduced to 5mph** (not 10mph) - *so less blanket disturbance*.

- **Viscous concentrates - kinematic viscosity 300cs at 25ºC** (*not 2cs for MilSpec AFFFs at 25ºC*). **NO requirement at 5ºC - *more relevant operationally* , when *AFFF MilSpec is 20cs at 5ºC).***
- **Corrosion rates now tested with 10% F3, diluted in 90% seawater!** (*not 90% AFFF diluted with 10% seawater*) – so presume seawater is less corrosive than F3s?
- **Aquatic toxicity LC50 requirement now reduced over 16-fold to 30ppm with more tolerant Fathead Minnow specified – *a pollution tolerant species*** (*not LC50 requirement of 500ppm with more sensitive Killifish in AFFF MilSpec*). *How good is that for our environment, when far more F3 is likely used?*
- **F3 PFAS content <1ppb - *potentially unrealistic*** - when five leading F3s each tested 10-87ppm TOF (Total Organic Fluorine – virtually all PFAS) by FAA in Jul.2022 report[24] (using US EPA 537.1 method[29]).
- **NO F3s are currently QPL qualified**[17] (at early May 2023), yet 10 C6-AFFFs are QPL qualified[19] under existing MilSpec 24385F[18].

Performance cannot be compared to the existing Defense standard MIL-PRF-24385F(SH)v4, 2020[18] which also permits F3 use offshore - providing any such F3 has been qualified by passing ***ALL*** the detailed fire performance tests in fresh and saltwater required by this specification[19], but none has so far. Evidence from US Naval Research Laboratory's (NRL) 2020 report[20] on F3 fire testing over a 28ft^2 (2.6m^2) pool fire of gasoline confirmed "*Performance of the fluorine-free foams improved when the fuel was switched to heptane and when the solution application rate was increased from 2 gpm to 2.5 gpm with both fluorine-free foams extinguishing the fire in 31 seconds*." Also "*A significant improvement in fire suppression over gasoline was not seen for the fluorine-free foams when the liquid application rate increased from 2.5 to 3 gpm*." NRL concluded[20] **"*The inability of the foams and concentrates to meet critical extinction and property metrics for military qualification testing indicate the difficulties of utilizing these commercial products for Navy operations*** [ie when seawater is used – like Offshore]."

4. **Sweden's Research Institute (RI.SE) conducted extensive fire performance testing on eleven F3s** (Dahlbohm, 2022)[21]. It concluded **"*Testing in seawater generally prolonged*** [F3] ***extinguishment times, or prevented extinguishment."*** It also established that when seawater was used only two F3s extinguished (2min47s and 4min11s), Nine F3s did not extinguish (EN1568-3). Continuing[21] **"*This is assumed to be due to interactions with the fuel causing rapid breakdown of the firefighting foam*."** It also confirmed[21] **"*The more forceful*** [F3] ***application, the greater the fuel pick-up*." None of 11x F3s was able to meet the 10min 25% burnback time** (EN1568-3), only one F3 exceeded this 10min requirement when used at an over-rich induction rate of 4.5% admixture (of nominal 3% foam). It concluded[21] **"*All the findings and conclusions point out the importance to perform tests as close to the real fire hazard situation as possible.*"**

5. **Part of the reason F3s have been unable to achieve this UL162 fire test approval**[22] is because F3s are generally more viscous at room temperature, becoming thicker, even solid or semi-solid as temperatures drop below freezing. Research by Batelle (US Dept. Energy) in 2020[28] assessed seven commercially available PFAS-free Foams (F3s) finding that F3 viscosities up to 90,000centistokes(cs) were possible, although significantly reduced in warmer 25ºC conditions. The new F3 MilSpec limit[16] is 300cs at 25ºC, but no requirement at more important 5ºC (AFFF requirement is 20cs at 5ºC[18]). This is not representative of most commonly occurring offshore operational conditions. It could cause reduced proportioning or potentially complete blockage at low operational temperatures.

   Therefore, F3 users are increasingly likely to experience viscosity issues causing incomplete mixing and reduced proportioning accuracy, especially at lower operating temperatures. Many F3s are unable to operate effectively even at -5ºC.

Only one of the 70 or so currently available F3s we know of, has a UL 162 listing[12] at -6ºC. None has achieved UL162 approval[12] with seawater at -18ºC, necessary to proportion effectively offshore.

6. **F3 foams are incompatible for mixing with any other F3**[16,23], so they cannot be mixed, which prevents mutual aid collaboration amongst platforms nearby during emergencies, even across different operators, which is currently the case. This is an important mutual aid consideration offshore, which would be lacking during any major fire emergency were F3s forced into use.

7. **F3 studies conducted by US Federal Aviation Administration (FAA) in July 2022**[24] confirmed that dry chemical powders (notably potassium bicarbonate widely used throughout aviation including helidecks offshore) reduced performance of all seven leading F3s tested under MilSpec and ICAO Level C protocols against two C6-AFFFs. This testing highlighted "***Overall, none of the tested FFF candidates can be considered a direct replacement for AFFF without compromising the efficacy of fire extinguishment***." *Also "**All the tested FFFs exhibited reduced performance with the application of dry chemical**. … **Since dry chemical is a common auxiliary agent and many ARFF vehicles have dual-agent turret nozzles, this quality may pose significant safety issues in a real-world response.**"…"Additionally, **surface burning was a commonly observed trait of the FFF candidates that is typically not observed with AFFF**."* This testing also confirmed "***extinguishing the fire on the edges of the fire pans and preventing reignition in these areas was generally more difficult with the FFFs than the AFFFs. In the manual application evaluations, this difficulty was more evident and was amplified by the application technique and cohesivity of the foam blanket***." Testing confirmed **F3s did best in over-rich *(15%)* MilSpec tests** *of 3% concentrate*.

FAA reported[24] that "***A direct discharge into the pan or change in direction of application frequently caused fire reignition in areas of the pan that were previously extinguished or pulled the entire foam blanket away from other areas, causing reignition.***" which could have serious consequences offshore as foam blankets are frequently disturbed and blown around changing their direction by wind. These test findings led to FAA issuing a Cert Alert (Oct.21)[25] of public safety concerns confirming *"…**interim research has already identified safety concerns with candidate fluorine-free products** that must be fully evaluated, mitigated, and/or improved **before FAA can adopt an alternative foam that adequately protects the flying public**. **The safety concerns FAA has documented include:***

- ***Notable increase in extinguishment time;***
- ***Issues with fire reigniting (failure to maintain fire suppression); and***
- ***Possible incompatibility with other firefighting agents, existing firefighting equipment, and aircraft rescue training and firefighting strategy that exists today at Part 139 air carrier airports*."**

These same concerns similarly apply to helidecks offshore.

8. **There is little research data on the effectiveness of F3 foams used within non-aspirated systems** especially against wind, when sea water is used, i.e. Risk of failure increases significantly. NFPA's Research Foundation reported in 2020[26] that **"**[F3] ***Expansion ratios of 3-4:1 required double the density of 7-8:1 expansion applications*."** Existing fire systems equipment is integral to offshore structures and not easily removed, cleaned or replaced as it is designed specifically

to combat the problems of wind while effectively controlling fires fast. Space and weight restrictions apply offshore, so adding concentrate for higher application rates and heavier higher aspirating delivery devices (to be blown away by wind) is not a practical or economic option. This would result in likely unacceptable increases in exposure of lives to loss and increasing risk of catastrophic fires by removing vital existing protections delivering unacceptable risks of increased harm.

NFPA-RF also confirmed[26] that (paraphrasing) '**F3 was not a 'drop-in' replacement for C6 AR-AFFF even using freshwater as individual products varied significantly, making it difficult to develop 'generic' design requirements.'** This research also concluded[26] "*From an application rate perspective,* ***the FFFs typically required between 1.5 to 3 times the application rates to produce comparable performance as the baseline AFFF for the range of parameters included in this assessment***." There is no extra space or weight allocation for 2 or 3 times more foam volume on offshore platforms. There is also very little evidence of F3 effectiveness in major industrial fires and no evidence of F3 effectiveness offshore.

9. **The current NFPA 403:2018 Standard for Aircraft Rescue and Firefighting Services at Airports**[32] Annex B.6 explains… "***There has been limited full-scale testing of ICAO C foams, but tests to date have reflected extinguishments on Jet A within 1 minute at ICAO Application rates of 0.992 gpm/ft² (3.75L/min/m²). The 0.13gpm/ft² (5.5L/min/m²) application rate requirement for AFFF meeting MilSpec in NFPA 403 is 40% higher***."

This raises a BIG question: …Are alternative ICAO Level B/C F3s still effective at this low 40% safety factor under challenging operational conditions? …considerably less than existing double or triple safety factors currently used by ICAO Level C/US MilSpec approved C6-AFFFs?

Annex B.6 continues "*Airports adopting ICAO foam concentrates should evaluate equipment requirements any time a switch to a new manufacturer of foam concentrates is considered.*

Therefore, starting with 2018 edition of NFPA 403, the following application rates by test standard are used:

(1) Mil-F 24385 and ICAO Level C = 0.13gpm/ft² or ***5.5L/min/m²***
(2) ICAO Level B = 0.18gpm/ft² or 7.5L/min/m²
(3) ICAO Level A = 0.20gpm/ft² or 8.2L/min/m²"

This is of particular concern to SEAC…and ICAO, when extensive comparative fire testing confirms F3s deliver inferior fire performance to C6-AFFFs and may require typically 2-3times higher application rates to even extinguish test fires on volatile fuels like gasoline and Jet A1. **Safety factors should therefore be significantly higher than just 40%, at least double confirming NFPA's recommendation** for operational use at 7.5L/min/m² or above for ICAO Level B approved F3s across EU (not 5.5L/min/m2 as currently)? This would add substantial exra foam storage on helidecks offshore where space and response times are at a premium when saving lives. We should also consider that F3s in Dubai were probably applied well above this 5.5L/min/m² application rate, after F3 was found not to be working effectively, yet still extinguishment was unachievable and the aircraft burned out after 16 hours[33].

Is it SAFE for Offshore platforms and European airports to be using ICAO Level B F3s at just 5.5L/min/m² application rates, when NFPA 403:2018[32] is recommending ALL ICAO Level B approved foams be used operationally at 7.5L/min/m² minimum, as a requirement to avoid compromising risks to life safety?

This also justifies a 10-year transition extension (with review) for Offshore Installations where helidecks are almost universally operated with personnel year-round.

10. Aviation fire comparison[33,34]

This Dubai aircraft fire has direct relevance Offshore, because there are numerous helicopter flights transporting personnel to and from platforms, day and night, year round, in often difficult weather conditions, which were also faced in Dubai. This is placing unacceptably increased risks to life safety, **particularly in storms and winter when F3s may be very viscous, even semi-solid, so unable to be proportioned effectively. This could prevent any rotary aircraft fire from being controlled or extinguished, leading to potentially catastrophic outcomes**.

Foam Type Used:	**Leading Non-Fluorinated Foam (F3)**	**Fluorinated Foam (C8-AFFF)**
Aircraft; Location:	**Boeing 777 - Dubai Int'l airport, UAE**	**Boeing 777 - Changi airport, Singapore**
Date:	3 Aug. 2016	27 Jun.2016
Major Fire Summary:	Engine detachment during 'attempted go-around' in 48ºC heat with difficult wind shear conditions. The detached engine caused fuselage damage and a subsequent fire. ICAO Level B approved F3 was applied soon after crashing, using non-aspirated jets, causing the foam bubbles ot breakdown on impact (as one would expect AFFF to work effectively).	Engine fire involving much of the wing with leaking fuel caught fire upon landing. Application of thrust reversers intensified the fire through the core of the engine. ICAO Level B approved fluorinated foam (AFFF & FFFP) was applied soon after crashing.
Fire Control Time:	**Full fire control not achieved until 16 hours after impact.**	**Fire extinguished within 5 minutes.**
Lives Lost; Injuries:	**1 firefighter tragically died 9 mins in during fuel tank explosion. 4 serious injuries (28 minor).**	**No injuries reported.**
Life Safety Issues:	**All 300 passengers and crew evacuated in 6 min.40secs after crash, before fire took hold (140 secs before tank explosion).**	**All 241 passengers and crew safely disembarked 15 mins *after* the fire was extinguished.**
Aircraft lost; damaged:	**Plane was destroyed.** Estimated value US$340million.	**Plane damage limited to engine and wing (replaceable).**

Outcomes:	Fire and toxic smoke burned for 16 hours. Suppose injured, infirm or disabled passengers, perhaps parents with babies and/or young children had inevitably delayed evacuation … <u>catastrophic carnage could have resulted.</u> *…Suppose passengers were kept on-board for their own safety, away from flames? Was this too close for comfort? …Shouldn't we be learning from this 'spine-chilling' near-disaster?* Excess foam and discharge of firewater run-off continued for 16 hours, distributing breakdown products of the fire (including PFAS from furnishings, computer screens, electronics, phones, items left on-board by fleeing passengers etc.) causing environmental contamination and on-going site pollution. On-going fire would have upset air traffic, reduced airport access for arrivals, caused extended disruption to airport operations and travelling passengers, potentially causing airport closure. Part of airport was closed for prolonged period.	Fast, effective, efficient, reliable extinguishment. Plane damage was limited to engine and wing. Runway re-opened with minimal disruption or safety concerns to air traffic, airport operation and travelling passengers.
Comment:	Q: Why no explanation for failed foam attack in final investigation report? Knowing the answer might help save lives in future. Q: Isn't firefighter's quick arrival and rapid fire control/extinguishment critical in saving lives? Flight attendants evacuated all passengers very quickly …just 3 minutes before the fuel tank explosion killed a brave firefighter. Did he die needlessly? Q: Might a different foam choice have led to a different outcome? Q: How many passengers may also have died had evacuation been delayed by 140secs?	**Firefighters quick arrival and fast, effective, reliable fire control/extinguishment was critical in extinguishing this fire - when all passengers were STILL on-board.** **It is widely recognised occupants are likely to die from toxic smoke inhalation potentially 3-4 minutes after the fuselage is engulfed in flames.** **<u>Seconds count when saving lives.</u>** **A quick, safe and well executed response.**
Were Society's expectations met?	<u>Desired outcomes were NOT met.</u>	**<u>ALL desired outcomes were met.</u>**

11. Because of the tenacious way that fluorosurfactants can adhere to storage tanks, pipework and equipment, any transition to F3 is likely to be economically prohibitive. It is not just the cost of clean-outs to 1ppm and lacking performance, but equally importantly the substantial financial loss of offshore platform operation during required shut-downs, realistically for 2-3 weeks during retro-fits and clean-out, on every platform - cleaning, re-designing pressure losses, engineering changes to piping configurations, retro-fitting equipment, changing to larger delivery devices and re-commissioning to provide a system which probably does not deliver existing levels of safety protection. This would leave everyone on the platform exposed, more vulnerable to lives lost in major fire emergencies, which is socially and ethically unacceptable. The Norwegian Oil and Gas Association comments in SEAC's draft opinion[13] confirmed "***<u>these shut-down costs at 2million Euros/day per offshore platform</u>***", a similar figure to that expected for a platform shut down in UK's offshore energy sector. This makes transitioning to F3 across all offshore installations (even a single one) prohibitively expensive, without providing guaranteed equivalent functionality to existing C6-AFFF-LF systems, nor proven effectiveness in major fires.

12. **The EC's Feb.2022 "Study on Decommissioning of Offshore Oil and Gas Installations**"[27] confirms that "*In the EU, UK and Norway, an increasing number of offshore oil and gas operations are approaching cessation of production and decommissioning as further exploitation of the reservoirs is no more economically viable. Decommissioning is expected to accelerate due to the ongoing shift from fossil fuels to renewable and low-carbon energy sectors and the resulting decreased demand for oil and natural gas."* Also *"**Although decommissioning in the EU will not be completed until at least 2050, the costs are high now and it is estimated that €4.8bn will be spent in the EU-27 on decommissioning of oil and gas infrastructure in 2020-2030**.*"

It therefore seems unreasonable to expect offshore platforms due for decommissioning by 2030 to now undergo an F3 transition in 2028-9, involving exceptional unnecessary additional costs to the decommissioning which is uneconomic, disproportionate and unjustifiable. A 10-year extension would correct this oversight.

13. **<u>FAA Research calculating firefighting agent quantities for aircraft crash fires in 2012[43] found</u> aircraft composite materials behave differently**. It cautioned:
    - ***There is also potential for re-ignition of a fuel fire from smoldering fuselage composites***." These are widely used in helicopters as well as fixed wing aircraft, so has relevance for offshore installations.
    - It referenced US Military graphite/epoxy/carbon fiber composite testing, finding "***this composite would self-sustain combustion in as little as 2.5 minutes of exposure to an external pool-type fire. …The pool fire was easily extinguished in all tests. However, extinguishment of the composite combustion was not as easy.** The surface flames were readily extinguished, but smoldering composite combustion was already established."*
    - ***"To extinguish …fire fighters applied a continuous stream of AFFF directly on the composite material. After applying AFFF for 3 minutes or more, the smoldering composite combustion was extinguished."*** Such re-ignition sources further expose F3 vulnerabilities, without vapour sealing additives.

14. **<u>The current NFPA 403: 2018 Standard for Aircraft Rescue and Firefighting Services at Airports</u>[44] Annex B.6 explains…**
    - ***"There has been limited full-scale testing of ICAO C foams, but tests to date have reflected <u>extinguishments on Jet A within 1 minute at ICAO Application rates of 0.992 gpm/ft2 (3.75L/min/m2).</u> The 0.13gpm/ft2 (5.5L/min/m2) application rate <u>requirement for AFFF meeting MilSpec in NFPA 403 is 40% higher</u>.***"
    - **This raises a BIG question: …<u>Are alternative ICAO Level B/C F3s still effective at this low 40% safety factor operationally?</u> when considerably less than existing double or triple safety factors currently used by ICAO Level C/US MilSpec approved C6-AFFFs?**
    - **Annex B.6 continues "*Airports adopting ICAO foam concentrates should evaluate equipment requirements any time a switch to a new manufacturer of foam concentrates is considered.***
    - ***Therefore, starting with 2018 edition of NFPA 403, the following application rates by test standard are used:***

      (1) Mil-F 24385 and ICAO Level C = 0.13gpm/ft^2 or 5.5L/min/m^2
      <u>(2) ICAO Level B = 0.18gpm/ft^2 or 7.5L/min/m^2</u>

(3) ICAO Level A = 0.20gpm/ft² or 8.2L/min/m²"

This is of particular concern to SEAC…and ICAO when extensive comparative fire testing confirms F3s deliver inferior fire performance to C6-AFFFs and may require typically 2-3times higher application rates to even extinguish test fires on volatile fuels like gasoline and Jet A1. Safety factors should therefore be significantly higher than just 40%, at least double confirming operational use at 7.5L/min/m2 or above potentially for ICAO Level B approved F3s (not 5.5L/min/m2 as currently) – not only for helicopters on offshore installations, but also civil aviation fixed wing aircraft operations across Europe.

Is it SAFE for European airports and heliports to be using ICAO Level B F3s at just 5.5L/min/m² application rate, when NFPA 403 is recommending ALL ICAO Level B approved foam be used operationally at 7.5L/min/m² to avoid increasing risks to life safety? *Who is liable should a tragedy happen?*

This justifies a 10-year transition extension (with review) for offshore installations where helidecks are almost universally operated, but also marine shipping with helicopters stationed or visiting (eg. cruise ships, research vessels, supply ships and others), plus civil aviation and defence.

15. **Offshore sole sourcing of specific F3 alternatives will be a likely enduring problem**, as quick AFFF replenishment is currently critical (which can involve other AFFF brands, providing they are listed to the same seawater at -18°C approval under UL162[12,22]). FAA's Cert Alert in Jan 2023[23] confirms the New F3 MilSpec 32725 warning label[16] that '*each F3 agent should not be mixed with others*' (even from the same manufacturer - (supported by manufacturers own recommendations[30]), which cannot be changed to avoid unexpected reactions, separation or premature performance issues in storage. Each system therefore has to be designed for a specific F3 agent, and disposed of similarly to AFFFs. Manufacturers also recommend[31] "*preventing entry of F3 to sewers and public waters*." NFPA Research Foundation's 2022 Fire Service Roadmap[15] endorses this "*Although these new foams are being developed and implemented as environmentally friendly AFFF alternatives, the* ***industry trends will require collection and disposal of these products in the same manner as AFFF is being handled today. So unfortunately, the ability to train with these foams will have the same cost burden as the legacy AFFFs requiring special facilities and waste containment/collection."*** This could be a major issue even during or following smaller fires (as well as major fires), adding potentially severe delays and shut-down costs, before platforms could again become operational. F3s are widely regarded as also incompatible with other F3s and existing AFFFs.

16. **Re-training ALL Offshore personnel (as everyone has to undergo basic fire training) to un-learn currently 'instinctive', semi-automatic emergency responses, adds huge cost**
Re-training firefighters to do the opposite of what many have found instinctive over a life-time will be very challenging, time consuming and expensive as NFPA-RF's Roadmap[15] advises "***As a result, innovative training approaches (e.g immersive reality approaches) should be considered/developed to more effectively and efficiently address the increased challenges of transitioning to these new products. Additional training resources will be required to address new foam alternatives (e.g., model procedures, model strategies or tactics with new foams, training facilities, equipment transition, etc.). Special education and training are needed for foam stewardship (e.g., why the transition is needed, why environmental contamination is important***," This training intensity, foam disposal and significant costs per firefighter have not been adequately considered in this restriction proposal so far. SEAC already recognises[1] this "***Some stakeholders (comment #3546, 3548, 3596, 3614) claimed that, further to technical costs,***

they will also incur organisational costs (adapting firefighting related procedures) and re-training costs (since alternative foams can require new firefighting tactics and tools), and these have not been accounted for by the Dossier Submitter*. According to one comment (#3548),* ***<u>these costs could represent 25% of substitution cost for big industrial installations</u>****"*

To use F3s effectively requires gentle (not forceful) applications, well aspirated (not non-aspirated), slower (not rapid attack), requiring closer engagement with the fire, meticulously addressing every area of flames, and re-visiting to check for any re-ignition before moving onwards in a painstaking, methodically focused manner, which is unfamiliar because of C6-foam's flexibility and capability to quickly spread and vapour seal the volatile flammable liquid fuel's surface (not possible with current F3s). This takes more courage, exposes firefighters to more risk, more heat stress, goes against natural instincts to stay further back. It requires a very different mind-set from their current training for fast, sweeping foam delivery onto pool fires, applied from as far back, in as safe an area as possible, to achieve rapid knockdown and extinguishment to deliver a rapid rescue of casualties, prevent spread and escalation, and get back to safety – 'job done'! …But it may not be 'job done' using F3s, despite every effort being made and no fault of the firefighters involved, the evidence confirms F3s lack necessary resilience offshore, so it could be '*job undone*'…leading to more damage, more danger and potentially more catastrophic outcomes.

NFPA-RF's 2022 Fire Service Road Map[15] on 'lessons learnt and tactics' confirms "*Specifically, one pass of a stream of AFFF typically extinguished all the fire in application, including on the far side of smaller obstructions.* ***<u>Conversely, the FFFs tended to leave small holes in the foam blanket and needed more agent to extinguish all of the obstructed fires. In short, the FFFs typically took two passes of foam application to match the single pass of AFFF explaining the 1.5-2 times longer extinguishment times</u>****. …As a result, these conditions could have been even more pronounced if the tests had been conducted with a flammable liquid like gasoline. …* ***<u>pre-fire planning and training will be key to successful implementation/deployment of these products going forward</u>***." Such re-training will be time-consuming and expensive, because it has to be very realistic. To achieve the best from F3s is counter-intuitive to conventional firefighter training and is not instinctive for any individual wanting to get the 'job done' and get back to a safer place. It will take many attempts on real fires for every firefighter, before the required technique is mastered and confidence slowly grows with application success. This will also require frequent on-going 'refresher' training to ensure firefighters do not lapse back into 'old ingrained ways' which could put theirs, and others, lives on the line, with increasing risk of catastrophic fires occurring more frequently.

Such comprehensive training should only be embarked upon, once independent comparative fire test data confirms a high degree of functional fire performance equivalency is possible using F3 alternatives, to adequately protect firefighter lives operationally. This is demonstrably far from the case currently and seems likely to continue for the foreseeable future. **It also seems not to have been adequately considered, or costed in the Socio-Economic Assessment, by the Document Submitters of this PFAS foam restriction proposal. Yet it is a substantial extra cost burden which will be disproportionate to any perceived benefit in several sectors, including offshore installations.**

17. **In the case of F3 transitioning offshore the evidence presented confirms the currently proposed review period is far too short** at 5 years. Because the consequences of reduced fire safety when using F3 could be disastrous, SEAC considered that review of the substitutional status should occur after 10 years (with review) for Seveso III establishments[13] (mostly using freshwater). SEAC also suggested a review to clearly identify whether F3 alternatives are capable (after 10 years) of delivering equivalent functionality, or not. The severity of challenges

offshore outlined in this submission (including seawater, non-aspirated delivery devices, extreme winter temperatures) and **the catastrophic consequences of inadequate functionality justify the same Seveso III transitional 10-year period (with review) should also be applied to the similarly high risk offshore sector**. **This would seem to be essential to adequately protect lives on these confined high risk hazardous installations offshore**. It is important to note this comprehensively includes all parts of offshore operations, including types of drilling rigs, jack-ups, production, exploration and accommodation platforms, associated helidecks, FPSO (Floating Production, Storage and Offloading) vessels and all other vessel types used offshore for tug, supply and operational duties.

18. **SEAC's draft opinion**[13] **makes clear** (p41) that *"SEAC also underlines, as noted above, that* ***transition times should ensure the avoidance of additional risks to human health and the environment from increased risk of fire damage****."* The evidence is clear that this objective cannot be achieved by existing leading PFAS-free (F3) foams, as extensive comparative fire performance data confirms. There are no 1% F3s listed or approved for seawater use at the low operating temperatures often experienced in European offshore waters down to -18°C during winter, particularly using non-aspirated delivery devices.

19. In summary: **Advantages of transitioning to F3s offshore are currently NONE**. Any anticipated environmental benefit from preventing small amounts of C6-PFAS discharging into the sea are likely to be offset by increased smoke from extended fire durations and likely increased spread/incident escalation; increased fire breakdown products released including toxic, carcinogenic substances and PFAS from other uses; more foam used during higher F3 application rates delivering slower fire control; increased risk of catastrophic fires occurring; greater risk of lives lost; greater resulting offshore and environmental damage.

    Disadvantages of transitioning to F3s offshore are numerous, including:

    - **Increased risk of fire escalating** out of control.
    - **Very high impacts of single catastrophic event** to humans and our environment.
    - **Demonstrated impaired functionality from poor F3 fire performance**, **particularly using seawater** and forceful, non-aspirated delivery devices required offshore to overcome wind.
    - **Reduced proportioning accuracy/reliability** due to viscosity issues, particularly at low winter operating temperatures of -18°C.
    - **Most F3s suffer attack and premature collapse from Dry Chemical** powder applications, regularly used offshore, particularly on helidecks.
    - **Disproportionate shut-down costs to allow transition**, including system clean-out, re-engineering, retro-fitting equipment for an F3 transition, re-commissioning, re-training, when existing protections are compromised - placing lives under increased risk of harm.
    - **Disproportionate when increasing decommissioning** of offshore installations are scheduled by 2030.
    - **Current evidence confirms F3s are not capable of effective operation using seawater** with non-aspirated devices at winter operating temperatures experienced of -18°C in North and Baltic Seas.

D. Conclusions

This fundamental gulf in current F3 fire performance compared with existing C6-AFFF-LF on widely used flammable fuels, particularly when seawater and non-aspirated applications (to combat wind) are integral to most offshore platforms. This explains why it is imperative that high performing C6-AFFF-LFs (Low Freeze protected to -18ºC) approved under UL162[12,22] are allowed to remain available for all offshore applications for at least 10 years with review (not the 5 years proposed) as a crucial step towards a successful transition. This enables avoidance of compromised life safety and inferior critical infrastructure protections for this very challenging sector, because of added congestion, constraints, complexities, challenges and criticality of tight time restrictions on foam's fire control effectiveness. This matches or even goes beyond those challenging but realistic fire scenarios already recognised by SEAC at Seveso III sites[13].

This is particularly due to the confined and congested spaces, seawater use, high winds requiring non-aspirated applications, low operating temperatures, proximity of fuels and helicopters to workstations and accommodation areas, all factors demanding rapid extinction of any fire developing. This critically requires current fast, flexible, effective and reliable action from the firefighting foam system under wide-ranging, often extreme incident and temperature conditions to gain rapid control and extinguishment. This is particularly relevant because accommodation areas and helidecks are usually adjacent to high risk oil/gas exploration and oil/gas production areas on these tightly congested platforms and installations.

Disproportionate F3 transition costs for platforms facing de-commissioning by 2030 (4.8billion Euros have been allocated by EC for offshore installation decommissioning before 2030[27]) should also be avoided, particularly when this seems neither economically viable nor socially responsible if existing fire and life safety protections are likely to be compromised and downgraded by such an F3 transition, as the current evidence suggests.

Offshore extension to a 10-year transition (with review) also allows foam manufacturers more time to develop improvements in F3 capability, potentially uncovering important new ingredients that could address these currently unachievable fire performance targets for F3s of the future.

As a result of the evidence provided above, ie. use of more varied and volatile fuels (than common test fuel heptane), unavoidable use of seawater, necessity of forceful and non-aspirated applications to combat wind, preventing more gentle application of higher aspirated foam expansion systems from being effective in offshore firefighting systems, plus imminent decommissioning of many offshore installations, so the number will be much smaller in 10 years. **This combined evidence confirms that Offshore installations require at least the same 10 yr transition period (with review) as Seveso III sites (possibly longer) since major incidents could more easily become catastrophic with serious loss of life because F3s are not shown equally effective under commonly challenging, realistic and credible major fire events offshore.**

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