Fifteen important checks when transitioning to Fluorine Free Foams (F3s)

Regulatory restrictions on legacy long-chain C8 foams of concern are in place in many countries. Legacy C8-PFAS foam stocks have been, or are increasingly being, removed from service and safely destroyed by high-temperature incineration (≥1,100°C) or other approved effective destruction methods.

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C6 and F3 alternatives

C6-foams are often necessary for high hazard flammable liquid incidents but increasingly restricted for firefighter training, testing or calibration unless all resulting foam is collected, contained, with safe disposal meeting regulations. Sometimes C6-foams are restricted or banned without a thorough evaluation of benefits and risks.

F3s are widely used by Fire Brigades where higher F3 application rates are shown effective on spill fires, vehicle roll-overs, smaller industrial fires etc. Sometimes F3 foams are put into service protecting high-hazard flammable liquids without a thorough evaluation of risks and benefits.

Are you considering transitioning to F3s?

Certainly, most fire professionals that use Class B foams have been overwhelmed by articles, ads, debates and salespeople who all have an opinion. Claims of performance, bans, exemptions and safer chemistry come in all formats. How do you make an informed decision? Hopefully this article helps.

Valuable guidance

US National Fire Protection Association Research Foundation's (NFPA-RF) 'Fire Service Road Map' (May 2022) and other experts provide valuable guidance, and practical cautions for all those transitioning to F3s.

NFPA-RF explains: 'The new fluorine-free foams are similar to the legacy protein foams in that they rely solely on the foam blanket to contain the fuel vapors to extinguish the fire (i.e., fluorine-free foams do not produce a surfactant film on the fuel surface like AFFF). As a result, air-aspirating discharge devices may be required to optimize the capabilities of these products.' It cautions: 'However, it is incorrect to assume that these new FFFs [F3s] are a "drop-in" replacement for AFFF, even though they may have a specific listing or approval. At this time, there is too much difference between specific FFF's in properties and performance to suggest that the class can be a drop-in replacement for the AFFF class of foams.' Foam quality is raised as critical: '… 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. … Specifically, reduced foam quality can be compensated for by increased application rate and vice versa.'

NFPA-RF and other experts stimulate 15 key questions to avoid common pitfalls

Obtaining firm answers to these important questions should help facilitate your decisions and transition journey, while also ensuring unintended consequences are not experienced along the way. Always gain written confirmation of advice and performance levels to avoid any risk of subsequent misinterpretation. Always compare your findings with your existing protection. Remember C6-foams are based on known technology, have decades of history, listings and proven performance in severe conditions, while

F3s do not. Such key considerations could help ensure your facility's current fire-protection levels for life safety and critical assets are maintained.

1 **Is your F3 effective on existing and proposed flammable liquids currently protected on site?** Seek test data on your specific fuels. Standard test fuels are not always representative of your hazards, especially with F3s. Heptane (EN1568-3, UL162, Lastfire, etc.) is not representative of F3 use on condensate, naphtha, gasoline blends, Jet A/A1 aviation fuel, crude oil etc. Research confirms most F3s require higher application rates/longer operating times on volatile fuels.

2 **If storing or handling crude oil, what F3 application rate is required to reliably extinguish, before any boil-over may arise at that rate?** Obtain a firm recommendation from the foam manufacturer, ask for meaningful scale test data. Premium AR-AFFFs achieve this at rates of 0.22–0.25gpm/ft^2 (9-10.25 L/min/m^2) for crude oil. Clear evidence for F3s is essential as proven performance on real incidents does not exist. Expect higher recommendations than AR-AFFF.

3 **Could longer extinguishment times increase risk of fire spread and incident escalation?** Firefighters usually aim to get flames out fast, protecting themselves but also minimizing risk of fire spread or incident escalation into new areas. This objective is more challenging using F3s. Also after successful extinguishments or unignited fuel spillages, what F3 re-application frequency is required? Faster deterioration of the foam blanket may require increased application and application times, which may vary with different fuels, requiring extra storage.

4 **Is it safe for firefighters to enter F3 blankets during firefighting or rescue operations?** Guidance in this area is always difficult and may differ with different F3s, specific fuels or delivery devices. The importance should not be underestimated as NFPA-RF confirms [paraphrased]: 'you are transitioning to a less forgiving agent, solely reliant on the foam blanket effectiveness from gentle application'. Your training, pre-planning, incident-command practices and decision making depend on this knowledge for firefighter safety and recognising unwise risks.

5 **Has a total-system-engineering approach been established (similar to UL and FM mandates)?** Foam concentrates, proportioners, foam makers and the fuel being protected should all be demonstrated effective together and listed through third-party approvals.

Check more viscous F3s still meet percentage proportioning rate accuracy requirements, and your specific devices are effective with your F3, otherwise they may need replacing. F3 systems 'will need to be designed and installed within the listed parameters in order to ensure a high probability of success during an actual event,' confirms NFPA-RF, clarifying 'it typically took two passes to extinguish all the fires [with F3] as opposed to one for AFFF.'

6 **Has a full cost-benefit analysis been conducted on your F3 transition?** Keeping control of expected costs and fire performance is an important part of ensuring existing safety protections are not unintentionally compromised, and the expected benefits from transition are being delivered. Alternative solutions should also be considered, including optimisation of existing C6 containment and collection during a major emergency.

7 **Is your F3 compatible in use with other agents on your site?** Does Dry Chemical discharge alongside, or above your F3 foam cause partial or instant collapse? The US Federal Aviation Administration (FAA) found limited/no dry chemical compatibility on leading F3s recently tested.

8 **Are your current back-up stock levels and application rates still appropriate?** F3 inventory levels may need to be increased due to the need for higher application rates and durations. Check whether your mutual aid group has *compatible* stock, for quick re-stocking after future events.

9 **What is your F3's storage life and reliability record?** Have 3- or 5-year storage samples been tested to verify it passes, without gelling or separating, and still extinguishes volatile fuels as effectively as when new? If not, have an aged foam sample tested by a reputable independent laboratory to verify continued effectiveness on your flammable fuels. Ensure no performance deterioration over time. If using an AR-F3 also ensure stability on your polar solvent fuels.

10 **Does your F3 contain toxic, persistent, or harmful ingredients?** Do Safety Data Sheets (SDS) provide aquatic toxicity (usually worse than AFFFs), human health data and residual Fluorine/PFAS levels on the complete F3 mixture, not just key components? NFPA-RF cautions: 'It needs to be understood that the elimination of PFAS and/or fluorine from the product does not address all the potential health and environmental hazards.'

11 **What level of existing system residual PFAS is 'clean enough'?** Define residual ppm/ppb PFAS levels of system and F3, before any new F3 is installed. NFPA-RF cautions: 'To date, there is no clear guidance for how clean final rinsate water must be to satisfy local regulators (i.e., it is currently not mentioned or is undefined). Discussion has been centered around trying to meet either the EPA drinking water advisory level for PFAS (70 ppt), the 1 ppb total PFAS requirement in the NDAA for DoD foams, or the 1 ppm PFAS that has become adopted by other industry standards (UL-162) and throughout Europe (ECHA).' FAA reported (2022) five leading F3 concentrates contained TOF levels of 10–87ppm (US EPA Method 537.1, 2020). Be sure of your chosen laboratory's ability to accurately test at detection levels necessary for concentrate, foam solution and/or rinse water.

12 **Has equivalent, alternative fire cover been arranged during this F3 transition?** Is a complete area/site shut-down envisaged? It may require several days or weeks before systems can be re-commissioned and re-activated. Turn-arounds, maintenance and facility shut-downs are often considered the most dangerous times since they include temporary coverage, contractors unfamiliar with sites and the precarious process of 'wind-down' and 'start-up' of normal operations.

13 **Has extra or extended containment been considered?** This may become necessary if higher application rates and/or more frequent top-ups during incidents is likely, to collect and contain firewater run-off preventing overflows which could cause a costly pollution event.

14 **Commissioning your F3 system?** Include video footage proving your system is working correctly. Also record system competency in readiness for any future major incident. NFPA-RF recommends containment and collection of all F3 solutions with safe disposal, according to applicable regulations. Alternate liquids have to be considered whenever possible as F3s are still formulated from man-made chemicals that should be collected and disposed of safely.

15 **Do existing training programmes need adjusting to ensure F3 is safely managed and operated?** NFPA-RF's Road Map suggests industry is trending towards collection and disposal of F3s in the same manner as AFFF today: '… the ability to train with these foams will have the same cost burden as the legacy AFFFs requiring special facilities and waste containment/collection' Proof of effectiveness and competency from F3 transitions, ensures your site is adequately protected from future fire dangers. Have you trained with your Mutual Aid group to understand all abilities and limitations of each foam being used at a major fire emergency?

NFPA-RF's 'Road Map' concludes: '*Ultimately, end users will need to design and install within the listed parameters in order to ensure a high probability of success during an actual event. … but a detailed evaluation must be completed prior to making that transition …*'. Adopting this '15 Question checklist' based on NFPA-RF's and expert's guidance could achieve the necessary assurances to keep everyone safe and regulators satisfied, while retaining fire-protection system objectives i.e. protecting your site from unintended consequences, including risking life loss and/or critical asset destruction.

Have you attained satisfactory answers to all these 15 key questions enabling you to move forward, or should you maintain present proven C6 foam capabilities keeping everyone safe, until any unresolved answers are finalised?