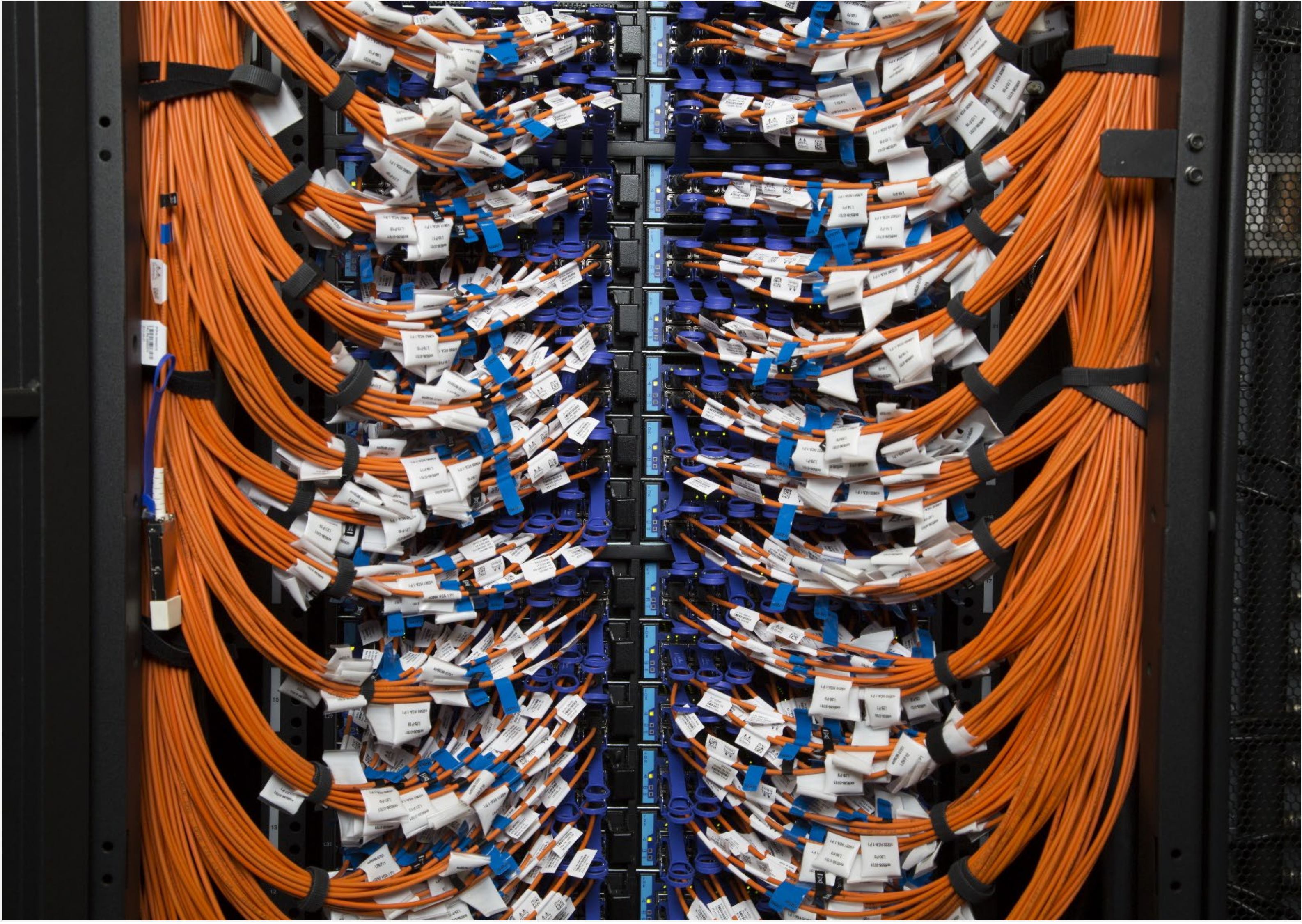

ExxonMobil Petroleum & Chemical BV (EMPC) Comments on Annex XV restriction report on per- and polyfluoroalkyl substances (PFAS)

Clean Agents in Fire Suppression Systems

21 September 2023

Project No.: 0691418

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Clean Agents in Fire Suppression Systems

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Acronyms and Abbreviations

ASTM	American Society for Testing Materials
BCF	Bio Concentration Factor
BSi	British Standards Institute
CNBOP	Polish Scientific and Research Centre for Fire Protection
CNPP	Centre National de Prevention et de Protection
EASA	European Aviation Safety Agency
ECHA	European Chemical Agency
EEA	European Economic Area
EiF	Entry Into Force
EN	European Standard
FK-5-1-12	1,1,1,2,2,4,5,5,5-NONAFLUORO-4-(Trifluoromethyl)-3- Pentanone (CAS: 756-13-8).
GWP	Global Warming Potential
HARC	The Halon Alternatives Research Corporation
HF	Hydrofluoric Acid
LPCB	Loss Prevention Certification Board
NFPA	National Fire Protection Association
ODP	Ozone Depleting Potential
PBT	Persistent, Bioaccumulative and Toxic
vPvB	Very Persistent and very Bioaccumulative
PFPA	Perfluoropropionic acid
R&D	Research & Development
SEA	Socioeconomic Assessment
TFA	Trifluoroacetic acid
VdS	Vertrauen durch Sicherheit

1. EXECUTIVE SUMMARY

This response is submitted on behalf of ExxonMobil Petroleum & Chemical BV (“EMPC”). For the purpose of this submission, EMPC is acting in its own name and in name and on behalf of the other affiliates potentially affected by the proposed REACH restriction (hereafter referred to as “ExxonMobil”). EMPC is a subsidiary of Exxon Mobil Corporation and part of the ExxonMobil group of companies (“ExxonMobil Group”).

A clean agent fire suppression system contains a gaseous fire suppressant that is electrically non-conducting and that does not leave a residue upon evaporation. This is ideal when protecting safety critical systems, high value items or systems that are business critical and where downtime would potentially lead to business continuity issues or trigger process safety issues. Water and other fire suppression agents can cause damage to sensitive assets like specialized equipment and electronics. Since clean agents are gaseous upon discharge, they cause no harm to assets and are fast acting as they can discharge within seconds, limiting fire damage as much as possible to a small area.

FK-5-1-12 (CAS: 756-13-8) is a PFAS-containing clean agent fire suppressant chemical and extinguishes a fire by rapidly removing heat, without posing an asphyxiant threat for people in occupied space. It also evaporates faster than water meaning the equipment being protected (including sensitive electronics, machinery, etc) can be returned to function with limited cleanup or residue remaining from the system.

All sectors of fire protection are required to meet safety requirements such as those given in EN, ISO, NFPA, EASA and ASTM standards. In addition, fire suppression systems and agents are generally required to be listed by an approval agency such as LPCB (global), CNPP(France), VdS (Germany, BSI (UK) or CNBOP (Poland) to EN standards.

ExxonMobil understand from fire suppressant suppliers that there will be the need for critical uses of fluorinated clean agents well beyond 13.5 years after EiF as the available alternatives will be technically inferior and lead to lower safety margin and so it will be **necessary to include a time-unlimited derogation for use as a clean agent in fire suppression systems** in the restriction until a suitable alternative is found that meets the latest standard requirements. As **FK-5-1-12 is not classified for human health, not PBT or vPvB,** ExxonMobil believe that the continued use of FK-5-1-12 in fire suppression systems can be justified, based on the information provided in this report, until a suitable alternative can be found that meets all required technical requirements and safety standards.

It should be noted, however, that ExxonMobil per its Safety Policy is committed to conducting its business in a manner that protects the safety of employees, others involved in its operations, customers and the public and complying with all applicable laws and regulations. In doing so, maintains high quality and safety standards in their operations, complying with the requirements of applicable industry standards. Therefore, if use of an alternative were to result in non-compliance with specifications, it would not be used and there would be a need to develop a new one.

ExxonMobil have sites across the EEA which contain safety critical systems to maintain the safe operations of sites in which clean fire suppressants are installed. If the continued use under the assumption of the time-unlimited derogation being requested by ExxonMobil and the wider fire protection industry is accepted, it should also include the requirement to meet safety standards by incorporating into a time unlimited derogation the same wording as the prohibition on HFCs for fire suppression in the revised F-gas regulation. In other words, this would be to include a clause that “the existing inspection regime meets ISO 14520 or EN 15004 standards”. Tying the derogation only to situations where alternatives only meet “safety standards” without explaining what those standards are could significantly limit the size of the derogation and mean that potential inferior fire suppressants be used adversely affecting safety standards.

This report also presents evidence that a limited derogation scenario would result in severe negative impacts for the EU where the expectation is that at the end of the derogation period a technically equivalent alternative to the PFAS fire suppressant currently in use, which can meet the latest ISO 14520 or EN 15004 safety standards will not be available. In this scenario sites would be faced with a choice to:

(1) Replace existing FK-5-1-12 systems at the end of their service life with an inferior system which may not meet the current safety requirements outlined in current standards or;

(2) Shut down the operation in the EU where the risk of an inferior fire suppression system is too great and potentially relocate the operation to another country where FK-5-1-12 fire suppression is still allowed.

(3) Scope new engineering projects in the EU with an inferior system which may not meet current safety standards, but if the risk of an inferior for suppression system is too great, potentially relocate the operation to another country where FK-5-1-12 fire suppression is still allowed.

It can also be reasonably expected that where an unplanned fire suppression system changed due to a release to extinguish a fire or failure as part of regular servicing (which is very unlikely), the unplanned downtime associated with replacing the fire suppression system could likely lead to decreased output from the facility the fire protection system is protecting. Such unintentional costs cannot be calculated and would be highly dependent on the site in question but would be material.

It is not expected that as part of this limited derogation scenario fire suppression systems containing PFAS will need to be exchanged if they are still in service after the end of the derogation period, having never been discharged. However, it is expected that after EiF plus 13.5 years, if the PFAS fire suppression system is discharged, it could not be recharged with a new FK-5-1-12 cannister and so an alternative system would need to be installed. The downtime associated with replacing the system would lead to an unplanned interruption in supply of what is manufactured at the site and would not only have an impact on the site undergoing the interruption but also the downstream users of the products being produced at the site. These costs would be material.

Finally, a widely commercialised alterative for protecting safety critical systems in unoccupied spaces are CO_2 based systems. Even though safeguards are in place as part of the system, in occupied spaces, discharge of these may cause O_2 depletion and may cause asphyxiation to any workers in the vicinity of a fire if the safeguards fail. A failure to extinguish a fire in time may potentially also cause critical control systems to fail increasing the risk of a process safety incident at a site.

As a conclusion and considering the high difficulty in identifying an alternative clean agent despite decades of research and the need to protect safety critical systems, high value items or systems that are business critical, ExxonMobil would request that derogation 5.m. be updated to a time-unlimited rather than time-bound derogation, as per the text below:

> **Clean fire suppressing agents where current alternatives damage the assets to be protected or pose a risk to human health.**

It should also be noted that no move should be made to an alternative unless the fire suppression system meets the latest ISO or EN safety standards.

This report details the use of a clean agent in fire suppression systems at ExxonMobil sites, as well as the required technical feasibility criteria and an overview of potential alternatives. Potential for substitution is discussed, as are the safety considerations. The report concludes with a socio-economic analysis which covers both the scenario where the use continues, and that where the derogation is time-limited, and finally the requested derogation is detailed.

2. BACKGROUND INFORMATION

Exxon Mobil Corporation manages an industry-leading portfolio of resources, and is one of the largest integrated fuels, lubricants and chemical companies in the world. The ExxonMobil Group evolved an operating model and global organization to better leverage the scale of its increasingly integrated company and global brands. There are three core businesses with operations around the world[1]:

- Upstream business - Focused on strengthening energy security by expanding low-cost-of-supply, high-return oil and natural gas operations.
- Product Solutions business - Integrating downstream and chemicals operations to develop lower emission fuels and innovative products needed by modern society.
- Low Carbon Solutions Business - Helping lower emissions by providing solutions to industrial and commercial customers in growing markets for carbon capture and storage, hydrogen and biofuels.

ExxonMobil´s history of operating in Europe is more than a century long and Europe has played an important role in some of the key milestones that marked their development into a manufacturer of the products that drive modern transportation, power cities, lubricate industry and provide petrochemical building blocks that lead to thousands of consumer goods.

The ExxonMobil Group's Corporate brands include:

- Esso: Customers around the world have come to respect and rely on Esso-branded fuels, services and lubricants for their personal and business needs;
- Exxon: Customers have also come to respect and rely on Exxon-branded fuels, services and lubricants for their personal and business needs;
- Mobil: Marketed around the world, Mobil is known for performance and innovation. Mobil is recognised for its advanced technology in fuels, lubricants and services; and
- ExxonMobil Chemical: There is a broad portfolio of petrochemical product brand and service solutions. These products play a key role in enabling the manufacture of affordable, sustainable and safe products that are helping meet the growing demands of an increasing global population.

With specific regard to chemicals and specialties, it has manufacturing capacity in every major region of the world, serving large and growing markets. More than 90 percent of the company's chemical capacity is integrated with refineries or natural gas processing plants[2]:

- The portfolio includes product and services (branched alcohols, branched higher olefins, butyl, EPDM rubber, linear alpha olefins, neo acids, plasticisers, polyethylene , polymer modifiers, polyolefin plastomers & elastomers, polypropylene, solvents & fluids, synthetic base stocks, tackifiers, transformer oils and thermoset systems);
- The industrial sectors supplied include: adhesives & sealants, agriculture, automotive, building & construction, compounding, consumer products, healthcare & medical, hygiene & personal care, industrial applications, energy, packaging, synthetic base stocks.

This document is being submitted by ExxonMobil in response to the public consultation on the universal PFAS restriction proposal, which was initiated by ECHA and runs until 25 September 2023.

The ExxonMobil Group does not manufacture per-and polyfluoroalkyl substances (PFAS). As part of their response, ExxonMobil wants to present relevant data on the uses and applications of certain PFAS and respond to ECHA's public consultation questions, which are applied in a number of

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[1] https://corporate.exxonmobil.com/who-we-are/our-global-organization#Aglobalcompany

[2] https://www.exxonmobilchemical.com/en/

products in industry sectors and applications including, but not limited to, the uses identified in this report.

ExxonMobil will be submitting reports covering the following uses:

- Fluoropolymer use in upstream, refining, and petrochemical manufacturing
- Aviation hydraulic fluid additive
- Additives in lubricants
- Processing additive for polyethylene
- Clean agent in fire suppression systems

Please note that the information able to be submitted at this juncture is incomplete. The scope and potential impact of the proposed restriction is unprecedented and open-ended. Many thousands of substances would be subject to the restriction, and few of these substances are identified in the proposal on an individual basis. Accordingly, more time would be needed to do a more comprehensive and complete assessment. Due to the absence of identification of the individual substances that are in scope of the proposed restriction, the current assessment has been limited to those substances that are known to be used by ExxonMobil and are within the proposed restriction's scope. ExxonMobil reserves our rights in this context.

The information provided will describe in detail the sectors and sub-uses involved and the potential impact of the current restriction proposal, demonstrating the necessity of the use of certain PFAS in these applications, the potential for substitution, and the importance of the use, and continued use, with specific regard to the European Economic Area (EEA).

3. OVERVIEW OF USE

3.1 Description of Sectors and Use of Clean Agent in Fire Suppression Systems

ExxonMobil Corporation is one of the largest integrated fuels, lubricants and chemicals companies globally. Its business encompasses all aspects of the oil and gas industry, including Upstream, Products Solutions (including downstream and chemicals), and Low Carbon Solutions. The value chain of ExxonMobil businesses extends to end users of products and services, which can be found across all industry sectors in the EEA, including, but not limited to, automotive and aerospace, building and construction, chemical processing, including agrochemicals and pharmaceuticals, packaging.

A clean agent fire suppression system contains a gaseous fire suppressant that is electrically non-conducting and that does not leave a residue upon evaporation. This is ideal when protecting safety critical systems, high value items or systems that are business critical and where downtime would potentially lead to business continuity issues or trigger process safety issues. Water and other suppression agents can cause damage to sensitive assets like technology and electronics. Since clean agents are gaseous upon discharge, they cause no harm to assets and are fast acting as they can discharge within seconds, limiting fire damage to a small area. The umbrella term “clean agents” includes both halocarbon agents and inert gas agents[3] and one of the more widely used halocarbon fire suppressant chemicals in a gaseous fire extinguishing system is FK-5-1-12. FK-5-1-12 is a fluorocarbon and a fluoroketones and contains C-H chemistry meaning that it comes within the scope of the currently proposed PFAS EU REACH restriction.

FK-5-1-12 agent fire suppression systems are routinely used in the following sectors[4]:

- Data Centres to help keep data centres protected from fire with minimal downtime and cleanup;
- Mission critical control centres with personnel in continuous attendance over electronic controls (onshore and offshore industries) Marine industry to help protect engine rooms and control rooms of ships at sea, with fast air-shipping of cylinders and quick system recharge;
- Museums, culture and archives to help safeguard art, archives and artifacts from both fire and water damage;
- Aviation to help protect people and critical assets in air traffic control towers, hangers and on the flight line;
- Medical centres and universities to help protect workers and equipment in surgical suites, MRI rooms, storage areas and data centres;
- Oil and gas industry to help extinguish fires in high volatile (Class B) environments, including onshore compressor enclosures and offshore facilities
- Power generation and transmission to help protect critical systems in generating facilities, substations and control rooms;
- Transportation to help reduce the risk of fire in rail switching stations and on electric-powered transit; and
- Industrial sites (including, but not limited, to refining and petrochemical plants) to help protect control rooms and production assets and reduce downtime.

In the above uses fire suppression systems are mainly used in closed rooms which may be occupied by people and so the safety of the occupants of the room when the fire suppression system is

[3] https://www.nfpa.org/News-and-Research/Publications-and-media/Blogs-Landing-Page/NFPA-Today/Blog-Posts/2022/05/06/Clean-Agent-System-Basics#:~:text=By%20definition%20a%20clean%20agent,artifacts%20or%20sensitive%20electronic%20equipment.

[4] Novec 1230 Fire Suppression & Protection | 3M United Kingdom

released is paramount. According to the manufacture[4], the concentration of FK-5-1-12 that is released to extinguish a fire safely has a large margin of safety between that concentration and the NOAEL (No Observed Effect Level) for FK-5-1-12.

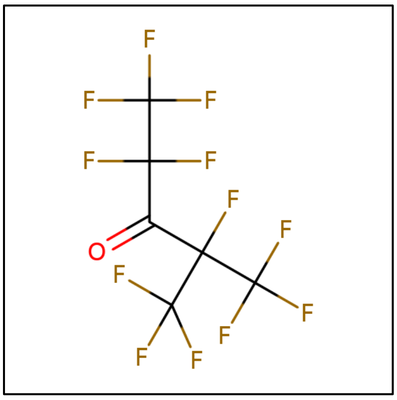
The use and installation of gaseous fire-extinguishing systems are governed by standards including ISO 14520 and EN 15004. CEN, the European Committee for Standardization, accepts the text of the ISO 14520 as the basis for EN 15004. ISO 14520-5:2019 'Gaseous fire-extinguishing systems — Physical properties and system design — Part 5: FK-5-1-12 extinguishant'[5] covering the physical properties, specification, usage and safety aspects and is applicable to systems operating at nominal pressures of 25 bar, 34.5 bar, 42 bar and 50 bar with a nitrogen propellant. Representatives for the fire protection industry are involved in the setting of these standards such as the US National Fire Protection Association (NFPA) and CFRA-Europe, the Confederation of Fire Protection Associations Europe.

ExxonMobil facilities are equipped with firefighting systems based on the clean fire suppression agent FK-5-1-12 as a recommended clean gaseous suppression system to extinguish potential fires in occupied enclosed spaces e.g. control centers, electrical / switchgear rooms, etc.

FK-5-1-12 is 1,1,1,2,2,4,5,5,5-NONAFLUORO-4-(Trifluoromethyl)-3- Pentanone (C.A.S. 756-13-8), a fluoroketone, is used as a compressed gas in fire suppression systems with compressed nitrogen (CAS. 7727-37-9) as a minor ingredient. (FK-5-1-12 meets the definition of PFAS given in the Annex XV of the REACH Restriction proposal).

Figure 3-1 below, shows the chemical structure of FK-5-1-12, 1,1,1,2,2,4,5,5,5-NONAFLUORO-4-(Trifluoromethyl)-3- Pentanone (CAS: 756-13-8).

Figure 3-1: Chemical structure of FK-5-1-12, 1,1,1,2,2,4,5,5,5-NONAFLUORO-4-(Trifluoromethyl)-3- Pentanone



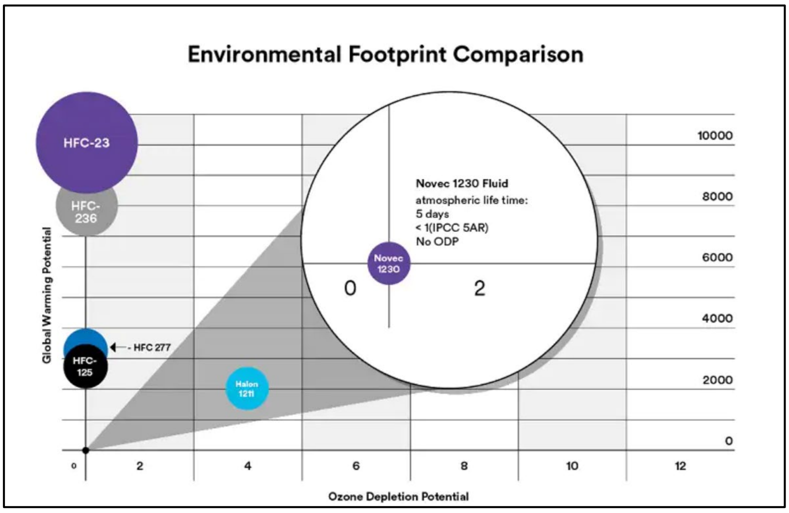
According to the EU REACH registration dossier[6] for the substance, FK 5-1-12 does not partition to water, is not persistent, bioaccumulative or classified for human health[6] (See section 3.2). It is not found in the atmosphere as it breaks down when exposed to ultraviolet light as it has a 5 day atmospheric lifetime. FK 5-1-12 also has a GWP of less than 1, while other HFCs typically have a GWP of more than 3000 as per the graph below[7].

Figure 3-2: Environmental Footprint Comparison of FK-5-1-12 to HFC fire suppression agents

[5] ISO 14520-5:2019(en), Gaseous fire-extinguishing systems — Physical properties and system design — Part 5: FK-5-1-12 extinguishant

[6] https://echa.europa.eu/registration-dossier/-/registered-dossier/19473/5/2/1.

[7] https://www.3m.co.uk/3M/en_GB/novec-uk/applications/fire-suppression/#protectingbusiness

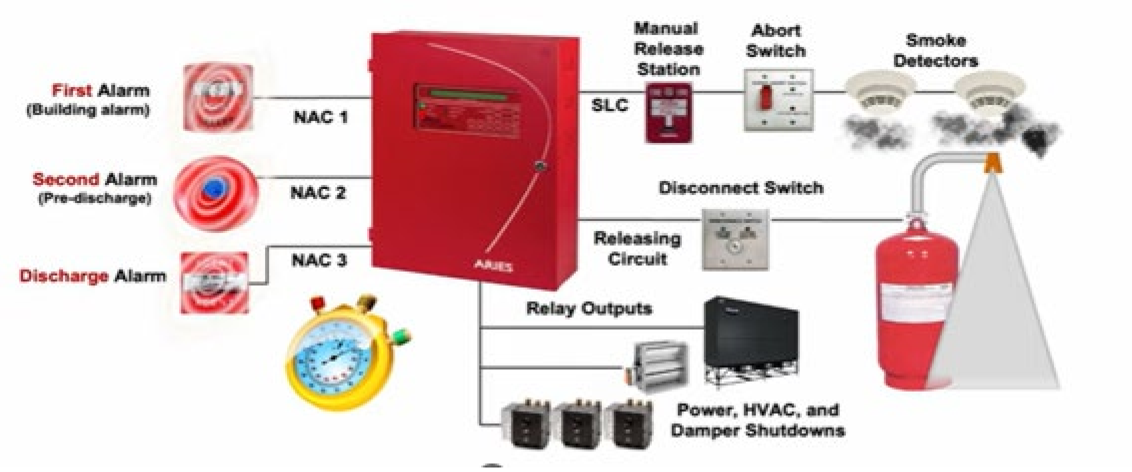


The patent for FK-5-1-12 expired in July 2020 and since that time other manufacturers entered the market meaning there are multiple suppliers of FK-5-1-12 as listed in US EPA's Significant New Alternatives Policy (SNAP) list. The original supplier of FK-5-1-12 was 3M who sells it under the trade name Novec 1230™. Alternative suppliers sell FK-5-1-12 under alternative trade names including Fike FK-5-1-12, Chemori5112 and Waysmos FK5112 Clean Agent Fire Extinguishing Systems, among others.

As show below, an FK-5-1-12 fire suppression system consists of a cannister containing the fluorocarbon as a liquid attached to a series of smoke and fire detection systems as well as a fire suppressant release mechanism. The liquid is released as a gas. The efficiency of FK-5-1-12 in extinguishing a fire means that less of it is required than other commercially available clean fire suppression systems such as CO_2, meaning these systems take up less space at sites.

Figure 3-3: Example gas canister in FK-5-1-12 clean fire suppressant system

Figure 3-4: Example configuration of complete clean fire suppressant system



Further information on the use of clean fire suppression systems can be found at: https://www.orrprotection.com/mcfp/3m-novec-1230-webinar-replay?utm_campaign=Novec%20Webinar&utm_content=252094039&utm_medium=social&utm_source=linkedin&hss_channel=lcp-130263

3.2 Relevant hazard properties of Fire Suppressant FK-5-1-12

ExxonMobil does not manufacture PFAS and defers to manufacturers' and distributors' knowledge of FK-5-1-12 hazard properties and provides information in this report as best efforts to describe such information.

3.2.1 Negative PBT/vPvB Assessment (EU REACH registration dossier)

FK-5-1-12 (CAS# 756-13-8) has been registered in the EU in tonnage band ≥ 1,000 to < 10,000 tonnes per year. The full registration dossier can be found at Registration Dossier - ECHA (europa.eu) and states that: "In accordance with screening criteria for persistence in Guidance document on information requirements and chemical safety assessment, chapter R.11: PBT Assessment (ECHA, 2017), the submission substance is not P/vP substance.

In accordance with screening criteria for bioaccumulation in Guidance document on information requirements and chemical safety assessment, chapter R.11: PBT Assessment (ECHA, 2017), the submission substance is not B/vB substance.

In accordance with criteria for toxicity in Guidance document on information requirements and chemical safety assessment, chapter R.11: PBT Assessment (ECHA,2017), no conclusion on T can be reached."

Therefore, FK-5-1-12 is not a PBT/vPvB substance.

3.2.2 Stability

The EU registration dossier states that[6]:

"CAS# 756-13-8 is a completely fluorinated ketone. The substance is a liquid at room temperature with a high vapour pressure (40 kPa at 25°C). The water solubility of CAS# 756-13-8 is very low, in the range of 1-25 ppm. A precise value cannot be measured owing to its extremely short half-life at all pH values measured. Most releases of CAS# 756-13-8 are expected to be atmospheric emissions based upon its intended uses. Fugitive emissions may occur at transfer points. During typical use, there is no anticipated release to water or wastewater in the EU. Therefore, this compound will remain in the atmosphere when released from industrial applications for short periods of time as a result of the extremely short half-life.

The half-life of CAS# 756-13-8 by direct photolysis in the atmosphere is approximately one week[6]. Photolysis products were not definitively assessed, however the expected photolytic pathways result in formation of trifluoroacetic acid (TFA, CAS# 76-05-1), CO_2 and hydrofluoric acid (HF,CAS# 7664-39-3). Perfluoropropionic acid (PFPA, CAS# 422-64-0) is also expected to form under conditions of limited NO_x concentration. Indirect photolysis of CAS# 756-13-8 was determined to be insignificant. CAS# 756-13-8 solubility in water is low. Upon unlikely accidental release to aquatic systems, CAS# 756-13-8 will degrade via hydrolysis to form perfluoropropionic acid and heptafluoropropane (HFP). Once dissolved into water, the hydrolytic half-life of CAS# 756-13-8 was found to be ca. 2.5 minutes. However, the rate of CAS# 756-13-8 hydrolysis in other studies was limited by dissolution of the chemical into liquid water. The ultimate fate of CAS# 756-13-8 in the atmosphere therefore depends on the relative contributions of photolysis and hydrolysis. In a supporting study addressing this question through a theoretical approach, the two processes were compared. The contribution of hydrolysis in liquid water droplets to overall atmospheric fate was estimated to be approximately 120,000 times less than the contribution of photolysis. The two factors that led to this decrease were the low tendency of CAS# 756-13-8 to partition from vapor phase to liquid water (estimated K_{aw} of 5300) and the extremely low fraction of liquid water as droplets in the atmosphere (ca. $1x10^{-8}$ on a volume basis). This study was deemed reliable with restrictions, in that not all degradation pathways were considered, no attempt was made to assess the variability of the input parameters used, and no sensitivity was done to determine robustness of the analysis to variability in input parameters. A reanalysis of the available data using the supporting study's approach suggests that the relative rate of photolysis may be 6000 to 120,000 times greater than that of hydrolysis, with photolysis still the overwhelming process for degradation in the atmosphere.

The primary degradation products, TFA and HF, and the negligible amount of PFPA formed in the atmosphere are expected to rapidly undergo wet deposition with no further significant transformation. Partitioning of these acids in the environment is driven by the fact that they are completely ionized at environmental pH values, are miscible in water, and are not likely to bind with organic matter based on low K_{oc}s and low log K_{ow}s. Thus, HF, TFA and PFPA will be associated with the aqueous phase of any environment where they are released. HF, TFA and PFPA that have deposited in aquatic compartments are expected to remain in the aquatic compartment. Please note that a published environmental risk assessment on TFA is available in the literature."

3.2.3 Biodegradation

The EU registration dossier states that[6]:

"Although CAS# 756-13-8 is immiscible with water, it hydrolyzes completely when forced into contact with water to PFPA (CAS# 422-64-0) and a volatile hydrofluorocarbon (heptafluoropropane), with a half-life of <2.5 minutes. Although the propensity for CAS #756-13-8 to go into water is extremely low, once CAS #756-13-8 is in the water phase, the rate of hydrolysis is rapid. Therefore, CAS# 756-13-8 cannot be meaningfully examined in biodegradation assays, and we have proposed waiving of all biodegradation tests for lack of technical feasibility. Ready biodegradability studies of PFPA demonstrated little or no biodegradation in screening tests and no toxicity to activated sludge", the registrants have proposed waiving of any further biodegradation tests as providing no useful information.

"CAS# 756-13-8 is expected to undergo photolysis in the atmosphere, forming TFA (CAS# 76-05-1), HF (CAS# 7664-39-3) and carbon dioxide; PFPA may also be formed photolytically under certain, NO_x-limited conditions. A review of available information indicates that TFA under aerobic conditions is not readily or inherently biodegradable. It appears possible that there could be some biodegradation of TFA in the environment, particularly under anaerobic conditions. However, while there is some evidence of defluorination and decarboxylation of TFA in a few laboratory studies, these data are inconclusive and the rates at which biodegradation could potentially occur in natural environments would be expected to be very low to negligible. To date, no evidence of hydrolysis and photolysis of TFA has been observed in laboratory studies[1, 2, 3]. In addition, it has been shown from studies with many other longer chain perfluorinated moieties that fluorochemicals are oxidatively recalcitrant and resistant to most conventional waste treatment technologies[4]. It can be assumed TFA will remain as TFA and not degrade further under environmental conditions. Therefore, little new information would be gained by conducting additional biodegradation/simulation studies with TFA."

The registrants have proposed to waive all tests pertaining to REACH Annex IX.9.2 for TFA. HF is an inorganic substance and therefore biodegradation studies do not need to be conducted.

3.2.4 Bioaccumulation

The EU registration dossier states that[6]:

"CAS# 756-13-8 is very volatile (VP 40 kPa at 25°C). During routine use, there is no anticipated release to water or wastewater in the EU. It is not expected to partition from air to aquatic systems. The modest amount of CAS# 756-13-8 which would partition from air to water would hydrolyse with a half-life of ca. 2.5 minutes.". The registrants have proposed waiving of tests of bioconcentration for CAS# 756-13-8. "The expected phototransformation products are very soluble (if not miscible) in water. PFPA has a measured BCF of <4.8 in carp and is not considered bioaccumulative. TFA as a smaller molecule (CF_3CO_2H v. $CF_3CF_2CO_2H$) is expected to be less bioaccumulative in fish than PFPA. At concentrations at or below the no effect level of 1 mg/L, literature BCF values in terrestrial plants ranged from 5.4 to 27(1). It should be noted that growth dilution and root excretion will result in the reduction of plant TFA concentrations while leaf fall from deciduous plants is an ultimate removal mechanism. It is believed that the TFA is transported into the shoots from the roots via either flow due to transpiration or xylem flow and left behind when the water exited the plant. When removed to clean media, clearance of TFA from plants was observed. Therefore, TFA is not bioaccumulative in terrestrial plants."

3.2.5 Human Health Toxicity

Note: the assessment below is based on robust study summaries (RSS) shared in the disseminated ECHA dossier and viewed on 24/08/2023.

According to the EU registration dossier, CAS# 756-13-8 has been tested for toxicological endpoints with robust (reliability 1) and GLP studies:

Table 3-1: Summary of Human Heath Toxicity End Points

Study	Guideline	Species *(in vivo)* Cells *(in vitro)*	Results
Acute oral toxicity	OECD 423	Rat	LD50 >2000 mg/kg bw
Acute dermal toxicity	OECD 402	Rat	LD50 >2000 mg/kg bw
Acute toxicity by inhalation route	OECD 403	Rat	LC50 >1275 mg/l
Skin irritation / corrosion	OECD 404	Rabbit	Not corrosive or irritant

Eye irritation	OECD 405	Rabbit	Not irritant
Skin sensitisation	OECD 406 (Buehler test)	Guinea Pig	Not skin sensitizer
Repeated dose toxicity by inhalation route	OECD 412 (28 days) <u>Tested dose levels:</u> 0, 1000, 4000, 10000 and 20000 ppm (actual concentrations: 0, 12.41, 49.6, 124.7 and 244.6 mg/l)	Rat	Pulmonary effects at very high dose (≥124.7 mg/l): increase of lungs weight and accumulation of alveolar macrophages. NOAEC $_{pulmonary}$ = 49.6 mg/l Hepatic effects including histopathological effects at very high dose (≥49.6 mg/l). NOAEC $_{hepatic}$ = 12.45 mg/l
	OECD 413 (90 days) Test item: MTDID 5789 <u>Tested dose level:</u> 0, 300, 994 and 2990 ppm (eq. to 0, 3.9, 12.8 and 38.6 mg/l)		Hepatic effects including histopathological effects at high dose, not considered adverse. NOAEC ≥ 38.6 mg/l
Genotoxicity (*in vitro*)	OECD 471 (Ames)	Bacteria (Salmonella typhimurium and Escherichia coli WP2uvrA) +/- metabolic activation	Negative
	OECD 473 (mammalian chromosome aberration)	Chinese hamster Ovary +/- metabolic activation	
	OECD 490 (Tk)	Mouse lymphoma L5178Y +/- metabolic activation	
	OECD 476 (HPRT)	Chinese hamster lung fibroblasts (V79) +/- metabolic activation	
Genotoxicity (*in vivo,*	OECD 474 (Erythrocyte Micronucleus Test)	Mouse	

intraperitoneal)			
Reprotoxicity by inhalation route	OECD 414 (Prenatal Developmental Toxicity Study) Test item: MTDID 5789* Tested dose levels (determined based on the subchronic toxicity study - 90-day study): 0 (control), 305 ppm (3.9 mg/L), 1006 ppm (13 mg/L) and 3056 ppm (39.5 mg/L). OECD 421 (Reproduction/Developmental Toxicity Screening Test) Tested dose levels: 0 ppm, 300 ppm (3.88 mg/L), 995 ppm (12.8 mg/L), and 2992 ppm (38.7 mg/L)	Rat	No treatment related observations were recorded up to and including the highest dose tested

Adverse effects were observed on hepatic and pulmonary function in the repeated dose toxicity studies at the highest dose levels. It is noted that at the end of the 14 or 28-day recovery these effects were either not present anymore or observed with limited severity.

According to the available toxicological data summarized above, there are no indications that FK-5-1-12 has hazardous properties related to human health.

Therefore, based on the available data, FK-5-1-12 is not classified for human health.

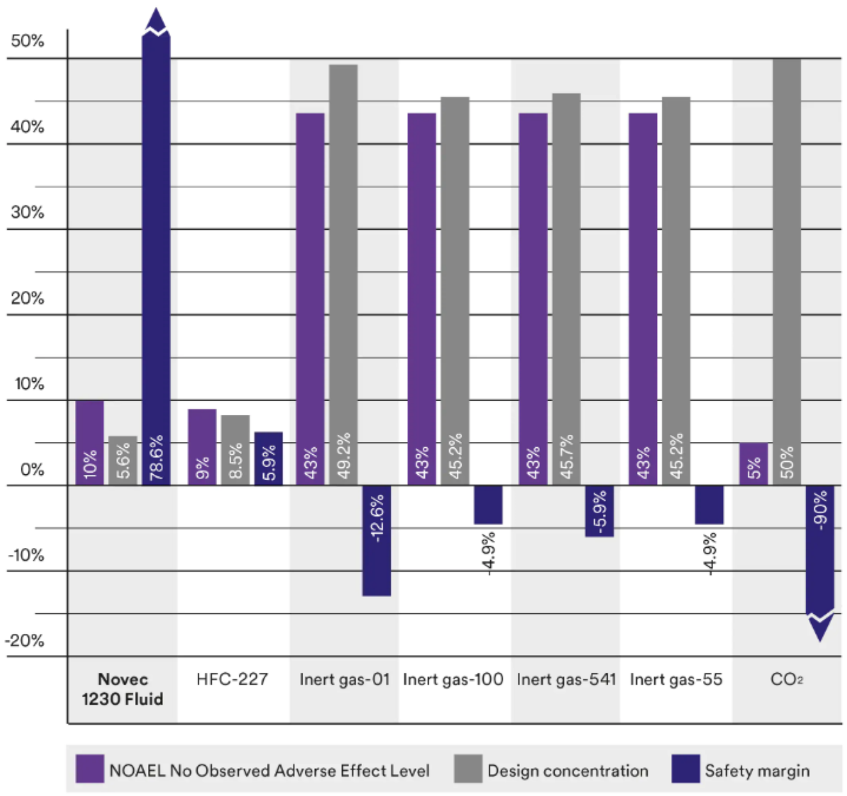
Further to this assessment the manufacturer[8] has calculated that when FK-5-1-12 is used as a clean agent in fire suppressant systems the concentration is far below the NOAEL as per Figure 3-5 below.

Figure 3-5 NOAEL safety margin of FK-5-1-12 compared with other gaseous fire suppressants[8].

[8] https://www.3m.co.uk/3M/en_GB/novec-uk/applications/fire-suppression/novec-1230-fluid/

Novec 1230 fluid provides widest safety margin for use in occupied spaces

Based on EN 15004 Higher Hazard Class A, and NFPA 12 for CO_2



3.3 Fire Suppression Performance requirements

Clean agent FK-5-1-12 extinguishes a fire by rapidly removing heat, without posing an asphyxiant threat for people in occupied space. It also evaporates faster than water meaning the equipment being protected (including sensitive electronics, machinery, etc) can be returned to function with limited cleanup or residue remaining from the system. These systems are ideal where discharging water may damage equipment or in the case of high voltage electrical equipment may cause arcing which can result in fire escalation.

Fire protection systems are generally required to meet safety performance requirements specified in EN, ISO, NFPA, EASA and ASTM standards. In addition, fire suppression systems and agents are generally required to be listed by an approval agency such as LPCB, CNPP, VdS, BSI or CNBOP to EN standards.

3.4 Control of potential emission

There are two potential modes of emission of clean agent FK-5-1-12 in fire suppression systems installed at a site, namely (1) during service life, and (2) at end of life. ExxonMobil cannot comment on emission sources during manufacture of FK-5-1-12 as it is a downstream user in the supply chain.

3.4.1 Service life

Gaseous Agent fire protection systems, such as FK-5-1-12, used at sites have limited potential for direct exposure as they are expected to be deployed only during emergency fire-fighting events. As part of the operational control to minimize discharge to the environment, FK-5-1-12 firefighting systems are not discharged during training purposes. During planned activities, such as equipment testing, maintenance, commissioning, and inspection, no release is expected from FK-5-1-12 firefighting systems. That said, there is limited history of accidental discharge of fire suppression systems at sites, but standard operating procedure requires that if discharge testing is needed, it should be strictly limited only to that which is essential to meet safety or performance requirements. The agent should also be recovered from the fire protection system in conjunction with testing or servicing and recycled for later use or destroyed and any residual chemicals immediately cleaned up in accordance with good industrial hygiene practices so that proper disposal is ensured.

Fire suppressant systems are serviced by the installer at least every 10 years where leakage of the gas from the storage cannister is inspected. Only if there had been a leak would the cannister be exchanged for another pre-filled cannister, there would be no topping up of the cannister which could lead to an accidental leak.

3.4.2 End-of-life

In the event that a fire suppression system containing clean agent FK-5-1-12 is replaced at end of life, the agent would be recovered from the fire protection. At the end-of-life phase, it must be noted that ExxonMobil complies with all applicable laws and regulations regarding the management of their operations and the handling of waste. For example, there are certain criteria on specific waste management for certain PFAS compounds within European Union Regulation (EU) 2019/1021 on Persistent Organic Pollutants. There are some Member States who have also implemented additional (either national or regional) requirements for management of PFAS impacted wastes.

It is not expected that at this time or as part of this limited derogation scenario that there is a requirement to immediately replace FK-5-1-12 clean agent containing fire suppressant systems. Replacement of an existing system is carried out on an as-needed basis per requirements in NFPA (National Fire Protection Association) and CFRA-Europe, the Confederation of Fire Protection Associations Europe. Where allowed by law, sites are advised to maintain adequate response capabilities.

4. OVERVIEW OF POTENTIAL ALTERNATIVES

4.1 Introductory Note

The assessment of potential alternatives is based on the recommendations found in 'ECHA's Guidance on Analysis of Alternatives under REACH Authorisations', published in 2021[9].

Basically, the workflow to identify alternatives encompasses to first describe the functionality of the PFAS substance in the particular use, followed by the analysis of the performance that an alternative must achieve. The latter requires in-depth experience of the characteristics of such alternatives to determine the extent to which such hypothetical candidates fall short in substituting away for the use of the PFAS substance.

This effort requires technical expertise within ExxonMobil to review the status of readiness for the suitability/unsuitability of potential alternative substances. Particular attention is paid to the research efforts in the past years. A literature search on further alternatives based on publicly available information is also being carried out. The analysis so far has been carried out in a scientifically sound manner and encompasses the following key assessed dimensions:

- Description of the functionality in the particular use and the technical feasibility criteria;
- Efforts made to identify alternative, including own R&D efforts, if any, and other publicly available information;
- Identification and shortlisted alternatives;
- Assessment of shortlisted alternatives, which includes: availability, safety considerations as technical and economic feasibility of the assessed alternative.

4.2 Availability of alternatives

According to the Halon Alternatives Research Corporation (HARC) response to the consultation (ECHA response #4457), the search for not-in-kind alternatives for use in fire suppression began over 30 years ago in anticipation of fluorocarbon production for fire protection being phased out in the EU and other countries. The regulation of HFC production has been part of this change. ExxonMobil understand from the fire protection industry that there is no indication or expectation that new non-PFAS, aka FK-5-1-12, alternatives will be identified in the near future. ExxonMobil is not party to the alternatives that have been investigated by the fire protection industry as part of the search for an alternative but understands from the HARC report that millions of euros and extensive time has been spent in identifying, testing, and ruling out candidate alternatives before those now in use were commercialized[10]. As all known candidate clean agent chemical groups have already been researched, discovering alternatives that are zero ODP, low GWP, and non-PFAS is highly unlikely in the next 20 years.

That said, there are commercially available alternatives to fluorocarbon-based fire suppression systems for projects which are considered at pre-engineering stage and in locations where the use of PFAS is likely to be restricted or where the current configuration is not available. Table 4-2 below, summarizes the main pros and cons of commercially available alternatives to FK-5-1-12 when compared to other fire suppression systems such as HFC's, inert gas and CO_2.

Table 4-2: Summary of the gaseous alternatives to FK-5-1-12 fire suppression agents

[9] How to apply for authorisation_v1_corrected (europa.eu)

[10] Halon Alternatives Research Corporation (HARC) response to the consultation (ECHA response 4457)

	FK-5-1-12	HFC-125	HFC-227	Inert gas	Water Mist	Water Sprinkler	Aerosol	CO_2
Performance								
Designed to extinguish fires	✓	✓	✓	✓			✓	✓
Leaves no residue	✓	✓	✓	✓				✓
Electrically non-conductive	✓	✓	✓	✓			✓	✓
Minimal Clean Up	✓	✓	✓	✓				✓
Speed of extinguishment	✓							
Sustainability								
<1 Global Warming Potential	✓			✓	N/A	N/A	✓	
Short atmospheric lifetime	✓			✓	N/A	N/A	✓	
Safety								
Safety margin compared with NOAEL	✓				N/A	N/A		LETHAL
Design Flexibility								
No room pressure venting requirement as defined by recognized test					✓	✓	✓	
No Sealed room required					✓	✓	✓	
Minimal space requirements to install	✓	✓	✓				✓	
No need to-engineer building/room protection					✓	✓		✓

4.2.1 *Quality standards and qualification procedure*

All facilities using clean agent FK-5-1-12 adhere to and comply with applicable local, state, national and EU legislation with regards to use of firefighting systems.

In addition, all sectors of fire protection are required to comply to guidance given in EN, ISO, NFPA, EASA and ASTM standards. In addition, fire suppression systems and agents are generally required to be listed by an approval agency such as LPCB (Global), CNPP (France), VdS (Germany), BSI (UK) or CNBOP (Poland) to EN standards.

In operational terms, ExxonMobil need to be certain that any material used must be able to meet the very strict safety and reliability specifications. If it is not possible to meet them, it is likely that the particular line or equipment will not be used until a suitable alternative can be developed – a process that can take many years and may have little chance of being successful.

4.3 Safety considerations related to alternatives

Clean agent FK-5-1-12 is safe to use as it is not classified for human health and not PBT or vPvB as explained in section 3.2.

It should be noted, however, that ExxonMobil per its Safety Policy is committed to conducting its business in a manner that protects the safety of employees, others involved in its operations, customers and the public and complying with all applicable laws and regulations. In doing so, maintains high quality and safety standards in their operations, complying with the requirements of applicable industry standards. Therefore, if use of an alternative were to result in non-compliance with specifications, it would not be used and there would be a need to develop a new one.

4.3.1 CO_2 based systems

Alternative gaseous systems based on CO_2 may cause O_2 depletion and may cause asphyxiation to any people in the vicinity of a fire. A failure to extinguish a fire in time may potentially cause critical control systems to fail increasing the risk of a process safety incident at a site.

The USEPA published an extensive study in Oct 2022 as part of the SNAP (Significant New Alternatives Policy) looking at Carbon Dioxide as a Fire Suppressant: Examining the Risks which can be found at: Carbon Dioxide as a Fire Suppressant: Examining the Risks | US EPA[11].

The report outlines that when humans are exposed to low concentrations (less than 4 percent) of carbon dioxide for up to 30 minutes, dilation of cerebral blood vessels, increased pulmonary ventilation, and increased oxygen delivery to the tissues are observed (Gibbs et al. 1943[12], Patterson et al. 1955)[13]. These data suggest that carbon dioxide exposure can aid in counteracting effects (i.e., impaired brain function) of exposure to an oxygen-deficient atmosphere (Gibbs et al. 1943) however, longer terms and more concentrated exposure can still lead to asphyxiation. During similar low-concentration exposure scenarios in humans, however, other researchers have recorded slight increases in blood pressure, hearing loss, sweating, headache, and dyspnea (Gellhorn and Speisman 1934[14], 1935[15]; Schneider and Truesdale 1922[16]; Schulte 1964[17]). This could be the case for clean agent CO_2 based fire suppression systems where asphyxiation could be an endpoint of exposure.

4.4 Technical feasibility of alternatives

Non-PFAS clean agent commercial alternatives have been shown not to be appropriate for use in all fire or explosion hazard situations. Though ExxonMobil is not party to the work that fire protection suppliers have done in looking for alternatives to clean agent FK-5-1-12 in fire suppression, the critical technical parameters they would need to meet include:

- Speed of extinguishment;
- Time required for agent discharge;

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[11] https://www.epa.gov/snap/carbon-dioxide-fire-suppressant-examining-risks#:~:text=From%201975%20to%20the%20present,carbon%20dioxide%20fire%20extinguishing%20systems.

[12] Gibbs, F.A.; Gibbs E.L.; Lennox, W.G.; Nims, L.F. 1943. The value of carbon dioxide in counteracting the effects of low oxygen. J. Aviat. Med. 14:250-261

[13] Patterson, J.L.; Heyman, H.; Battery, L.L.; Ferguson, R.W. 1955. Threshold of response of the cerebral vessels of man to increases in blood carbon dioxide. J. Clin. Invest. 34:1857-1864

[14] Gellhorn, E.; Spiesman, I.. 1934. Influence of variations of O2 and carbon dioxide tension in inspired air upon hearing. Proc. Soc. Exp. Biol. Med. 32:46-47.

[15] Gellhorn, E.; Spiesman, I.. 1935. Influence of hyperpnea and of variations of O2- and CO2-tension in the inspired air upon hearing. Am. J. Physiol. 112:519-528.

[16] Schneider, E.C.; Truesdale, E. 1922. The effects on the circulation and respiration of an increase in the carbon dioxide content of the blood in man. Am. J. Physiol. 63:155-175.

[17] Schulte, J.H. 1964. Sealed environments in relation to health and disease. Arch. Environ. Health 8:438-452

- Weight of the agent and equipment;
- Space required for the agent and equipment;

The alternatives also need to meet safety and standard requirements.

ExxonMobil does not believe that alternatives to the clean fire suppression agents currently commercially available or meets the same technical standards required for all fire scenarios.

4.5 Economic feasibility of alternatives

Replacement of a fully functioning clean agent FK-5-1-12 system in an existing installation will require downtime at the facility to allow shutdown and turnaround time to replace the existing fire suppression systems. Currently sites will only program in the changing of a fire suppressant system if the system is no longer functioning or if a change in configuration is required. It is unlikely that any fire suppressant manufacturer will allow the sole replacement of just the clean agent alone to an alternative to FK-5-1-12 and instead the whole system will need to be replaced to maintain the systems warranty and thereby the required technical capabilities. Such additional costs would be planned within site capital expenditure if there was a requirement to move away from clean agent FK-5-1-12. These costs would be realised when the existing clean agent FK-5-1-12 system comes to the end of its service-life which could be due to either an intentional release in the event of a fire or finding that there had been a leak from the cannister at the time of servicing such that the clean agent needed replacing.

4.6 Actions and time required for substitution

Within the Restriction Report there is currently a proposed derogation for "Clean fire suppressing agents where current alternatives damage the assets to be protected or pose a risk to human health (until 13.5 years after Entry into Force)".

The Restriction Report further notes that "The proposed derogation applies to fire-suppressing agents in the form of fluorinated gases used for extinguishing fires in high-risk situations where alternatives pose significant risk to health or the assets to be protected. These situations may include aviation, data centres and cultural/historic resources".

ExxonMobil's use(s) of PFAS-containing fire suppression agent FK-5-1-12 meet the proposed EU REACH restriction derogation criteria. However, it is not clear if the proposed derogation time period is sufficient to enable necessary facility redesign, shutdown and turnaround time to replace the existing fire suppression systems when they reach the end of their service life and can no longer be replaced (or refilled) with FK-5-1-12. ExxonMobil do not expect that there will be a requirement to replace all fully functioning FK-5-1-12 systems at the end of the derogation period, but it does expect that FK-5-1-12 would no longer be available in the EU if a cannister needs to be replaced, which would lead to a need for an unplanned replacement with a non FK-5-1-12 system with associated cost and downtime. At present, alternatives would mean replacement with a lower safety, potentially slower fire extinguisher capability and lower sustainability profile fire suppressant system as outlined in Table 4-1.

ExxonMobil believe that that there is a need to continue to use fluorinated clean agents in critical fire suppression applications well beyond 13.5 years after EiF and that it will be necessary to include a time-unlimited derogation for clean fire suppressing agents in the PFAS restriction until a suitable alternative is found that meets the latest safety standard requirements.

4.7 Conclusion

ExxonMobil believe that that there will be a need to continue to uses of fluorinated clean agents in critical applications well beyond 13.5 years after EiF and that it will be necessary to include a time-unlimited derogation for clean fire suppressing agents in the PFAS restriction until a suitable alternative is found that meets the latest standard requirements. As clean agent FK-5-1-12 is not classified for human health, not PBT or vPvB it believes that the continued use of clean agent FK-5-1-

12 in fire suppression systems can be justified until a suitable alternative can be found that meets all required technical requirements and safety standards.

In operational terms, use of less effective materials, and the subsequent potential for more frequent incidents, may result in more frequent and longer downtimes in production, impacting in the end the total output of the facility. In that case, it is unlikely that ExxonMobil would select to use such materials, as they need to be certain that any material used must be able to meet the very strict safety and reliability specifications. If it is not possible to meet them, it is likely that the particular line or equipment will not be used until a suitable alternative can be developed – a process that can take many years and may have little chance of being successful.

5. SOCIO-ECONOMIC ANALYSIS

5.1 Introductory note

This socioeconomic impact assessment compares two scenarios, the ‘continued use scenario’ and the ‘limited derogation scenario’:

- The ‘continued use scenario’ considers a scenario whereby ExxonMobil’s requested derogation for uses are granted (i.e. the company can ‘continue using’ fire suppression systems where required), which means that the use of FK-5-1-12 as a clean fire suppressant agent will continue indefinitely – as has been highlighted in Section 5.2.1. Sites are anticipated to explore options to use alternatives to the clean agent fire suppressant system where technically and economically feasible. The volume of use of the PFAS FK-5-1-12 used is therefore likely to decrease over time; and
- The ‘limited derogation scenario’ considers a scenario whereby the restriction is implemented in its current form, and a time- limited derogation will be applicable to clean fire suppressant use for 13.5 year after EiF. The current proposed derogation wording does not give any option for a review toward the end of the 13.5 years, so as to assess the need for extending the derogation if all attempts to find a suitable alternative or alternative technology have been unsuccessful.

From a geographical scope perspective, emphasis has been placed predominantly upon describing the nature of impacts inside the EEA. This is based on clear information from ECHA’s original SEA guidance, which highlights that “*In setting the geographical coverage and undertaking the assessment of impacts, it should be kept in mind that the final comitology decision… on whether or not to grant an authorisation will most likely focus mainly on impacts inside the EU. As a consequence, it is recommended that the emphasis be placed on describing and possibly quantifying what happens inside the EU*”[18].

Whilst the key focus of the SEA is considered to be EEA society as a whole, information is also provided regarding higher level indirect impacts to ExxonMobil and its customers. This is in order to provide clarity regarding wider downstream and societal impacts.

It is also noted that whilst efforts have been made to quantify impacts where possible, some of the impacts are described qualitatively.

ExxonMobil understand that the Annex XV restriction proposal itself presents impacts mainly in qualitative terms. For example, the restriction proposal highlights that “*benefits to human health are evaluated qualitatively as data is limited, or missing, to assess (i) the hazard of many of the individual PFASs*”.

Importantly, the proposal also highlights that “*as specific information on costs of a ban of PFASs for the different actors associated with the addressed uses was scarce and mainly qualitative, the derogations and their duration were mainly based on the availability and applicability of alternatives to PFASs*”. ExxonMobil wish to add that whilst the scope of applicable derogations to ExxonMobil within the restriction proposal is limited, significant information has been provided in the above analysis of alternatives which highlights the significant lack of technical and economic feasibility for substitution of PFAS for use in fire suppression systems. In this regard, the current SEA is provided to further support ExxonMobil’s request for a time-unlimited derogation.

[18] ECHA (2008): Guidance on Socio-Economic Analysis – Restrictions Available at: https://www.echa.europa.eu/documents/10162/2324906/sea_restrictions_en.pdf/2d7c8e06-b5dd-40fc-b646-3467b5082a9d.

5.2 Continued use scenario (aligned with preferred derogations)

5.2.1 Overview of continued use scenario

As highlighted in Section 2, ExxonMobil is one of the largest integrated fuels, lubricants and chemical companies in the world. With specific regard to chemicals and specialties, the ExxonMobil group has manufacturing capacity in every major region of the world, serving large and growing markets.

ExxonMobil have sites across the EEA which contain safety critical systems to maintain the safe operations of those sites. Clean agent fire suppressants are installed so that in the event of a fire, it is extinguished quickly, with minimal residue, and no effect on human health and to enable minimal downtime and continued safe operation of the people, site and operations being protected from fire.

ExxonMobil understands from fire suppressant suppliers that there will be critical uses of fluorinated clean agents well beyond 13.5 years after EiF as the available alternatives are expected to be technically inferior and lead to lower safety margin and so it will be necessary to include a time-unlimited derogation for clean fire suppressing agents in the restriction.

The continued use scenario considers the situation arising under the assumption the time-unlimited derogation requested by ExxonMobil and the wider fire protection industry are accepted. It therefore covers the continued industrial use of the PFAS clean agent FK-5-1-12 in the use identified within this report. In line with HARC recommendation[10], ExxonMobil also recommend incorporating the requirement to meet safety standards into a time unlimited derogation by using the same wording as the prohibition on HFCs for fire suppression in the revised F-gas regulation, this would be to include a clause that “the existing inspection regime meets ISO 14520 or EN 15004 standards”. This is based on the fact that FK-5-1-12 is not classified for human health or a PBT or vPvB. As described in section 3.2.

This is appropriate as both regulations cover clean agents. Tying the derogation only to situations where alternatives meet “safety standards” without explaining what those standards are could significantly limit the impact of the derogation and mean that potentially inferior fire suppressants be used adversely affecting safety standards.

5.2.2 Market and business trend considerations

The use of fluorinated clean agents is small and decreasing, the emissions are low, and the rate of recycle is high. As such, the impact of a time-unlimited derogation for clean fire suppressing agents on overall emissions of PFAS should be relatively small[19].

ExxonMobil will continue to invest in evaluating if there is an opportunity to move to an alternate fire suppression system for new sites and when reconfiguring existing sites which would require clean fire suppression to meet safety standards. ExxonMobil may look into alternatives to PFAS clean agent in suppression systems for projects which are at pre-engineering stage and in locations where the use of PFAS is likely to be restricted in the future or where the current configuration is not available.

5.2.3 Risks associated with continued use

As outlined in Section 3.2, clean agent FK-5-1-12, despite falling in the scope of the PFAS definition in the EU PFAS restriction proposal, does not itself persist in the environment, does not bioaccumulate and is not classified for human health which were the identified properties for the PFASs giving rise to the current proposal to restrict their use in the environment. It is also not classified for human health and well below the NOAEL at the concentration in which it is released in the event of a fire.

Further as outlined in section 3.4, clean agent FK-5-1-12 fire protection systems used at critical industrial sites have limited potential for generating direct exposure as they are expected to be

[19] Halon Alternatives Research Corporation (HARC) response to the consultation (ECHA response 4457)

deployed only during emergency fire-fighting events. Furthermore, as part of the operational control to minimize discharge to the environment, clean agent FK-5-1-12 firefighting systems are not used for training purposes. During planned activities such as equipment testing, maintenance, commissioning, and inspection, no release is expected of clean agent FK-5-1-12 from the fire suppression system. There is limited history of accidental discharge of fire suppression systems at any industrial sites[19]. Standard operating procedures are also in place and require that if discharge testing is needed, it should be strictly limited only to that which is essential to meet safety or performance requirements; in which case, the clean agent should be recovered from the fire suppression system in conjunction with testing or servicing and recycled for later use or destroyed; an immediate clean-up of any residual chemicals in accordance with good industrial hygiene practices is also required, as is proper disposal.

5.3 Limited derogation scenario (aligned with current ECHA Restriction proposal)

5.3.1 Overview and limited derogation scenario

The 'limited derogation scenario' considers a scenario whereby the restriction is implemented in its current form.

The derogation proposed in the current EU REACH restriction proposal is covered in Annex E.2.8: Applications of fluorinated gases (Fire suppressants) where it is stated that:

"Given the sufficiently strong evidence indicating the unavailability of alternatives at EiF for some applications, a derogation is proposed for:

> *Clean fire suppressing agents where current alternatives damage the assets to be protected or pose a risk to human health.*

With a ban with a transition period of 18 months and a 12-year derogation, because the information provided in the consultation suggests the unavailability of alternatives. Current R&D development appears to focus on alternative fluorinated gases, rather than on non-PFAS alternatives [weak evidence base]."

It is not expected that as part of this limited derogation scenario, fire suppression systems containing PFAS will need to be exchanged if they are still in service after the end of the derogation period. However, it is expected that after EiF plus 13.5 years, if the PFAS fire suppression system is discharged, it cannot be recharged with a PFAS-containing cannister and so an alternative system will need to be installed.

5.3.2 Impact of limited derogations on ExxonMobil

ExxonMobil support the proposal in the Annex XV report for a derogation for clean fire suppressing agents however it is not yet clear if there will be an available alternative for ALL uses of clean fire suppression systems in sites where it is needed to protect safety critical systems. Where a suitable and safe alternative is not available, sites in the EU will either have to:

(1) Replace existing clean agent FK-5-1-12 systems at the end of their service life with an inferior system which may not meet the current safety requirements outlined in current standards or;

(2) Shut down the operation in the EU where the risk of an inferior fire suppression system is too great and potentially relocate the operation to another country where clean agent FK-5-1-12 fire suppression is still allowed. This will be more likely where there is a compounding effect that multiple control rooms and safety critical systems are affected at the same operation.

(3) Scope new engineering projects in the EU with different and potentially inferior system which may not meet current safety standards, but if the risk, potentially change the planned location of the site to another country where clean agent FK-5-1-12 fire suppression is still allowed.

The choice of a new alternative differs depending on the designated or intended use of the area.

It can also be reasonably expected that where an unplanned fire suppression system needs to be changed to an alternative due to a release to extinguish a fire or failure detected as part of regular servicing, the unplanned downtime associated with replacing the fire suppression system could likely lead to decreased output from the facility the fire protection system is protecting. Such unintentional costs cannot be calculated and would be highly dependent on the site in question but could be material.

5.3.3 Impact of the limited derogation on Customers

Any unplanned interruption in supply would not only have an impact on the site undergoing the interruption but also the downstream users of the products being produced at the site. Though many companies would have a business continuity contingency plan, it can reasonably be expected that customers may seek to recover their own business interruption costs from ExxonMobil but these have not been assessed as part of this study.

5.3.4 Societal impacts associated with limited derogations

ExxonMobil have strict safety standards to maintain the safe operation of its sites. If these cannot be maintained due to the installation of inferior fire suppressant systems, there is a potential for an increase in the reportable incidents related to exposure to CO_2 or fire. If the replacement fire suppressant system is inferior to the one currently in use, sites may not be able to sufficiently protect the integrity of their equipment and facilities and may even have increased risk for the health and safety of their personnel and the general population near their sites.

The October 2022, USEPA published study as part of the SNAP (Significant New Alternatives Policy) looking at Carbon Dioxide as a Fire Suppressant: Examining the Risks which can be found at: [Carbon Dioxide as a Fire Suppressant: Examining the Risks | US EPA], found that from 1975 to the present (2022) , a total of 51 carbon dioxide incident records were located that reported a total of 72 deaths and 145 injuries resulting from accidents involving the discharge of carbon dioxide fire extinguishing systems. (Information was requested on any incidents of death or injury resulting from the use of carbon dioxide fire extinguishing systems. Data were requested on both fire- and no fire-related incidents; however, it was significantly more difficult to gather information on fire-related incidents. Injuries and fatalities from fire situations are generally classified only as fire-related and are not broken down by the fire suppression agent that was used. Therefore, carbon dioxide deaths and injuries from fire-related situations may not be adequately represented. In addition, it should be noted that any discharge of carbon dioxide which resulted in no injuries and/or deaths was not included in the analysis.) All the deaths that were attributed to carbon dioxide were the result of asphyxiation. Details about the injuries were generally not provided in the incident reports, although some OSHA inspections listed asphyxia as the nature of the injury.

No wider societal impacts or costs have been assessed as part of this study.

5.3.5 Wider economic Impacts

Wider economic impacts can be foreseen as a result of an interruption in supply, but these have not been assessed as part of this study.

6. SUMMARY

A clean agent fire suppression system contains a gaseous fire suppressant that is electrically non-conducting and that does not leave a residue upon evaporation. This is ideal when protecting safety critical systems, high value items or systems that are business critical and where downtime would potentially lead to business continuity issues or trigger process safety issues. Water and other suppression agents can cause damage to sensitive assets like technology and electronics. Since clean agents are gaseous upon discharge, they cause no harm to assets and are fast acting as they can discharge within seconds, limiting fire damage to a small area.

FK-5-1-12 (CAS: 756-13-8) is a PFAS based clean agent fire suppressant chemical and extinguishes a fire by rapidly removing heat, without posing an asphyxiant threat for people in occupied space. It also evaporates faster than water meaning the equipment being protected (including sensitive electronics, machinery, etc) can be returned to function with limited clean up or residue remaining from the system.

All sectors of fire protection are required to meet safety requirements such as those given in EN, ISO, NFPA, EASA and ASTM standards. In addition, fire suppression systems and agents are generally required to be listed by an approval agency such as LPCB (global), CNPP(France), VdS (Germany, BSI (UK) or CNBOP (Poland) to EN standards.

ExxonMobil understand from fire suppressant suppliers that there will be the need for critical uses of fluorinated clean agents well beyond 13.5 years after EiF as the available alternatives will be technically inferior and lead to lower safety margin and so it will be **necessary to include a time-unlimited derogation for use as a clean agent in fire suppression systems** in the restriction until a suitable alternative is found that meets the latest standard requirements. As **FK-5-1-12 is not classified for human health, not PBT or vPvB.** ExxonMobil believe that the continued use of FK-5-1-12 in fire suppression systems can be justified until a suitable alternative can be found that meets all required technical requirements and safety standards.

It should be noted, however, that ExxonMobil per its Safety Policy is committed to conducting its business in a manner that protects the safety of employees, others involved in its operations, customers and the public and complying with all applicable laws and regulations. In doing so, maintains high quality and safety standards in their operations, complying with the requirements of applicable industry standards. Therefore, if use of an alternative were to result in non-compliance with specifications, it would not be used and there would be a need to develop a new one.

ExxonMobil have site across the EEA which contain safety critical systems to maintain the safe operations of sites in which clean fire suppressants are installed. The continued use scenario under the assumption the time-unlimited derogation requested by ExxonMobil and the wider fire protection industry is accepted should also include the requirement to meet safety standards into a time unlimited derogation by using the same wording as the prohibition on HFCs for fire suppression in the revised F-gas regulation, this would be to include a clause that "**the existing inspection regime meets ISO 14520 or EN 15004 standards**". Tying the derogation only to situations where alternatives only meet "safety standards" without explaining what those standards are could significantly limit the size of the derogation and mean that potential inferior fire suppressants be used adversely affecting safety standards.

This report also presents evidence that a limited derogation scenario would result in severe negative impacts for the EU where the expectation is that at the end of the derogation period a technically equivalent alternative to the PFAS fire suppressant currently in use, which can meet the latest ISO 14520 or EN 15004 safety standards will not be available. In this scenario, sites would be faced with a choice to:

(1) Replace existing FK-5-1-12 systems at the end of their service life with an inferior system which may not meet the current safety requirements outlined in current standards or;

(2) Shut down the operation in the EU where the risk of an inferior fire suppression system is too great and potentially relocate the operation to another country where FK-5-1-12 fire suppression is still allowed or;

(3) Scope new engineering project in the EU with an inferior system which may not meet current safety standards, but if the risk of an inferior for suppression system is too great, potentially relocate the operation to another country where FK-5-1-12 fire suppression is still allowed.

It can also be reasonably expected that where an unplanned fire suppression system change to an alternative due to a release to extinguish a fire or failure as part of regular servicing, the unplanned downtime associated with replacing the fire suppression system could likely lead to decreased output from the facility the fire protection system is protecting. Such unintentional costs cannot be calculated and would be highly dependent on the site in question but would be material.

It is not expected that as part of this limited derogation scenario fire suppression systems containing PFAS will need to be exchanged if they are still in service after the end of the derogation period, having never been discharged. However, it is expected that after EiF plus 13.5 years, if the PFAS fire suppression system is discharged, it could not be recharged with a new PFAS cannister and so an alternative system would need to be installed. The downtime associated with replacing the system would lead to an unplanned interruption in supply of what is manufactured at the site and would not only have an impact on the site undergoing the interruption but also the downstream users of the products being produced at the site. These costs would be material.

Finally, a widely commercialised alternative for protecting safety critical systems in unoccupied spaces are CO_2 based systems, however in occupied spaces, discharge of these may cause O_2 depletion and may cause asphyxiation to any workers in the vicinity of a fire. A failure to extinguish a fire in time may potentially also cause critical control systems to fail increasing the risk of a process safety incident at a site.

As a conclusion and considering the high difficulty in identifying an alternative clean agent despite decades of research and the need to protect safety critical systems, high value items or systems that are business critical, ExxonMobil would request that derogation 5.m. be updated to a time-unlimited rather than time-bound derogation, as per the text below:

> **Clean fire suppressing agents where current alternatives damage the assets to be protected or pose a risk to human health.**

It should also be noted that no move should be made to an alternative unless the fire suppression system meets the latest ISO or EN safety standards.