



“AFFF” The Chemical Chain Dilemma (PFOA/PFOS)



FireStopper Marketing Department
WHITE PAPER

September 20, 2016



FIRESTOPPER®
Industrial - Commercial
Government



Preface

FireStopper International Limited, a transnational Registered Company, is the developer of the most advanced, powerful and safe fire fighting and anti-explosive technology in the “World. It devoted the first 25-years of its existence to R&D and is the recipient of subsequent stand alone testing results based on the ratings and certifications awarded by the most recognized and respected third-party testing and listing facilities in the world.

Moreover, this unique FFC (Fire Fighting Catalyst) Technology does not contain any **PFOA or PFOS**, which has derived the only available foaming concentrate that has equal and effective usage in applications at 1%, 3% and 6% with full certifications at 1A (as provided in the grading scheme by EN1568) in each mixing percentage and all fire class/subclass effectiveness. Moreover, this technology has derived fire and anti-explosive products, which are non-toxic, non-irritant, environmentally safe (determined “Green” under the HOCNF Protocols), and non-hazardous over all other existing and available products in the fire and safety channel of business.

Having proven the former statement through the outstanding results of the products testing, rating, and certifications thus received, FireStopper®, in tandem with its novel fire fighting and anti-explosion products (the “software”), developed the most durable and reliable supporting hardware and detection systems available today, which also meet and exceed the relative standards used to certify said product lines.

Moreover, the FireStopper® lines of products reach across the full spectrum of safety application including environmental remediation post spills both onshore and offshore.

In the International arena, the FireStopper® brand is the recipient of the highest certifications in all category of Governmental requirements to market such as defined below:

Handheld Portable Extinguishers:

*ANSI/UL711, ULC – Southwest Research Institute (San Antonio, TX)
Defense Logistics Agency (DLA) US Gov. NSN Approval #s’*

*EN3-7; EN3-8¹ – MPA, Dresden (Germany)
CE² – DNV*

Firefighting Foam Concentrates:

*EN1568 – MPA Dresden
ICAO – CNPP (France)
IMO – MPA Dresden, Lloyds Registry: DNV & MED
CE*

Environmental Testing:

¹ This Standard refers to hardware durability, reliability and efficacy

² This Mark assures manufacturing quality through yearly inspections

NAMSA, USA
Associated Laboratories, CA USA
Environmental Medicine, Inc., USA
OPUS, Ltd., UK

Executive Summary

A Desperate And Backwards Effort To Reintroduce Non PFOS with marginal PFOA fluorinated products and Non-Fluorinated Foams As A Replacement To Standard AFFFs Exposes The Environment And Life To Greater Harm

Never before has there been a greater demand for fire protection both against industry related events and the externally driven maleficence. The security needed to protect this valuable infrastructure is currently in the hands of proven inadequate old technology product (*AFFF, FFFP, Dry Chemical Powders and dangerous Streaming Gases and marginal water mist systems*) and now, the usual suspect so called "New" AFFFs claiming no PFOS or marginal PFOA content or non-fluorinated foams. Actual history shows that when these catastrophic events occur, the infrastructure is massively damaged or totally destroyed causing massive loss of revenue and the irreplaceable loss of life and time.



In today's economic environment, Industry cannot afford business as usual with the usual products at hand. Over 60-years of R&D, real world applications and firefighting, have determined that hydrocarbon born fires cannot safely, efficiently or economically be extinguished using the same old tired AFFF. This represents a serious backwards step to even consider the use and application of the so-called new AFFF formulations or non-fluorinated foams.

These new products being pushed into the market misrepresent themselves as environmentally responsible/safe products, while at the same time obscuring in their required Safety Data Sheets (SDS) the direct harm exposure to human/animal and environment will have should these products be deployed as a substitute/replacement to AFFF. Moreover, these so-called new AFFFs depend on employing the same limited effective technology that requires massive application of product in order to "Control" the fire event. On the other hand, aqueous based silicone surfactants in conjunction with harsh solvents that can provide the capability to produce a film formation in order to suppress the common vapors that produce and feed the dynamic fires hydrocarbons emit. As an example, the sum effect of these types of chemical formulas can destroy sight should the chemical make contact with the eyes.

In addition to the above, it is a known scientific fact that silicones when entering the human/animal bodies will cause CANCER. What makes this line of products even more dangerous than the existing fluorinated AFFFs is that the aqueous silicone will enter the water table below ground much faster and directly causing the ingestion of silicone by human and animals.

Government and Industry have accepted and implemented a series of required testing and certifications both for safety in human/animal exposure and the environment both inland and offshore.

These new products have not produced the results that would represent safety in use and applications. What they have produced is the ability to pass the recognized commercial fire tests in a limited form. What this means is that they will extinguish a hydrocarbon-based fire, however, these products will have to deploy massive amounts of volume in order to suppress and finally extinguish the fire event.



The two most commonly researched PFCs and most prevalent in the environment are:

- Perfluorooctanoic acid (PFOA)
- Perfluorooctane sulfonate (PFOS)

The science surrounding PFCs is still evolving, especially in the fields of health and environmental effects and human toxicology. Much research has been and is being performed in the U.S. and internationally. PFCs are persistent, bio-accumulative, and toxic substances that have been detected all over the world, even in remote locations. They have been shown to be toxic to laboratory animals, and there is inconclusive evidence that they might cause cancer in animals. The toxicity to humans is still being debated; although some studies suggest that these chemicals function as endocrine disruptors and mimic fatty acids in the body. The chemicals are not easily excreted and remain in the human body for years (estimated 4-8 years). In addition, PFCs do not degrade in the environment and are not removed by conventional water treatment methods, such as in-situ pump and treat, soil vapor extraction and air sparging.

AFFF products containing PFOS may still be in use. Although AFFF was reformulated in the early 2000s and no longer contains PFOS, civilian and military airports continue to maintain an inventory of PFOS-based AFFF. In recent years, the U.S. Environmental Protection Agency (EPA) issued Significant New Use Rules (SNURs) under its Toxic Substances Control Act (TSCA) authority to restrict the production and use of products that contain PFOS and its precursors; however, the U.S. EPA, Federal Aviation Authority, and other regulatory agencies continue to allow its use. (FAA, 2011)

In 2004 and 2011, Robert L. Darwin, P.E. (NAVSEA, NRL), prepared estimates on the quantities of AFFF in the U.S. for the Fire Fighting Foam Coalition. Estimates provided in 2011 are provided in Table 1 below:

Table 1: Estimates of AFFF Quantities by Sector, 2004 – 2011 (Darwin, 2011)

Sector	PFOS-based AFFF (2004), gallons	PFOS-based AFFF (2011), gallons
Military & Other Federal	2,100,000	1,094,700
Civil Aviation (Aircraft Rescue and Fire)	130,000	20,000
Oil Refineries	950,000	152,000
Other Petro-Chem	1,000,000	500,000
Civil Aviation (Hangars)	190,000	70,300
Fire Departments	120,000	60,000
Miscellaneous	150,000	75,000
TOTALS	4,600,000	1,972,000

PFOA

PFOA has been manufactured in industrial quantities since the 1940s, and unlike PFOS, PFOA continues to be manufactured in the United States although several companies are phasing out its use. PFOA has been used primarily as an aqueous dispersion agent (additive) in the manufacturing of fluoropolymers, which are substances with special properties that have

thousands of manufacturing and industrial applications. Of course, Fluorinated telomers are used in fire-fighting foams.

ENVIRONMENTAL FATE AND TRANSPORT

PFOS and PFOA compounds are highly soluble in water and typically present as an anion (conjugate base) in solution and have very low volatility due to their ionic nature (ATSDR, 2009). Long chain. PFCs have low vapor pressure, and aquatic environments are expected to be their primary sink in the environment (Environment Canada, 2010). These compounds do not readily degrade by most natural processes. They are thermally, chemically, and biologically stable and are resistant to biodegradation, atmospheric photooxidation, direct photolysis, and hydrolysis. The structure of PFCs increases their resistance to degradation: the carbon-fluorine bonds require a lot of energy to break, and the fluorine atoms shield the carbon backbone (OECD, 2002).

In the absence of national regulatory standards some States have developed regulatory and guidance advisory and cleanup levels for PFCs. In 2014-2015, the Remediation and Reuse Focus Group requested information from States in order to document current State regulations and guidance for PFCs, and to gather and compile State resources that may assist other States that may soon develop their own. Information provided by States and additional research conducted by the Focus Group on guidance and/or regulatory cleanup levels for PFOS and/or PFOA are provided in Table 2:

Table 2: State Guidelines for PFOS and PFOA

State	Guidelines	Source
Illinois	Provisional Groundwater Remediation Objectives - PFOA <ul style="list-style-type: none"> · 0.4 µg/L (Class I) · 2 µg/L (Class II) Provisional Groundwater Remediation Objectives - PFOS <ul style="list-style-type: none"> · 0.2 µg/L (Class I) · 0.2 µg/L (Class II) Illinois uses Reference Doses derived by the State of Minnesota with the procedures of 35 IAC Part 742 to develop a suite of provisional soil remediation objectives for the Ingestion and Migration to Groundwater pathways.	Illinois EPA, personal communication, October 8, 2013.
Maine	Groundwater Remedial Action Guidelines <ul style="list-style-type: none"> · PFOA: 0.06 ppb · PFOS: 0.1 ppb Maine Center for Disease Control has derived non-cancer human health risk-based screening levels for exposures to soil, sediment, groundwater, surface water, and ingestion of fish, for PFOA and PFOS.	http://www.maine.gov/dep/spills/publications/guidance/rags/final_5-8-2013/3%20MERAG%20Tables%205-8-2013.xlsx Maine DEP, personal communication, 2015
Washington	Listed PFOS as a Persistent, Bioaccumulative, and Toxic (PBT) under Washington State's PBT rule.	WAC 173-333-320
North Carolina	Groundwater Interim Maximum Allowable Concentration, PFOA: 2 µg/L May lower to 1 µg/L based on new data.	http://daq.state.nc.us/toxics/risk/sab/ra/PFOA_Pending.pdf

State	Guidelines	Source
Pennsylvania	Safe Drinking Water Program developed an action plan as a result of two ongoing cases where PFCs were discovered and treatment proposed.	PA DEP, personal communication, 2015
Texas	Texas has established protective concentration levels for 16 PFCs and published in update in its Tier 1 PCL Tables in November 2014.	A. Strahl, personal communication, 2013 http://www.tceq.texas.gov/assets/public/remediation/trrp/pcls2014.xlsx
Michigan	Fish advisories for Clarks Marsh and the Ausable River. Surface water used as drinking water, PFOA: 0.420 µg/L Ambient water quality standard, PFOS: 0.012 µg/L	Michigan DEQ, personal communication, October 8, 2013. http://www.michigan.gov/deq/0,1607,7-135-3313_3686_3728-11383--,00.html http://www.michigan.gov/deq/,4612,7-132-5478354784_56159-285528--.html
Minnesota	<p>Drinking Water Health Risk Limit: 0.3 µg/L (PFOA, PFOS) Fish Consumption:</p> <ul style="list-style-type: none"> • 1.6 µg/L (PFOA, Lake) • 2.7 µg/L (PFOA, River) • 12 ng/L (PFOS, Lake) • 6 ng/L (PFOS, River) <p>Drinking water plus fish consumption:</p> <ul style="list-style-type: none"> • 0.61 µg/L (PFOA, Lake) • 0.72 µg/L (PFOA, River) • 12 ng/L (PFOS, Lake) • 6 ng/L (PFOS, River) <p>Ecological, Acute:</p> <ul style="list-style-type: none"> • 15,000 µg/L (PFOA) • 85 µg/L (PFOS) <p>Ecological, Chronic:</p> <ul style="list-style-type: none"> • 1,700 µg/L (PFOA) • 19 µg/L (PFOS) <p>Soil:</p> <ul style="list-style-type: none"> • Tier 1, Residential soil value (SRV): 2.1 mg/kg (PFOA, PFOS) • Tier 2, Recreational SRV: <ul style="list-style-type: none"> • 2.5 mg/kg (PFOA) <ul style="list-style-type: none"> ○ 2.6 mg/kg (PFOS) • Tier 2, Industrial SRV: <ul style="list-style-type: none"> ○ 13 mg/kg (PFOA) ○ 14 mg/kg (PFOS) 	<p>Minnesota Administrative Rule, Section 4717.7860, Health Risk Limits Table</p> <p>http://www.revisor.mn.gov/rules/%3Fid=4717.7860</p> <p>mailto:http://www.pca.state.mn.us/index.php/waste/waste-and-cleanup/cleanup/superfund/perfluorochemicals-pfc/perfluorochemicals-pfcs.html</p>

State	Guidelines	Source
New Jersey	Preliminary Drinking Water Guidance Level, PFOA: 0.04 µg/L	mailto:http://www.state.nj.us/dep/drs/pfoa/doc.pdf
Nebraska	Screening levels for some PFCs are provided in Voluntary Cleanup Program guidance.	NE DEQ, personal communication, 2015

Department of Defense

DoD has identified PFCs as emerging contaminants. DoD Instruction 4715.18, Subject: Emerging Contaminants (ECs), establishes policy for the identification and management of all emerging contaminants. Emerging contaminants are identified and assessed through a three-tiered process called “scan-watch-action” and are defined as (DoD, 2009):

- Have a reasonably possible pathway to enter the environment;
- Present a potential unacceptable human health or environmental risk;
- Do not have regulatory standards based on peer-reviewed science, or the regulatory standards are evolving due to new science, detection capabilities, or pathways.

Additional information on DoD’s policies and activities related to emerging contaminants is available on its Chemical and Material Risk Management Program’s Emerging Chemical and Material Risks webpage: <http://www.denix.osd.mil/cmrm/ECMR/index.cfm>.

U.S. Air Force

The U.S. Air Force issued Interim Air Force Guidance on Sampling and Response Actions for Perfluorinated Compounds at Active and BRAC installations on September 17, 2012, which has since led to a nationwide assessment of installations for potential PFCs contamination. The guidance notes that the U.S. Air Force will, on a case-by-case basis, review and address requests for action on PFCs “when a regulatory driver, direct human exposure, and/or off-site migration is identified.” The guidance also provides details on how Air Force personnel should respond to regulatory requests for investigations and provides details on contracting for assessments, treatment technologies, and other technical resources (USAF, 2012). In accordance with the guidance, the U.S. Air Force has begun assessing PFCs using a systematic, risk-based approach, starting with installations that had fire-training areas (FTAs) in operation between 1970 and 2000. The approach includes determining if a release of PFCs has occurred at the FTA, delineating the extent of PFCs contaminated media, and taking mitigating action (if necessary) when there are any confirmed human exposures (USAF, 2012).

U.S. Navy

On October 21, 2014, The Assistant Secretary of the Navy (Energy, Installations and Environment) issued a memorandum, Subject: Perfluorinated Compounds (PFCs) – An Emerging Environmental Issue. The memorandum directs the Navy’s Defense Environmental Restoration Program to identify all BRAC and active installations where PFOS and/or PFOA have been released or suspected to have been released, and to address releases in accordance with DoD Instruction 4715.18. The memorandum also directs testing and reporting of U.S. Navy drinking water systems that could be impacted from potential release sites by December 2015, and requires that

alternative drinking water be supplied if testing exceeds U.S. EPA's PHA values (USN, 2014).

The Solution Is Here Now!

With the advent of the **NO PFCs** FireStopper® FFC (*Fire Fighting Catalyst*) Technology, the assigned individual or personnel charged with protecting the infrastructure can safely, effectively and quickly extinguish the fire event and transforming the affected area to the ambient temperature environment, which will enable the repair crews to return the facility to a working and productive enterprise reducing time loss to a minimum. In contrast with the above information, the FFCs produce surface tension reduction of water from 17 to 21-dynes in addition to many other factors that contribute to the reduction of application rates well below any product employed today. The additional advantages FireStopper® deliver, not available before in any other currently employed products or technologies, are as follows:

1. *Effectiveness on all classes and sub classes of fire:*

- a. *FireStopper® XL "PLUS" FFC is the only concentrate in the world capable to deliver the highest fire extinguishment efficacy, according to its EN1568 Certification, equally in all three (3) industry recognizes percent usage (1%, 3%, & 6% inclusively).*
- b. *It is certified to perform equally on all three (3)-percentage uses while mixing with both fresh and salt water (only product to ever achieve certification level of 1A rating in all three-percentage and in mixture with fresh and salt water).*
- c. *The only concentrate to achieve "GREEN" rating under the HOCNF protocol, and:*

i. **ENVIRONMENTAL & TOXICOLOGY TESTING**

FFCs' are independently tested and found to be non-hazardous to fish or any other life forms. The mixture is not an eye or skin irritant and is non-toxic when tested according to the FHSA protocols. It is judged to pose no chronic health hazard. Under European standards OECD 306, and 117 Method 2004, ISO 14669 (1999), ISO 5667-16 (1998), and ISO 10253 2006, (OSPAR/HOCNF) Part B, the FFCs meet "Green" 1qualifying requirements. The FFCs need no special labeling or chronic health hazard warning statements and are in compliance with FHSA Regulations, 16 CFR 1500 and California Proposition 65.

2. *Fast extinguishment*

3. *No re-ignition*

4. *Non-Irritant (skin or eyes), Non-Toxic, Non-Aggressive*

5. *Freeze resistant to -34.5°C*

Comparison Overview Of Fire Testing And Certification Standards EN1568 To UI162

EN1568	NFPA11/UL162
<p><i>Fuel Type & Volume: n-Heptane, 300-L</i> <i>Test Pan Shape & Size: Round, 79 ft²</i> <i>Pre-burn Time: 1-min</i> <i>Fire Extinguishing Time: 3-min or less</i> (A Rating is assigned based on the overall performance during the fire test) <i>Burn back: 5-min – 25% allowed</i> <i>Torch and burning & pot methods</i> <i>Foam Quality Physical Testing</i> <i>Temperature Resistance Testing</i></p>	<p><i>Fuel Type & Volume: n-Heptane, 227-L</i> <i>Test Pan Shape & Size: Square, 50 ft²</i> <i>Pre-burn Time: 1-min</i> <i>Fire Extinguishing Time: 3-min or less</i> (Rating not available in this Standard) <i>Burn back: 5-min – 20% allowed</i> <i>(No Rating is applied)</i> <i>Torch & Stove Pipe methods</i> <i>Foam Quality Physical Testing</i> <i>Temperature Resistance Testing</i></p>

As a global supplier of fire and explosion suppression products designed to meeting all possible needs of the industry, FireStopper® additionally offers the following innovative product lines:

- **Fixed and Portable Systems** - powered by the most powerful, all flammables effective, all environment usable and human and environment friendly liquid suppressant
- All fixed systems are individually designed and engineered to fit the purpose
- All FireStopper® branded hardware fabricated in non oxidizing stainless steel for long term durability and reliability
- Built around the most advanced, military grade detection and deployment support system designed to minimize and ameliorate the unexpected destructive event
- Providing the longest Limited Warranty in the Industry; twenty (20)-years
- **Environmental Remediation and Drilling Support Products** – please review the FireStopper® Liquids Catalog for individual product specifications

FIRE EXTINGUISHER LIQUID PRODUCT SPECIFICATIONS

- All fire class effective ABCDK
- Non-Toxic, Non-Hazardous, Eco-Safe according to HOCNF (Harmonized Offshore Chemical Notification Format and *FHSA regulations, 16 CFR 1500 and California Proposition 65*) **will meet and exceed all environmental requirements for fire safety products**
- **FireStopper® PFE-FR FFC** (a premix exclusively designed and available for use in conjunction with FireStopper® trademarked systems)

Advantages:

- This product is designed for use exclusively with FireStopper® trademarked systems and delivers:
 - DLA (US Defense Logistics Agency) approved
 - Full efficacy on all fire class and subclasses
 - -100°F freeze resistance while in use without harmful antifreeze additives
 - Viscosity: water-thin
 - Anti-explosive properties
 - Highest ratings in the world both: EN3-7 & UL7-11
 - Highest Eco-Safety testing results under HOCNF, and meet or exceed *FHSA regulations, 16 CFR 1500 and California Proposition 65*
 - Ideal for use where extreme cold temperatures may be a factor
 - The ideal product for use in concert with FireStopper® CAC (*Compressed Air Catalyst*) units; please see CAC Catalog

- **FireStopper® EXP FFC** (*an anti-explosive premix exclusively designed and available for use in conjunction with FireStopper® trademarked systems*)
 - This product offers all the above advantages in the explosion suppression application against all potential explosive environment inherent in the Petrochemical Industry

Conclusion

Because of the vulnerabilities present in the nature of Government/Political environments, petrochemical business, political unrest giving birth to Asymmetric warfare and conventional engagements will require a new generation of fire protection. FireStopper® has developed the deepest variety and most flexible hardware to deploy the most advanced, powerful, reliable and safe array of firefighting and anti-explosion media available in the world. No matter whether it is necessary in a concentrated form for massive use or in a premix format exclusively designed for use through FireStopper® trademarked portable or fixed systems, FireStopper® stands alone in the level of quality, performance, and safety; *“we are ready to deliver on any demand...”*

VISIT US

AT: <http://firestopperintl.com/>

CERTIFICATIONS:



"GREEN"

