W. L. Gore & Associates' Comments on Dossier Submitters' Draft EU REACH restriction on PFAS

Public consultation

Request for Derogation: Petroleum and Mining Industry

August 2023

Gore appreciates the opportunity offered by the public consultation process to provide comments on the Proposal for a Restriction of Per- and polyfluoroalkyl substances (PFAS) (hereinafter '**Restriction Proposal**').

With this statement, we would like to explain why we agree with the Dossier Submitters (DSs) that a derogation for applications in petroleum and mining industry and, in particular, for **equipment designed to cope with harsh conditions**[1] is needed and justified. Further, we would like to explain why this derogation should be time unlimited. Although most of the applications are covered by the derogations currently proposed under paragraph 6f, we would like to highlight an additional use of PFAS in the oil and mining industry.

The conclusions from our statement are summarized as follows:

- The petroleum and mining industry has been researched in detail and multiple applications requiring resistance to corrosive and chemically aggressive compounds and high temperatures have sufficiently been taken into account. Gore would like to provide additional evidence for the need of fluoropolymers for electrical components used in the petroleum and mining sector.
- For applications in harsh environments typical of petroleum and mining, neither alternative materials nor alternative techniques are available now or are likely to become available in the future. The timing of a future unforeseen scientific discovery cannot be predicted, and even then, would likely require significant time to commercialize and validate as long-term safe and reliable alternatives in these applications.
- Without a derogation, the lack of alternatives would mean a significantly higher risk of equipment failures, emissions, major leaks, or other catastrophic events that present safety risks to workers. Equipment and processes in the oil and mining industry would have to be redesigned to cater for an inferior material/technology where they require the containment of harsh chemicals.

I. Derogation Request

Considering the arguments and evidence presented below, Gore respectfully requests to modify the application-specific derogation for petroleum and mining industry in Column 2, paragraph 6f of the proposed restriction as follows:

> ***Fluoropolymer applications in petroleum and mining industry*** ~~*until 13.5 years after EiF*~~

[1] extreme temperature (-265°C/315°C) and pressure, corrosive or other aggressive chemical (pH 0—14), …

II. Description of the End Use

As acknowledged by the DSs in the Restriction Proposal, there are various products based on fluoropolymers that are needed in the petroleum and mining industry. Among others, linings, seals, gaskets, cables and wiring insulation are mentioned.

Operation conditions in Petroleum and Gas applications can be extremely harsh, especially in “downhole” (deep inside a drilled well or borehole) uses. As shown in Figure 1, oil and gas wells can commonly have conditions where temperature reach as high as 260°C and pressures up to 240 MPa. Extreme cases can also exceed those levels. These conditions create significant challenges for performance and reliability of downhole electrical components.

Figure 1. Schlumberger HPHT classification system. This classification system is based on pressure and temperature boundaries that reflect stability limits of common components used by Schlumberger, which include electronics, hardware and sealing elements. The HPHT-hc classification defines environments unlikely to be seen in oil and gas wells, although geothermal wells may exceed 500°F and some deepwater wells have downhole pressures that exceed 35,000 psi.

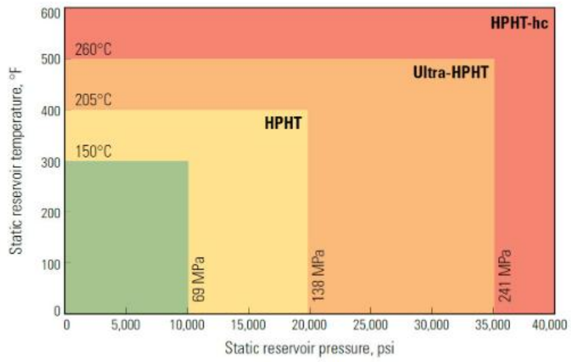

Figure 1. Example Oil and Gas Well Classification[2]

The need to use fluoropolymers in seals and gaskets in harsh environments has already been demonstrated in Gore’s separate derogation request regarding equipment for manufacturing or use of chemicals at industrial sites. The arguments provided in that derogation request also apply to the petroleum and mining sector. We would like to provide additional information on the electrical component products which are briefly mentioned in the Restriction Proposal.

Operation of oilfield equipment requires a variety of downhole tools, which are pieces of oilfield equipment that are used during well drilling, completion, and intervention or well workover activities and helps the oil well in optimizing the production levels and maintain a continuous flow from a reservoir. The primary purpose of using downhole tools is to carryout workover operations and well completion processes as well as examining the reservoir properties such as rock, sand, and liquid by bringing their sample to the well surface. They are mostly used during extreme temperatures and pressure conditions.[3] Many of these tools have electrical components, such as motors and sensors, which need to perform reliably for both safety and economic reasons. Example electrical components used in petroleum and mining applications include Capacitors and Magnet Wire for motors.

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[2] https://www.slb.com/resource-library/oilfield-review/defining-series/defining-hpht
[3] https://www.bracetool.com/definition/416/downhole-tools-oilfield

1) Capacitors

Downhole tools require power to operate sensors and drive actuating equipment such as those used for steering, sampling, and communications. A turbine (known as a mud motor) converts fluid flow into electrical power which is stabilized and converted by capacitors (known as DC-link) between the inverter and rectifier. Thus, capacitors are critical electrical components which power downhole tools. They are integral to the power management of the system in addition to providing protection from voltage transients that could otherwise damage the system.

Downhole tools are subject to high temperatures as well as shock and vibration. A variety of high temperature capacitor dielectrics exist such as multilayer ceramics (MLCCs[4]) and electrolytics, however, these suffer catastrophic failure[5] risk due to fracture from shock and vibration or loss of electrolyte respectively. Of these two technologies, MLCC has been the dominant choice (85% share) since electrolytes carry additional risk of system damage if the electrolyte becomes uncontained.[6] Despite efforts to overcome critical failure, capacitors are recognized in the industry as a critical reliability problem due to these catastrophic and unpredictable failure modes.

This impedes the industry-wide transformation to improve reliability ultimately aimed to improve worker safety while lowering carbon footprint through reduced backup/contingency tools along with transporting people and equipment engineers (by helicopter to offshore rigs) to address failure situations. The industry has the vision of one day achieving autonomous drilling to completely remove people from the safety hazards involved with oilfield operations, generally.

2) Magnet wire

For downhole tool operations, a variety of electric motors are required for conveyance (horizontal movement), telemetry (communications with the surface), sampling, and a variety of mechanical actuation. The coil windings that provide the magnetic field to spin the motor's rotor are comprised of an insulated conductor, which is known as the magnet wire. Durable magnet wires help extend motor life and increase tool reliability while drilling deep into the Earth. In addition to high temperatures, pressure and exposure to chemicals, hydrolysis (chemical breakdown due to reaction with water) is a challenge to materials because downhole conditions can accelerate the degradation effects on some polymers. Breakdown of the insulating material on magnet wires can cause motor failure and therefore tool failure.

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[4] MLCC stands for Multilayer ceramics capacitors

[5] A failure is classed as catastrophic when it results in the replacement of the capacitor (or the device). As opposed to other failure that might lead to a lower output/efficacy but continued operation, albeit with reduced performances.

[6] A leading oilfield service company technical director tasked with improving reliability cites *"Ceramic capacitors are a nightmare."*

Gore has worked with Oilfield Service Majors to eradicate this failure mode which is cited as the “#1 pareto failure of downhole motors” by using PTFE as the insulating system for the magnet wire. PTFE adds hydrophobicity to the other properties required (temperature stability, mechanical durability, and electrical insulating properties) preventing hydrolysis and broader chemical resistance. Following very successful field trials that demonstrate more than 10x lifetime improvement, the industry is shifting to this solution to improve equipment reliability and therefore reduce carbon footprint and improve safety by reducing the need for people to be on-site to repair equipment and recover from downhole mission failures.

The product examples below are all Gore products, as details of comparable products manufactured by other companies are not publicly available.

Table 1. Selected Petroleum and Mining Products

Product	**Illustration**	**Description**
GORE™ High Temperature Capacitors		Capacitors deliver stable voltage and capacitance at elevated temperatures. PTFE dielectric materials uniquely combines reliable self-clearing, low dissipation factor, and thermo-mechanical stability.
GORE™ Magnet Wire for Motors		PTFE insulated Magnet Wire for Motors extends motor life and increases tool reliability. Fluoropolymers enable hydrolysis resistance at high temperature allowing continued operation in conditions that cause traditional motors to fail.

All these products are made of polytetrafluoroethylene (PTFE) or FEP which meet the criteria for Polymers of Low Concern (PLCs), under the definition provided by the OECD Expert Group on Polymers. The fluoropolymers used for each product are shown in Table 2.

Table 2. PFAS used in Petroleum and Mining Products

Gore product	Type of PFAS	CAS number	Is this PFAS a PLC?
GORE™ High Temperature Capacitors	PTFE	9002-84-0	Yes
GORE(TM) Magnet Wire for Motors	PTFE (90%)	9002-84-0	Yes
	FEP (10%)	25067-11-2	Yes

III. Reference in Restriction Proposal

The Dossier Submitters (DSs) have researched petroleum and mining in detail (Annex A, Table A.1, page 5) and Gore welcomes that the DSs considered fluoropolymers as necessary for various applications in the petroleum industry. Among others, the following properties of fluoropolymers are acknowledged to justify the need: high temperature resistance, chemical resistance, mechanical strength, corrosion resistance (see Annex E, Table E.158, page 496). The DSs also highlight “the extreme durability” of fluoropolymers “under the extreme environments found in down hole drilling (e.g., high temperature, high pressure, presence of steam and harsh chemicals)” (Annex A page 148f.).

In paragraph 6f. the DSs have proposed a derogation for fluoropolymer applications in petroleum and mining industry until 13.5 years after EiF as sufficiently strong evidence exists that technically and economically feasible alternatives are not generally available (Annex XV report, Table 8, page 114). Gore agrees with this statement but believes that no alternative can be foreseen, and the time needed to discover one is not predictable. Despite our efforts and the work of other stakeholders so far, no material has been found that would fulfil the requirements needed in oil and mining industry, warranting a time-unlimited derogation.

We will discuss in Section 3 the alternatives proposed in the oil and mining industry (in Annex E section E.2.15.2.3, from page 498) and demonstrate that there are no viable alternatives.

- Gore proposes to provide a time-unlimited derogation for petroleum and mining industry.

IV. Need and Justification for Derogation

Without a derogation, the lack of alternative would mean a significantly higher risk of equipment failures, safety risks, and operational costs. Malfunctions would lead to increased generation of electronic waste and consumption of resources due to replacement, as well as the potential for increased safety risks for individuals. We propose that a derogation is justified based on the following points:

- The **performance requirements** for petroleum and mining applications.
- The **lack of availability of alternatives** that would provide the required level of performance.
- The **time required** for research and development to investigate and evaluate potential alternative materials, and if a feasible alternative is identified, the time required to identify, develop, test, and commercialize new products.
- The **large socio-economic cost** of restricting the use.

1. Summary of Performance Requirements

a) *Chemical resistance*

Downhole equipment is exposed to oil, salt, water, and harsh chemicals. The number of different chemicals used during various steps of oilfield production is large and diverse, requiring equipment to be resistant to the same diverse range.[7] Equipment needs to resist being damaged or degraded by exposure to these conditions and chemicals.

b) *Temperature resistance*

Downhole drilling tools operated by oilfield service companies (where capacitors are used) are rated for use up to 200°C operating temperature. Cables used for temperature measurements are required to withstand up to 300°C while maintaining signal integrity in steam assisted gravity drainage operations. Downhole motors are generally designed for use up to 250-260°C.[8]

c) *Mechanical strength*

For magnet wires, cut-through resistance and abrasion resistance is required to prevent insulation damage during installation of the wire on the motor stator. For capacitors in downhole tools, they must be qualified to endure 500 to 1000 G mechanical shock thousands of times.[9]

Insulation systems, while thin to reduce size, must be durable enough to prevent cut-through which would compromise the signal or power integrity. The wires and cable materials must be highly durable and withstand frequent/rapid flexing, torsion, and pulling without compromising electrical performance under demanding environments. The capacitors must withstand extreme temperatures and repeated shock.

d) *Size / Dielectric strength*

With limited space available for the various system components and electronics needed in downhole tools, materials with low dielectric constant enables thinner insulation for magnet wires and smaller capacitor sizes to save space, which is critical in deep wells, while maintaining system and power integrity. Using the lowest possible dielectric strength material is preferred to improve resistance properties or enable smaller components.

e) *Hydrolysis Resistance / Breakdown Voltage – Magnet Wire*

Insulating films for magnet wire used in downhole motors can become subjected to water-contaminated oil during a tool breach which creates short circuits in the motor for insulating systems lacking hydrolysis resistance. Magnet wire for downhole motors must maintain 1.5 kV following when exposed to 260°C with water in the oil per NEMA Hydrolysis Test (MW 1000-2008, Sec. 3.54).

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[7] Reference for chemicals used: https://pubs.acs.org/doi/pdf/10.1021/bk-1989-0396.ch001

[8] https://www.sciencedirect.com/science/article/pii/S1381514821000705?viewFullText=true

[9] 1 G is equal to the acceleration from gravity

f) Ability to Self-Clear - Capacitors

Self-clearing is a phenomenon intrinsic to metallized film capacitors which significantly increases reliability. When a metallized film capacitor exhibits an electro-mechanical stress such as a system overvoltage (transient), weak spots (flaws) in the film allow localized heating that combusts the film and removes the surrounding metallization, which self-extinguishes, as shown in Figure 2. Thus, the fault is then isolated from the rest of the device which continues to perform its job as a capacitor.

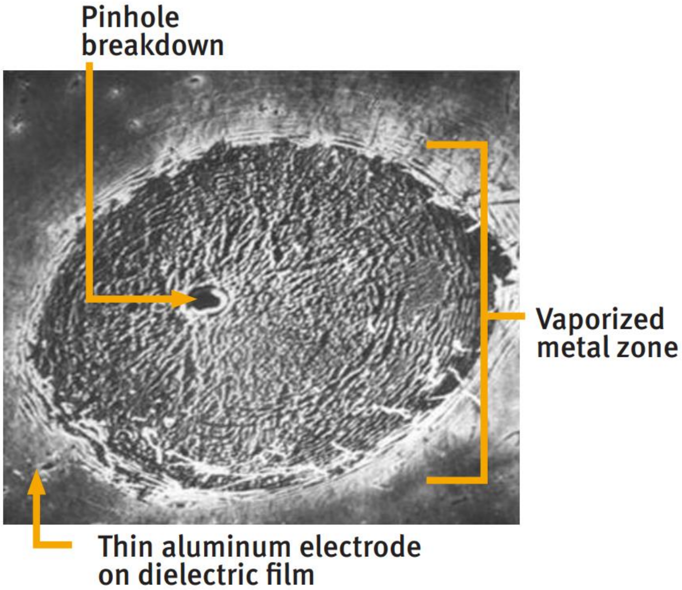

Figure 2. Illustration of Isolated Fault in a Self-Clearing Capacitor

An effective self-clear removes a negligible portion of the overall effective device area, resulting in a slow and predictable capacitance degradation for metallized film capacitors. The decay in performance will be predictable to the point that the end of life of the device can be planned. Other dielectrics (like MLCCs) can catastrophically fail (sudden loss of capacitance) from a voltage transient and/or mechanical shock. The ability for a capacitor to clear depends strongly on the dielectric polymer and physical construction (thickness of the film).

2. Assessment of Alternatives

Alternative materials can be assessed based on overall suitability to survive extreme conditions in Petroleum and Mining applications, then additionally for suitability for the specific sub-uses.

a) Assessment against General Performance Requirements

i. Chemical resistance

Many potential alternative materials are not feasible due to poor chemical resistance. Table 3 below shows the chemical resistance of common polymer substances when in contact with some common chemical types. Note the poor resistance of many polymers to hydrocarbons which are particularly relevant in this use.

Table 3. Chemical compatibility[10]
Note that PTFE is referred to as TFE

	ETFE	FEP/TFE/PFA	FLPE	FLPP	HDPE	LDPE	PC	PETG	PP	PVC	TPE***
Acids, Dilute or Weak	E	E	E	E	E	E	E	G	E	E	G
Acids, **Strong/Concentrated	E	E	G	G	G	G	G	N	G	G	F
Alcohols, Aliphatic	E	E	E	E	E	E	G	G	E	G	E
Aldehydes	E	E	G	G	G	G	G	G	G	G	G
Bases/Alkali	E	E	F	E	E	E	N	N	E	E	F
Esters	G	E	G	G	G	G	N	G	G	N	N
Hydrocarbons, Aliphatic	E	E	E	G	G	F	G	G	G	G	E
Hydrocarbons, Aromatic	G	E	E	N	N	N	N	N	N	N	N
Hydrocarbons, Halogenated	G	E	G	F	N	N	N	N	N	N	F
Ketones, Aromatic	G	E	G	G	N	N	N	N	N	F	N
Oxidizing Agents, Strong	E	E	F	F	F	F	F	F	F	G	N

*Not for tubing chemical resistance (except PVC) **Except for oxidizing acids (See oxidizing agents, strong) ***TPE gaskets

EXCELLENT	GOOD	FAIR	NOT RECOMMENDED
30 days of constant exposure causes no damage. Plastic may tolerate for 30 years.	Little or no damage after 30 days of constant exposure to the reagent.	Some effect after 7 days of constant exposure to the reagent. The effect may be crazing, cracking, loss of strength or discoloration.	Immediate damage may occur. Depending on the plastic, the effect may be severe crazing, cracking, loss of strength or discoloration, deformation, dissolution or permeation loss.

ii. Temperature resistance

The extreme temperatures for petroleum and mining applications were described above in Section II routinely reaching more than 200°C.

PTFE maintains its physical strength and chemical resistance over a temperature range from -269°C to +260°C. Fluoropolymers do have this very high temperature resistance due to the high dissociation energy of C-F bond and its semi-crystallinity.

PTFE materials exceeding these temperature ranges and have been tested as fit for use in different applications up to temperatures of 300°C.

These temperature requirements prevent the use of most of the alternatives proposed by the Dossier Submitters listed in Table E.159 of the Restriction proposal. The Dossier Submitters acknowledged that XL PE, HNBR, and EPDM all were unable to be used above 150°C.

Additionally, the Dossier Submitters proposed Stainless Steel and other metals. Being conductive, metals cannot be used as insulating materials in electrical components.

The remaining material identified as a potential alternative in the Restriction Proposal was PEEK. **PEEK has a maximum operating temperature of 154°C**[11] **making it unable to be used in this application.**

[10] Eason, M., & Vogel, R. (2022, May). Sealing Devices and the need for PFAS. Valve World, 20-22.
[11] https://omnexus.specialchem.com/polymer-properties/properties/min-continuous-service-temperature

iii. Dielectric Constant

Fluoropolymers like PTFE, FEP and PFA have a **low dielectric constant of 2.1,** where lower numbers enable higher precision and more reliable signal transmission. PTFE, in particular, can be processed into an expanded form which has **an exceptionally low dielectric constant of 1.3. As show in Figure 3, no other materials have the necessary combination of low dielectric constant and temperature resistance.**

[redacted]

iv. Mechanical Strength

PTFE is known for its high tensile strength, tensile elongation, and tear strength along with abrasion resistance and cut-through resistance.[12]

a) Assessment against Specific Sub-use Requirements

i) Summary of Alternatives for Capacitors

Two main technologies have typically been used in downhole applications: Multilayer Ceramic Capacitor (MLCC) and Electrolytic capacitor (polarized capacitor).

Between the two technologies, MLCC has been the primary choice (approximately 85% of capacitors used in this application estimated based on publicly available information) since electrolytes carry additional risk of system damage if electrolytes become un-contained. However, each of these capacitor types are recognized in the industry as a critical reliability

[12] https://www.sciencedirect.com/science/article/pii/S1381514821000705?viewFullText=true

problem due to unpredictable and catastrophic failure modes. This impedes the industry-wide goal of one day achieving autonomous drilling to remove people from the safety hazards involved.

Metallized film capacitors, as illustrated in Figure 4, represent a different category of capacitor type that have leveraged polymer films as the dielectric since the early 1950's. Metallized film capacitors exhibit a self-clearing phenomenon that make them an ideal candidate for mission-critical applications as a fault does not result in a catastrophic failure. Self-clearing means excursions of mechanical or electrical stress can be accommodated without catastrophic failure. However, such capacitor design has been historically limited by their lower operating temperature (‹ 125°C), and therefore, the Oilfield Service (OFS) Companies have previously ruled out metallized film capacitors.

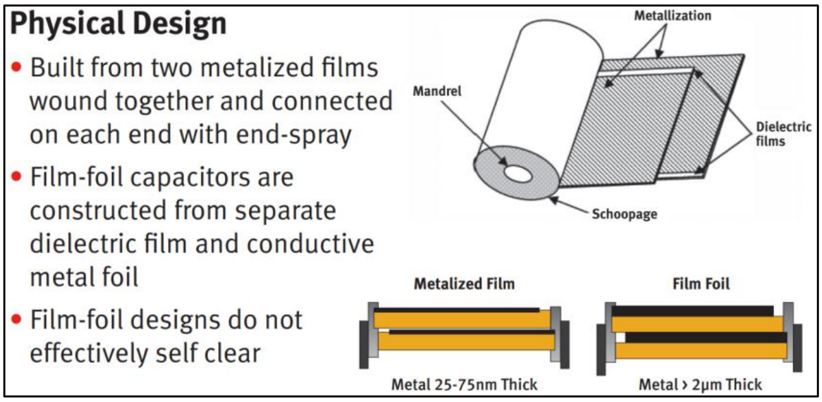

Figure 4. Diagram of Metalized Film Capacitors

A solution to the limitations with all these alternatives has been achieved by using a PTFE-based alternative developed by Gore and made available for the first time to the industry in 2016. It performs up to 200°C and resolves the temperature limitation of the metallized film capacitor. To highlight the dramatic advantage gained in surviving the mechanical stresses of the downhole environment, Gore created a simple demo video to highlight the key reason all 3 major OFS companies have been shifting from MLCCs to this new technology: ***https://www.youtube.com/watch?v=NG_vATVpJg4***

Non-fluorinated materials have also been investigated for metallized film capacitors, but they have been found deficient to reliably self-clear at higher temperatures (›125°C) (see Figure 5).

[redacted]

Figure 5. [redacted]

b) *Summary of Alternatives for Magnet Wire and Sensor Cables*

i) Poor Temperature and Chemical Resistance of Additional Alternatives

Operating in the downhole environment requires a combination of chemical and high temperature resistance. As shown in the Table 3 below, amongst commonly chosen dielectric (conductor insulation) and jacket (outer element on single or bundle of integrated elements), fluoropolymers have a significantly broader temperature operating range capability with PTFE the highest. This is critical especially for operations in arctic/cold weather conditions on the surface down into the well where temperatures are commonly in the 125–200°C range. Of the few non-fluoropolymers listed with operating temperatures above 150°C both silicones and the high temp nylon/carbon fibre blends have poor resistance to many chemicals used in downhole operations and are therefore not feasible alternatives.

[redacted]

Table 3. Dielectric and jacket materials[14]

Material	Operating temperature range (°C)	Use	
		dielectric	Outer jacket
Polytetrafluoroethylene (PTFE)	- 75 to + 250	X	X
Polyethylene	- 40 to + 85	X	X
Foamed polyethylene	- 40 to + 100	X	
Foamed or solid ethylene propylene jackets	- 40 to + 105	X	
Fluorinated ethylene propylene (FEP)	- 70 to + 200	X	X
Polyvinylchloride (PVC)	- 40 to + 85		X
Ethylene chloro trifluoroethylene (ECTFE)	- 65 to + 150	X	
Polyurethane	- 100 to + 125	X	
Perfluoroalkoxy (PFA)	- 65 to + 260	X	
Nylon	- 60 to + 120	X	
Ethylene propylene	- 40 to + 105	X	
High molecular weight polyethylene	- 55 to + 85	X	
Cross-linked polyolefin	- 30 to + 85	X	X
Silicone Rubber	- 70 to + 200	X	
Silicone impregnated fiberglass	- 70 to + 250	X	
High temperature nylon/ carbon fiber	- 100 to + 250	X	

ii) Hydrolysis of Polyimide

For downhole tool operations, a variety of electric motors are required for conveyance (horizontal movement), telemetry (communications with the surface), sampling, and a variety of mechanical actuation. The coil windings that provide the magnetic field to spin the motor’s rotor are comprised of a conductor (typically copper) insulated by Polyimide (Kapton), chosen for its large range of temperature stability, mechanical durability, and electrical insulation properties.

As shown in Figure 6 however, polyimide does have a critical failure mode brought on by the onset of hydrolysis, particularly at elevated temperatures. This is a well-known limitation of polyimide.

Gore has directly characterized this failure mode for motors in the downhole operating condition to verify that small amounts of water present in the oil lead to rapid failure. In downhole tools, while actions are taken to protect the motor windings from water ingress (tool seals and motor encapsulation), ultimately these protective measures are compromised leading to motor failure.

[14] The Global Cable Industry; Gunter Beyer; 2021

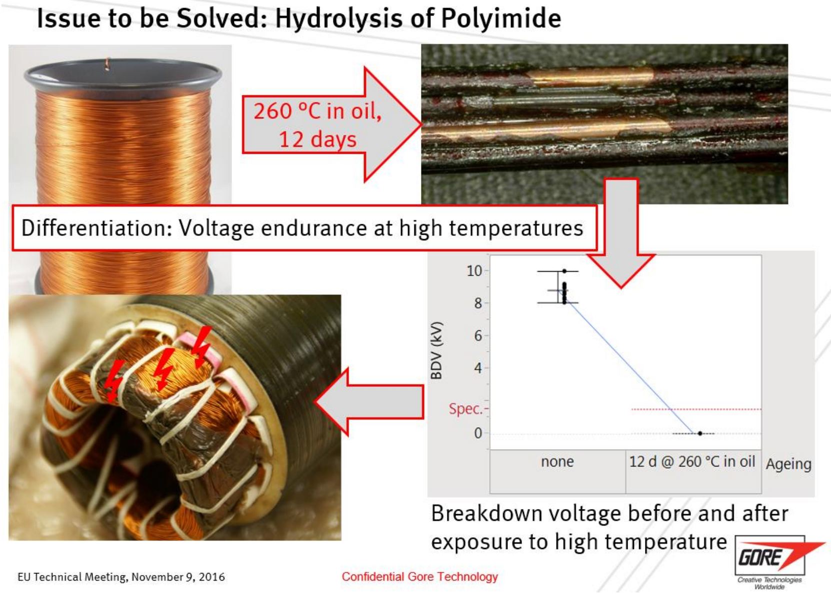

Figure 6. Hydrolysis of Polyimide

As described above in Section II.2, PTFE is hydrophobic and not subject to hydrolysis. As shown in Figure 7, the difference in performance is visually demonstrated – the color change to polyimide is an indicator of hydrolysis (chemical degradation of the material).

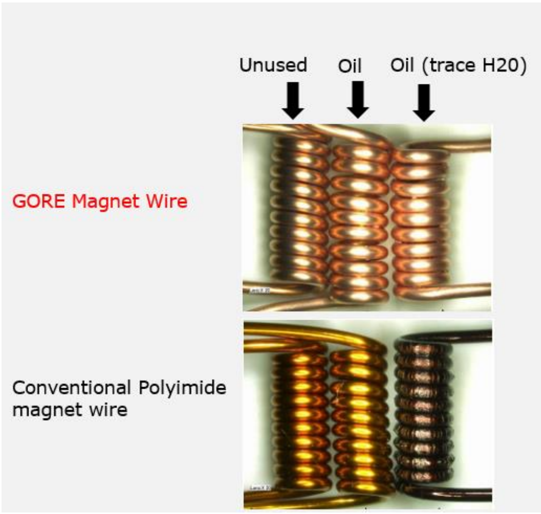

Figure 7. Difference in hydrolysis resistance performance

c) Summary of alternatives analysis

Material property screening, as well as experimental trials, demonstrate that there are no feasible alternatives to fluoropolymers in Petroleum and Mining applications, particular for electrical components.

3. Timeline

As noted by the DSs for petroleum and mining applications and underlined by Gore for the broader context of chemical manufacturing, there is currently no alternative available and none is likely to become available in the foreseeable future.

The reasoning of the Restriction Proposal only allows an arbitrary transition period of 13.5 years even in such cases where no alternatives are foreseen. The succinct explanation provided on page 77 of the Annex XV Restriction Dossier points to the assumption by the Dossiers Submitters that 13.5 years are "*normally sufficient for industry to take benefit from technical progress and to carry out scientific R&D activities to find and deploy technically and economically feasible alternatives*." **For highly technical and complex uses with strict performance requirements such as petroleum and mining, we believe that a more in-depth assessment of alternatives demonstrates that 13.5 years is insufficient.**

Since an alternative material is not apparent for those applications that require a combination of properties that so far has been found only with some fluoropolymers, a new material would need to be found or invented. Thus, the development process needs to begin with creating a new material, potentially a non-fluorinated polymer. It is obvious that the time needed for such development is not known and very difficult to predict.

Examples from the past show that the time span to develop new materials can vary significantly. For example, the development of acrylic polymer took several decades. The process from the first synthesis of acrylic acid to the introduction of the commercial polymer, was an 85-year journey.[15] The development of PTFE from the "accidental" discovery to a commercial product took about 10 years, from 1938 to 1948,[16] and then decades more to mature that technology into the materials used today. Development advances over this time have had to occur in polymerization, finishing, lubrication and blending, pelletization, and extrusion to develop forms usable in end products. In the absence of such an initial unexpected discovery, we can only speculate that developing a new polymer to commercial availability will take more than 20 years.

4. Additional Information

a) Emissions

As PTFE and FEP do not erode or off gas, no emission is expected during the service life. Additional information on responsible manufacturing, processing, and disposal of fluoropolymers, and products made from fluoropolymers, are provided in Gore's separate derogation request for fluoropolymers. Considering that the PFAS used are polymers of low concern, it is not apparent that restricting this use is proportional nor would it lead to a net improvement for the environment.

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[15] See https://www.ptonline.com/articles/tracing-the-history-of-polymeric-materials-part-20.

[16] https://www.teflon.com/en/news-events/history#:~:text=An%20Accidental%20Discovery&text=Roy%20J.,to%20form%20polytetrafluoroethylene%20(PTFE).

b) Impacts on Human Health and the Environment

Capacitors, magnet wires, and cables provide important functionality for their end uses and wider society. The EU chemical, oil and mining industry has come to rely on properties (chemical and thermal stability, …) that enable efficient and safe energy exploration processes.

Gore, as well as the wider industry, have searched for alternatives to PFAS for the use in these applications over several decades, but there are currently no alternatives available that can provide a sufficient functionality. Without a derogation, the lack of alternatives would mean a significantly higher risk of equipment failures, emissions, major leaks, or other catastrophic events that present safety risks to workers. Equipment and processes in the oil and mining industry would have to be redesigned to cater for an inferior material/technology where they require the containment of harsh chemicals.

i) Health and Safety Considerations

Petroleum and mining operations are inherently dangerous based on handling flammable and hazardous chemicals, proximity to heavy equipment used in high temperature and high-pressure conditions, and extreme operating locations. As described above, reduced reliability of equipment prevents the automation of many tasks. When workers are required to operate, intervene, or repair equipment, they are exposed to safety risks. By restricting the use of materials that contribute to safe and reliable operation of equipment, one of the obstacles to automation that had recently be solved will be reintroduced to the industry.

ii) Environmental Impacts

In addition to safety considerations, premature failure of equipment can lead to generation of waste, increased resource consumptions, and corresponding CO2 emissions related to producing replacement equipment, in addition to significant operational impacts related to retrieving failed equipment from deep wells and transporting or maintaining a workforce to address equipment failures.

iii) Economic Impacts

Unplanned disruptions to petroleum and mining operations also have economic consequences due to investment in replacing equipment, reduced production output, and expenses related to retrieval and repair of downhole tooling. More catastrophic failures of equipment can lead to damage to other equipment and infrastructure, further increasing potential costs and delays.