nucleareurope response to the ECHA consultation on PFAS

SECTION III. Non-confidential comments

Please provide your general comments in the box below :

In line with our culture of safety, worker protection, and environmental protection, the European nuclear energy sector supports any initiative aimed at preventing and limiting the risks of hazardous substances for human health and the environment. Alternatives to hazardous substances should be pursued when equivalent properties (especially safety properties) are available at acceptable economic conditions. This should be done considering the necessary time for certifying certain equipment under accidental conditions, in accordance with regulatory requirements on nuclear safety (Directive 2009/71/Euratom). In doing so, we are merely emphasizing a requirement of the REACH regulation itself, which states that any new restriction "must take into account the socio-economic impact, including the availability of alternative solutions" (Article 68).

As far as the proposed restriction on PFAS is concerned, not only the nuclear sector but also the entire electricity sector would be affected due to the essential presence of PFAS in equipment necessary for the proper functioning of installations in this sector (such as photovoltaic panels, rotors for wind power, electrolysers and fuel cell applications for hydrogen production, heat pumps thermal and decarbonized thermal, batteries, switchgear, etc.).

In the nuclear sector, as in many other industrial sectors, the presence of PFAS-containing equipment in installations (e.g., seals, lubricants) serves important functions, particularly for heat and corrosion resistance, and contributes more broadly to the safe production of low-carbon electricity (e.g., sealing, operation of backup pumps, safe transport of radioactive materials enrichment process of uranium).

Then, the implementation of the proposed restriction, without specific derogations or exclusions, would immediately impact the maintenance of nuclear power plants, their safety and the production of low-carbon electricity in Europe. The deployment of new low-carbon generation capacities would also be affected.

Additionally, there are risks:

- of manufacturing relocation for activities requiring the use of PFAS in the production process but not present in the final product (e.g., uranium enrichment process that requires PFAS not found in enriched Uranium: possibility of importation into the EU without domestic production capability)
- to lose the capacity to produce (separation and enrichment) stable isotopes for health care (cancer diagnostics and treatment), as well as for industrial applications (semiconductors, by using gas centrifuges)
- to lose main parts of the enriched uranium products supply chain for 21 countries who decided to go for nuclear as an option to reduce CO2 emissions
- Maintenance of electrical networks (cables)

Besides, it is important to consider and expand upon the concept of “essential uses” for the society, as proposed in the European Commission’s communication of October 14, 2020, titled “Chemicals Strategy for Sustainability Towards a Toxic-Free Environment”, which provides for a phasing out the use of PFAS in the EU, “unless their use is essential”. This concept is also mentioned in a 2022 article by Glüge et al., which acknowledges that the utilization of PFAS in industrial processes can be highly intricate, requiring a comprehensive evaluation of the technical functionality of each PFAS compound and the suitability of alternative substances.

The nuclear energy industry plays a crucial role in helping the EU achieve its decarbonization objectives. It currently supplies about a quarter of the EU's electricity and nearly half of its low-carbon electricity, making it an essential contributor to the EU's energy transition. Moreover, the nuclear sector enhances the EU's energy security by reducing dependence on third countries. As the EU engages in ongoing discussions about enhancing the competitiveness of net-zero technologies and strengthening energy resilience, the nuclear sector emerges as a critical player. **It is vital to safeguard this role by ensuring uninterrupted access to essential components and substances necessary for nuclear operation in a safe manner, especially in the form of fluoropolymers and fluorinated gases.**

With regards to fluoropolymers, several studies (Chemours, 2021; Henry et al., 2018; EPA, 2021) have found that they do not pose significant risks to human health or the environment. These studies demonstrate that the majority of fluoropolymers meet the OECD criteria to be classified as "polymers of low concern" (PLC). Therefore, **it is recommended to exclude these fluoropolymers from the list of PFAS affected by the proposed ban**. The UK government, for instance, has already decided to exempt fluoropolymers, along with other groups of chemicals of lower concern, from their forthcoming PFAS restriction proposal. Despite this classification of low concern, the nuclear industry considers further research into the possible risks of fluoropolymers to be important.

As a consequence and considering nuclear energy as essential for society, in particular to secure electricity supply and to fulfil decarbonization objectives, the PFAS restriction should provide a special regime for any article or mixture containing PFAS that contributes to nuclear facility safety, electrical supply security, or low-carbon electricity production (see Section 5 for specific recommendations of derogations).

Specific Information Requests

5: Proposed derogations – Tonnage and emissions:

As many other industries, the nuclear energy sector uses PFAS, mainly PTFE and PVDF, in gaskets, rings, pump and tank coating, secondary containment liner, pipes, valves… mainly because of their ability to withstand harsh corrosive atmosphere (fluorine, hydrofluoric acid, UF_6...), as well as for sealing and refrigerant applications. Although it is not feasible within the limited consultation period to identify all equipment containing or potentially containing PFAS, given the multitude of substances involved (several thousand), this section provides detailed information on some specific uses that we consider crucial and representative for the safe operation of nuclear installations in Europe, and for which specific derogations or exclusions should be considered.

1. Focus on specific uses:

1.1 Seals

Nuclear power plants use PFAS for sealing application especially in the “RIS”, “EAS” and “TPA” circuits (all belonging to the “Primary circuit” – see Figure 1), as explained below.

One of our members operating 56 nuclear power plants provides the following detailed figures (for its whole fleet):

- The RIS circuit is the Safety Injection System circuit used, in case of an accident, to inject a large quantity of boric acid into the primary circuit to halt the nuclear reaction. This circuit **must always remain available**, and its unavailability leads to preventive reactor shutdown. In practice the RIS circuit utilizes mostly PTFE-based Teflon tape (15,530 pieces consumed between 2018 and 2022) and specific PTFE-based stainless steel washers (252 pieces consumed between 2018 and 2022).
- The EAS circuit is the Containment Spray System circuit used in case of an accident to spray soda ash in the upper internal part of the reactor building to neutralize radioactive gaseous iodines emanating from a breach in the primary circuit. This circuit **must always remain available**, and its unavailability leads to a preventive reactor shutdown. The EAS circuit mostly uses PTFE-based Teflon tape (12,696 pieces consumed between 2018 and 2022), ERTAFLUOR plates based on Teflon specific to the EAS circuit (31 pieces consumed between 2018 and 2022), sets of PTFE-based rings and seals (141 pieces consumed between 2018 and 2022), and subassemblies of seal-bearings for EAS injection pumps (75 pieces consumed between 2018 and 2022).
- The TPA speed control circuit's main objective is to maintain a certain water level in the steam generators. It is an essential circuit for steam production to power the turbine. The TPA circuit mostly utilizes PTFE-based Teflon tape (15,576 pieces consumed between 2018 and 2022) and specific ERTAFLUOR plates based on Teflon for the TPA circuit (38 pieces consumed between 2018 and 2022).

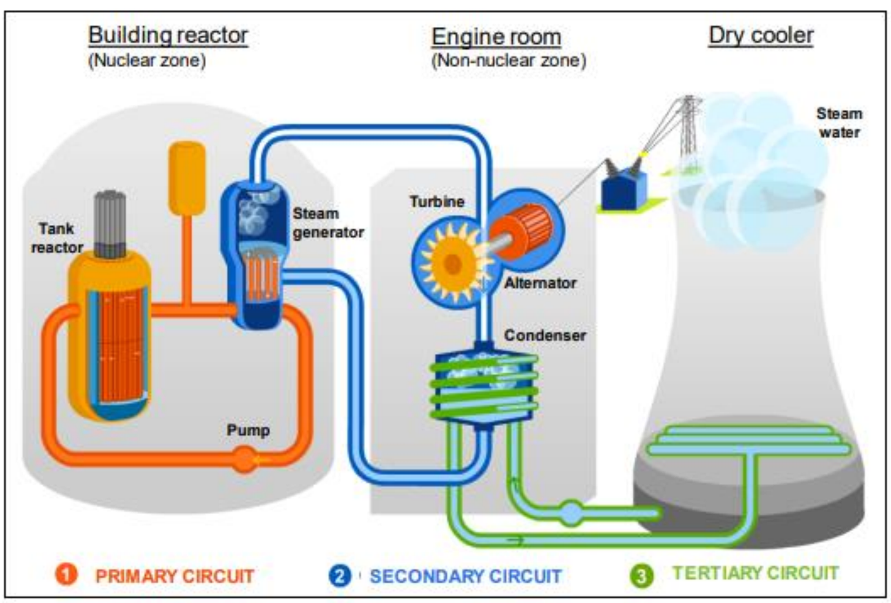

Figure 1. Simplified figure of a nuclear power plant with a cooling tower.

- In addition, concerning polyvinylidene fluoride (PVDF)-based seals, 5,800 O-rings were consumed between 2018 and 2023 for all circuits combined, including a significant number (1,500) on equipment or circuits qualified for accident conditions. **In this case, any substitution process must meet additional deadlines, requirements and tests to guarantee the safety of the installations.**

For more information about seals, please refer to the response by the European Sealing Association (ESA).

1.2 Refrigerants

The F-Gas Regulation (Regulation (EU) No 517/2014), which is under ongoing review, mandates the phasing out of greenhouse gases, including HFCs (hydrofluorocarbons) used in refrigeration systems. The preferred substitute currently is HFO (hydrofluoroolefins), belongs to the PFAS family but combines zero ozone depletion potential (ODP) and low global warming potential (GWP).

Nuclear power plants operated by some of our members currently use HFC in order to maintain the "nuclear island" at a suitable temperature and prevent materials' ageing. The choice of this fluid is a result of the implementation of the Ozone Regulation (2014) which lead to the replacement of HCFC and CFC by HFC-R134a, considering technical and safety parameters, such as flammability, toxicity to workforce and corrosiveness. The nuclear industry made a lot of efforts in recent years to reduce as far as possible its HFC emissions and to implement-the highest standards to prevent leakages in its refrigerant circuits.

The questioning of the use of HFOs as substitute for HFC by the PFAS restriction proposal raises a question of consistency with the F-Gas regulation currently being finalized, and a question of technical feasibility.

Studies carried out by our members show that the technical and economic feasibility of operating without synthetic refrigerants (HFCs, HFOs) cannot be envisaged in the medium term and **therefore requires special arrangements that could involve excluding fluorinated gases from the draft PFAS restriction in order to avoid regulatory cumulation or, at the very least, a long-term derogation for the use of fluorinated gases in refrigeration units in nuclear power plants, which play a direct role in the safety of installations.** More specifically

- The inventory carried out to date shows that only four "natural" technologies could be used to produce cold at 5°C with an average cooling capacity of 1 MW, but none of them can be applied as an immediate replacement solution in nuclear power plants. Indeed, they all present physical, operating or safety constraints for the installations:
    - **Alternative with R744 / CO_2**: loss of power at high outside temperatures.
    - **Alternative with R717 / NH_3**: highly toxic, flammable, and explosive.
    - **Alternative with R290 / hydrocarbon**: highly flammable.
    - **Absorption alternative**: availability of the hot source, double heat rejection, loss of performance at high outside temperatures.
- Any alternative requires research over the long term, taking into account economic, engineering and safety impacts , as well as the design of the installations (need to be installed in an outdoor building to eliminate safety constraints, maintenance and replacement).

Refrigerants are also used in the Uranium and stable isotopes enrichment process (see below). The substitution of these substances is impossible for now.

1.3 Uranium and Stable Isotopes enrichment (energy, health care) and industrial applications (e.g. semi-conductors)

In the entire front end of the nuclear fuel cycle, perfluoropolymers, lubricants and elastomers are quintessential for the production processes which are all based on uranium hexafluoride (UF_6).

For the production of natural UF_6 from uranium ore concentrate, both hydrogen fluoride (HF) and fluorine (F_2) are required. To handle these highly corrosive chemicals only perfluorinated polymers are suitable and there are no alternatives as any other polymer will be attacked by F_2 which has the highest oxidation potential of all elements. Natural UF_6 is subsequently enriched. To safely handle this highly corrosive compound, all the enrichment installations are equipped with perfluoropolymers, lubricants and elastomers. Usage of these materials is also required for the next step in the fuel cycle during which UF_6 is converted to UO_2 fuel pellets by the fuel fabricators. Finally depleted UF_6 is deconverted to stable U_3O_8 for long term storage. Again, perfluorinated polymers are indispensable for this process.

PTFE and PVDF used in gaskets, rings, pump and tank coating, secondary containment liner, pipes, valves are used because of their ability to withstand harsh corrosive atmosphere (fluorine, hydrofluoric acid, UF6) **in uranium conversion facilities**. The substitution of these substances is impossible for now. This situation is also found in used fuel recycling plants due to the use of nitric acid.

Industrial facilities involved in the uranium and stable isotopes enriching and separating process contain PFAS, which are the only chemical organic compounds resistant to HF, F_2 and UF_6. PFAS, and more specifically PTFE or PFPE, are used in limited quantity as lubricants (oils, grease), and sealants for process equipment in UF6 enrichments plants, due to their critical properties (chemical and mechanical resistance, low vapour pressure, viscosity, electrical, low surface tension, friction property). Lubricants containing PFAS are used because they are non-hydrogenated (hydrogen is replaced by fluorine). It therefore contributes to the moderation of criticality within fuel fabrication plants.

In addition, the following types of PFAS substances are used in the front end of the nuclear fuel cycle to produce UO_2, as well as for stable isotope enrichment: PFPE Lubricants; fluoropolymers; PTFE, fluoroelastomers (Viton, PKM); PVDF, PTCFE, refrigerants. Based on the chemical properties of the process media (UF_6, HF and F_2) no alternatives are currently available or have even been identified. There are no significant emissions to the environment during the use and end of life phases because all materials are used in confined systems and are disposed of in nuclear repositories. The total PFAS volume in Europe (except refrigerants) is about 6t (PFPE lubricants; fluoropolymers; PTFE, fluoroelastomers (Viton, PKM); PVDF, PTCFE)). PFAS waste streams in Europe are approximately 200kg/y. The substitution of these substances is impossible for now.

The planned restriction will lead to a shut-down of the EU enrichment and separation facilities, which means that more than 20 countries (including the US) depending on EUP (Enriched Uranium Products) will no longer be supplied and will not be able to operate their nuclear power plants. In addition, a tremendous shortage of stable Isotopes for

cancer diagnostics and treatment as well as to the semiconductor industry across Europe is foreseen.

For more information about the use of PFAS in lubricants, please refer to the response made by the Union of the European Lubricants Industry(UEIL). For more information about the use of PFAS in semiconductors, please refer to the response made by the European Semiconductor Industry Association (ESIA).

1.4 Fuel assembly transportation

FKM and FFKM are used in limited quantities in gaskets and rings for nuclear packaging. Their high temperature resistance, coefficients of thermal expansion, permeation to some gases and long life allow them to withstand qualifying temperature in the environment within which they are used. There are no emissions during the use and end of life phases because all materials are used in confined systems and are disposed of in nuclear repositories. R&D efforts are ongoing, but EPDM, silicone and new elastomers without fluoropolymers do not have all the properties required to comply with nuclear safety standards.

1.1 Electric systems, Instrumentation and Cables

PFAS are present in many of the constitutive components of a Control and Instrumentation systems. Those products are used for different sub-components and could be found in (non-exhaustive list):

- Semiconductor electronic components
- Coating of electrotechnical components (switches, connectors, relays, capacitors, transformers, etc.)
- Printed Circuit Board (dielectric performance, temperature resistance…)
- Instrumentation (detectors, pressure sensor, flow measurement, T°, level, etc.)
- Surface treatment and metals
- Fluids (grease, oil, lubricant, paint, cleaner, …)
- Filters, seals (need PTFE membranes)
- Wires, cables, coaxial with PTFE insulation, ETFE, etc (good temperature resistance, dielectric strength, fire resistant, corrosion resistant)

Nuclear instrumentation and control products and systems are qualified to multiple nuclear industry standards. These qualifications demonstrate their functional (performance) robustness (safety) and environmental compliance as PFAS allow the increase of withstanding of our products to, for example, seismic vibrations, cold and hot temperatures (with extreme values).

A PFAS ban where no substitution meeting equivalent safety properties is available, will induce a very important impact on nuclear industries that may goes to incapacity to provide any instrumentation to the field.

For more information about the use of PFAS, in electric systems, please refer to the response made by Federation of electrical, electronical and communication industries (FIEEC).

1.2 Technical textiles

PFAS are used in personal protective equipment (PPE) to protect workers from ionising radiation in a nuclear environment. These PFAS are regulated by the PFHxA restriction proposal. SEAC supports not applying the restriction on PFHxA for PPE as specified in Regulation (EU) 2016/425 of the European Parliament and of the Council, Annex I, Risk Category III (a), (c), (d), (e), (f), (h), (l) in the ECHA Opinion on PFHxA.

For more information about the use of PFAS in PPE, please refer to the response made by EURATEX.

2. **Request**

- Considering nuclear energy as essential for the society, in particular to secure electricity supply and to fulfil decarbonization objectives, the PFAS restriction should provide a special regime for any article or mixture containing PFAS that contributes to nuclear facility safety, electrical supply security, or low-carbon electricity production. These include (but are not limited to):
    - Fluoropolymers including PTFE/PFPE/PVDF/FKM/FFKM (time unlimited derogation)
    - HFOs (time-unlimited derogation)
- In addition, the PFAS restriction should expand:
    - the proposed derogation "*Additives to hydraulic fluids for anti-erosion/anti-corrosion in hydraulic systems (including control valves) in aircraft and aerospace industries (until 13.5 years after entry into force)"* to the energy sector.
    - the proposed derogation "*Lubricants where the use takes place under harsh conditions or is necessary for safe functioning and equipment safety (until 13.5 years after entry into force)*" to all articles (e.g., seals) and mixtures.
    - The proposed derogation “Fluropolymer applications in petroleum and mining industry until 13,5 years after EIF" to the energy sector
- Provide a time-unlimited derogation for all PFAS related substances in the front-end business of the nuclear fuel cycle, as well as for the enrichment of stable isotopes for health care and industrial applications. In addition to the substances listed in the point above, these include (but are not limited to):
    - Fluoroelastomers (Viton, PKM)
    - PTCFE
- Provide a time-unlimited derogation for PFAS used in personal protective equipment intended to protect users against risks as specified in Regulation (EU) 2016/425 of the European Parliament and of the Council, Annex I, Risk Category III (d)
- Furthermore, for all uses benefiting from derogations, a mechanism should be established to reassess the derogation period if no substitution meeting equivalent safety or production efficiency properties is available within the specified timeframe.