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From: Commander, Naval Facilities Engineering Command

Subj: PERFLUORINATED COMPOUNDS (PFCs) INTERIM GUIDANCE/ FREQUENTLY ASKED QUESTIONS (FAQs)

Ref: (a) Department of Defense, Under Secretary of Defense for Acquisition, Technology and Logistics (DOD USD (AT&L) Instruction 4715.18 of Emerging Contaminants, June 2009

(b) Department of Navy, Assistant Secretary of the Navy (Energy, Installation and Environment) (DON ASN (EI&E)) memorandum, Perfluorinated Compounds (PFCs) – An Emerging Environmental Issue, 21 October 2014

Encl: (1) Perfluorinated Compounds (PFCs) Guidance/ Frequently Asked Questions (FAQs), December, 2014

1. In accordance with reference (a), Interim guidance and procedures for addressing Perfluorinated Compounds (PFCs) under the Environmental Restoration, Navy (ER,N) Program and Navy Base Realignment and Closure (BRAC) Program are provided in Enclosure (1). As many Navy installations have been receiving requests to evaluate PFCs at restoration sites, this PFCs Guidance/FAQs assists with identifying issues and promoting a consistent approach for dealing with these contaminants at Navy Environmental Restoration (ER) sites.

2. A main point of interest in the PFCs Interim Guidance is how to address PFCs when there is a potential Drinking Water (DW) exposure. Consequently, reference (b) provides direction in indicating that when the DON installation produces DW from on-installation sources, the DW must be sampled where there is an identified or suspected PFC release within an approximate 1-mile radius upgradient of the DW source. Coordination should be made between ER Remedial Project Managers (RPMs) and Compliance PMs on this issue.

3. The main objective of the PFCs Interim Guidance is to assist Remedial Project Managers (RPMs) with programmatic and technical issues related to PFCs at Naval ER sites. These issues include: eligibility and funding responsibilities and scenarios, investigation and sampling methodology, and remedial response considerations.

3. The Headquarters point of contact is Ms. Kim P. Brown, who can be reached at kim.brown@navy.mil or (202) 685-0096. Technical questions can also be directed to Mr. David Barclift at david.barclift@navy.mil or (215) 897-4913.

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Interim Perfluorinated Compounds (PFCs) Guidance/ Frequently Asked Questions

Objective/Purpose

The objective of this document is to assist Naval Remedial Project Managers (RPMs) with programmatic and technical issues related to a group of chemicals called perfluorinated compounds (PFCs) at Department of Navy (DON) Environmental Restoration (ER) sites. These issues include: funding responsibilities, risk assessment, and regulatory requirements. The "Frequency Asked Questions" are presented to give general guidance. However, the RPM is encouraged to discuss site-specific conditions with their respective ER Manager or Base Closure Manager (BCM) to determine if circumstances allow for Environmental Restoration, Navy (ER,N) or Base Realignment and Closure (BRAC) eligibility.

Applicability

The guidance and procedures in this document apply to actions taken under the ER,N and BRAC funded Defense Environmental Response Program (DERP).

Background

Certain PFCs have been identified as emerging contaminants (ECs) relevant to the DERP program. PFCs have been used in a variety of industrial and military applications, including as a historical component in aqueous film forming foam (AFFF), which was routinely used at former firefighting training areas (FTAs). Because these compounds are environmentally persistent, they have been detected in environmental samples long after a release was reported. This environmental persistence, combined with their tendency to bioaccumulate in living organisms and some demonstrated toxicity in laboratory animals, has resulted in increased interest in these ECs.

The U.S. Department of Defense (DoD) works with the U.S. Environmental Protection Agency (EPA) and state agencies to reach consensus on how to address ECs such as PFCs. ECs may have insufficient or limited health and science data, or the science and technology necessary to address them is not currently available. There also may be new detection limits or contaminant migration pathways associated with ECs, which must be investigated before agreement can be reached on a path forward. Due to some of these potential complications, the Naval Facilities Engineering Command (NAVFAC) has prepared this interim guidance to provide support to RPMs in how to handle PFCs at their sites.

PFC Guidance FAQ Highlights

1. Investigation of Perfluorinated Chemicals (PFCs)

RPMs should consider investigating ER sites for PFCs when the conceptual site model (CSM) indicates:

a. Historical release or use of aqueous film forming foam (AFFF), or
b. Historical use of an area for other industrial activities (e.g. plating operations) that may have released PFCs.

Based on recent Navy experience, sites at Naval and Marine Corps Air Stations (NASs and MCASs respectively) or other applicable installations with potential repeated (e.g., former firefighting training areas) or significant (e.g., crashes) AFFF releases should be prioritized for investigation.

For additional information, see FAQs G4, E2, S1, S2, S4, and S6.

2. Sampling and Analysis of PFCs

Initially, PFC investigations should focus solely on PFCs for which vetted[1] toxicity values are available. Currently perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) are the only two PFCs for which toxicity values are available. Sampling and analysis of additional PFCs may be included in the future to facilitate remedial design or when the state of the science improves and additional toxicity information become available.

For additional information, see FAQs S6 – S13.

3. Human Health Risk Assessment for PFCs

Currently there are Tier 3 noncancer toxicity values for two PFCs, specifically PFOA and PFOS. These Tier 3 toxicity values can be used to estimate risk-based screening levels (Tier 1A or 1B risk assessments) or can be used to estimate noncancer hazards from oral exposure in a Tier 2 baseline human health risk assessment (HHRA). If potentially unacceptable risks are identified in the baseline HHRA, these toxicity values can be used to develop site-specific risk-based cleanup goals. However, as with any other Tier 3 toxicity values, RPMs should be cognizant of the potentially significant uncertainty inherent in these values. These toxicity values are for the oral route of exposure. At this time, potential effects from other routes of exposure (i.e., inhalation and dermal) are not able to be quantified.

For additional information, see FAQs R1 – R3.

4. Response to PFC Detections

If sampling indicates the presence of PFCs, then the response should be consistent with DoD Emerging Contaminant (EC) Guidance (DoD 2008 and DoD 2009).

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[1] Vetted toxicity values for chronic exposure are available in the EPA's Regional Screening Level (RSL) table. Vetted toxicity values for subchronic exposure are available from the EPA's online RSL calculator. Note that these sources are updated two times per year and the most current toxicity information may not always be reflected in these sources.

a. At a minimum, the nature and extent of contamination should be delineated
b. If there is no current or potential future exposure, then further action should be delayed until there is greater certainty regarding toxicity and/or remedial technologies.
c. If further action is delayed, then consideration should be given to include the extent of contamination on the Base Master Plan or other appropriate documents.
d. Interim response actions may be initiated to prevent exposure (e.g., monitoring, controlling land use, controlling plume migration, providing drinking water).

For additional information, see FAQs RR1 – RR6.

5. Remedial Actions for PFCs

At present, information regarding degradation and transformation pathways and effective remedial technologies is limited. As such, it may only be possible to (1) prevent exposure by implementing Land Use Controls (LUCs) or (2) initiate interim remedies (e.g. well head treatment).

For additional information, see FAQs RR7, S12, S13, and LUC1.

Organization of this Document

The remainder of this document is presented as Frequently Asked Questions (FAQs), as follows.

FAQ – General/Definitions

G1. What are emerging contaminants (ECs)?
G2. What are perfluorinated compounds (PFCs)?
G3. Are PFCs naturally occurring?
G4. What were PFCs used for?

FAQ - Eligibility and Funding

E1. Are PFCs considered CERCLA contaminants?
E2. Can ER,N or BRAC funding be used to investigate and, if necessary, remediate PFCs?
E3. What if this site has achieved site closure (SC)?

FAQ - Investigation and Sampling

S1. Should I start analyzing for PFCs as part of the “full suite”?
S2. Should we sample for these chemicals even if the regulators are not asking?
S3. What should be expected regarding fate and transport of PFCs?
S4. Is it reasonable to assume that PFCs will be present at my site?
S5. If a release is suspected which media should be sampled?
S6. Is there a recommendation on how to prioritize sites for PFC sampling?
S7. Which PFCs should be included in the sampling plan?
S8. Are there special sampling techniques for these chemicals?
S9. What method should be used to analyze samples?
S10. Are there DoD ELAP accredited laboratories that can perform PFC analysis?
S11. What are the typical costs for PFC analysis?
S12. What if a release is suspected to have migrated offsite?

S13. What if drinking water supply wells could have been impacted?

FAQ - Risk Assessment

R1. Should PFCs automatically be included in the risk assessment?
R2. What human health risk assessment screening levels are available?
R3. What human health toxicity values are available?
R4. What exposure pathways should be included in a human health risk assessment?
R5. Do PFCs need to be considered in the ecological risk assessment?
R6. What ecological risk assessment screening levels are available?

FAQ – Remedial Response Considerations

RR1. If sampling indicates presence of PFCs, is response warranted?
RR2. How should cleanup levels be established for PFCs?
RR3. If PFCs are the only risk driver, does it drive a DERP response?
RR4. What if other contaminants are not present at levels requiring action and it is unclear that PFCs are present at levels that would warrant action?
RR5. What if other contaminants are present at levels requiring action and it is unclear if PFCs are present at levels that would warrant action?
RR6. What if other contaminants are present at levels requiring action and it is likely that PFCs are present at levels that would warrant action?
RR7. What treatment technologies are available for PFCs?

FAQ – Land Use Controls

LUC1. Should land use controls (LUCs) be considered when PFCs are present?

FAQ - Five-Year Review Issues

FY1. Should PFCs be considered during 5-Year Reviews?

FAQ – General/Definitions

G1. What are emerging contaminants (ECs)?

There is no single, consensus definition of ECs across agencies; different organizations (e.g., DoD, EPA, state agencies) have different definitions of ECs and thus possibly different chemicals identified as ECs. For DoD, an EC is defined as a contaminant that:

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

For reference, EPA's definition is: "An "emerging contaminant" is a chemical or material that is characterized by a perceived, potential or real threat to human health or the environment or by a lack of published health standards" (EPA 2014a).

G2. What are perfluorinated compounds (PFCs)?

PFCs represent a large family of chemicals, including:

Perfluorooctane sulfonate (PFOS)
Perfluorooctanoic acid (PFOA),
Perfluorohexanesulfonic acid (PFHXS),
Perfluoroheptanoic acid (PFHPA),
Perfluorononanoic acid (PFNA), and
Perfluorobutanesulfonic acid (PFBS).

There are other PFCs but, to date, these are the only ones listed by EPA in the Unregulated Contaminant Monitoring Rule 3[2] (UCMR3). For additional information on PFOA and PFOS as ECs, see EPA's fact sheet (EPA 2014a).

G3. Are PFCs naturally occurring?

These chemicals are manmade and do not occur naturally.

G4. What were PFCs used for?

PFCs have many commercial uses, but at DoD facilities the primary sources will be firefighting training areas (FTAs) where aqueous film forming foam (AFFF) was released in uncontained areas. Additional sources of PFCs include the testing or other release of hangar fire suppression systems that use AFFF and leaks from tanks and supply lines associated with the fire suppression

[2] The 1996 Safe Drinking Water Act (SDWA) amendments require that once every five years EPA issue a new list of no more than 30 unregulated contaminants to be monitored by public water systems (PWSs). The first Unregulated Contaminant Monitoring Rule (UCMR 1) was published on September 17, 1999, the second (UCMR 2) was published on January 4, 2007 and the third (UCMR 3) was published on May 2, 2012. This monitoring provides a basis for future regulatory actions to protect public health.

systems and hangar floor drains. Also sites of aircraft fires or major fuel spills that may have been treated with AFFF should be considered.

PFCs were also used to aid in mist suppression in plating facilities in order to meet air emissions. This issue is thought to be negligible with respect to the ER program unless a spill or leak occurred. However, at this point sufficient data is not available to confirm this assumption.

FAQ - Eligibility and Funding

E1. Are PFCs considered CERCLA contaminants?

PFCs, including PFOA and PFOS, are not listed as Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) hazardous substances and therefore have not historically been included in typical CERCLA/DERP environmental investigations. Although PFCs are not a CERCLA hazardous substance, they are considered a CERCLA pollutant or contaminant.

However, because PFCs fall within the definition of ECs contained in DODI 4715.18, these chemicals can be investigated in a DERP investigation if a reasonable basis exists to suspect a potential release.

E2. Can ER,N or BRAC funding be used to investigate and, if necessary, remediate PFCs?

If the conceptual site model (CSM) indicates the use or release of AFFF or other industrial activities for which PFCs are associated with ER,N or BRAC funds can be used to investigate, and if necessary, perform restoration of media impacted by PFCs. However, ER,N or BRAC funds can only be used to address past releases of PFCs (that is, ER,N or BRAC funds cannot be used to investigate/remediate potential ongoing releases at active operations).

As with any ECs, it can sometimes be very challenging to get teams to concur on the potential risk and/or cleanup levels for contaminants with limited toxicity information, such as PFCs (see Risk Assessment section). Therefore RPMs should check with ER Managers (for ER,N) or Base Closure Managers (for BRAC) before agreeing to cleanup levels to ensure that the state of the science information is being appropriately considered.

E3. What if the site has achieved site closure (SC)?

If a site has already been investigated and achieved SC, then any additional investigation should only be initiated after careful consideration, with adequate justification, and with concurrence from the respective ER Manager (for ER,N) or Base Closure Manager (for BRAC). To consider sampling a site for PFCs, the conceptual site model (CSM) must be well understood and strongly suggest that there is reason to believe these chemicals have impacted environmental media in areas where exposure can occur.

FAQ - Investigation and Sampling

S1. Should I start analyzing for PFCs as part of the "full suite"?

No. Sampling for PFCs should only be initiated based on a well-developed CSM that provides a clear link between historical DON activities and a potential release of this EC.

S2. Should we sample for these chemicals even if the regulatory agencies are not asking?

Yes, provided that the CSM is consistent with historical release of AFFF or PFCs.

S3. What should be expected regarding fate and transport of PFCs?

Current sampling results indicate that the highest groundwater concentrations will likely be found nearest the source and diminish with distance. PFCs are very water soluble and yet they have been found in soils at FTAs that have been closed for years.

Due to the emerging status and complex chemistries, a clearer picture of environmental fate and transport is not available at this time. In an effort to begin answering some of these questions the DoD has funded SERDP Project No. 11 ER-02-025, "*Characterization of the Fate and Biotransformation of Fluorochemicals in AFFF-Contaminated Groundwater at Fire/Crash Testing Military Sites.*" The goals of the study are to delineate the fluorochemicals that persist in AFFF-contaminated groundwater, sediment, and soil.

S4. Is it reasonable to assume that PFCs will be present at my site?

At DoD facilities, one of the primary sources of environmental PFCs will be firefighting training areas (FTAs) where aqueous film forming foam (AFFF) was used. The historical manufacturing process of AFFF resulted in complex mixtures of fluorinated chemicals being present, which can include several PFCs. AFFF manufactured from between approximately the mid-1960's to 2000 could potentially have included PFCs in the chemical formulation. The Navy maintains a large amount of this AFFF in its inventory and continues to use it to this day. If the CSM suggests that AFFF was released into the environment, it is probable that a variety of PFCs will be present at the site in the soil and water. The base Fire Department should be contacted to determine if the base currently or historically used AFFF, and locations where it has been used (e.g., training, crashes, etc.). Coordination with the Water Program Media Managers, Spill Program Managers, the regional Navy On Scene Coordinators (NOSC) will also provide information on AFFF releases/spills.

Note that other potential source areas could include anywhere else where AFFF may have been released in significant quantities. This may include, but is not limited to, runways, hangars where fires or accidental releases of AFFF occurred, oil-water separators or other piping systems where

released AFFF may have flowed, and crash sites. Additionally, PFCs may have historically been used for mist suppression in some plating shops. Since PFCs have been used in a number of other commercial and industrial processes, our understanding of potential source areas is still evolving. As such, it is recommended that RPMs confirm with technical support if PFCs could potentially be associated with their sites.

S5. If a release is suspected which media should be sampled?

Depending on the CSM and proximity of the release to shallow groundwater, groundwater should be tested as these compounds are very water soluble. Depending on the CSM, other media such as soil, sediment and surface water may also be considered for collection and analysis. This decision should be made by the entire team, with consideration of both fate and transport and potentially complete exposures.

S6. Is there a recommendation on how to prioritize sites for PFC sampling?

The most current understanding of the conceptual site model (CSM) should always be used to determine the need for sampling and to prioritize sites for sampling. Based on recent Navy experience, Naval and Marine Corps Air Stations (NASs and MCASs respectively) are candidate sites for PFC investigation. These installations are likely to have areas where AFFF releases historically have occurred, whether due to repeated routine use (e.g., firefighting training) or a single significant release (e.g., crash site or spill). Sites at NASs/MCASs or other applicable installations with potential AFFF releases should be prioritized for investigation. In the absence of site-specific information, in general the following site sampling prioritization should be used:

1. Former firefighting training areas (FTAs),
2. Crash sites,
3. Hangars, runways and flight line areas,
4. Other (e.g., plating shops, sludge disposal areas, oil-water separators in the vicinity of historical releases, etc.).

This prioritization is simply a starting point and the CSM should always be used to help make decisions regarding how to prioritize investigations. Additional input from the CSM may include, but is not limited to depth to groundwater, proximity to drinking water wells/sources, proximity to surface water, etc.

S7. Which PFCs should be included in the sampling plan?

As noted in G2, there are many PFCs which may be associated with AFFF or with degradation of AFFF chemical components. However, at this time the only compounds which have vetted[3]Tier

[3] Vetted toxicity values for chronic exposure are available in the EPA's Regional Screening Level (RSL) table. Vetted toxicity values for subchronic exposure are available from the EPA's online RSL calculator. Note that these sources are updated two times per year and the most current toxicity information may not always be reflected in these sources.

3 toxicity values available to help understand potential toxicity from exposure to these chemicals are PFOA and PFOS. As such, environmental sampling should initially be limited to these two compounds since they are the only two PFCs for which vetted toxicity values are currently available. If vetted toxicity values become available for other compounds in the future, this recommendation may change so RPMs are encouraged to verify the state of the science on this issue with Navy technical representatives or by contacting NAVFAC Headquarters. Sampling and analysis of additional PFCs may be included in the future to facilitate remedial design.

S8. Are there special sampling techniques for these chemicals?

Because PFCs can be found in a number of consumer products, there are several precautions that should be taken during sample collection to avoid inadvertent sample contamination:

- Post-it Notes should not be used at any time during sample handling, or mobilization/demobilization.
- Samples should be collected in plastic bottles. Personnel involved with sample collection and handling should avoid wearing new clothing (e.g., at least 6 washings since purchase).
- Personnel involved with sample collection and handling should not wear water resistant clothing immediately prior to or during sample collection.
- Personnel involved with sample collection and handling should not wear Tyvek® suits.
- Personnel involved with sample collection and handling should wear nitrile gloves at all times while collecting and handling samples.
- Many food and snack products are packaged in wrappers treated with PFCs. Therefore, hands will be thoroughly washed after handling fast food, carryout food, or snacks.
- Pre-wrapped food or snacks (like candy bars, microwave popcorn, etc.) must not be in the possession of the sampling personnel during sampling.
- Blue Ice® must not be used to cool samples or be used in sample coolers.
- Products containing Teflon® will not be used during sample handling, or mobilization/demobilization.

S9. What method should be used to analyze samples?

Currently the recommended analytical instrumentation uses a High Performance Liquid Chromatography (HPLC) coupled with tandem mass spectrometers (MS). This is not a standard EPA method and coordination with laboratory is recommended.

If drinking water is potentially impacted and therefore sampled, EPA Method 537, Version 1.1 is recommended. This is a liquid chromatography (LC) coupled with tandem MS method.

S10. Are there DoD-ELAP accredited laboratories that can perform PFC analysis?

Yes, the project chemist should be able to locate these laboratories as they would when procuring any other laboratory service. If questions persist, RPMs should contact a Navy chemist.

S11. What are the typical costs for PFC analysis?

Currently, several laboratories have reported analytical cost of approximately $400 per sample, regardless of the matrix being analyzed.

S12. What if a release is suspected to have migrated offsite?

If the CSM indicates that a historical release may have migrated offsite, then as with any other potential release, sampling may need to be initiated offsite to identify nature and extent and potential complete exposures. Of particular concern would be the potential impact that offsite migration would have on drinking water wells in the vicinity. In this instance, both FEC-specific ER Managers (for ER,N) or Base Closure Managers (for BRAC) and NAVFAC HQ should be notified. The sampling should be expedited if potentially complete exposures are expected. Coordination with legal, real estate, and possibly the regulators will be needed to gain right of entry access agreements to private properties.

S13. What if drinking water wells could have been impacted?

If the CSM indicates that a historical release may impact on-installation Navy drinking water wells, or public/private drinking water wells off-installation, then sampling needs to be expedited and coordinated with additional parties to determine if there are potentially complete exposures. In this case, the procedures detailed in the "Perfluorinated Compounds (PFCs) – An Emerging Environmental Issue" memo (DON 2014) should be followed; including identifying Navy and non-Navy drinking water wells within a one mile radius downgradient of an identified or suspected PFC release. In this instance, both FEC-specific ER Managers (for ER,N) or Base Closure Managers (for BRAC) and NAVFAC HQ should be notified. If DON released PFCs are confirmed in drinking water supplies, immediate response actions should be implemented to reduce/eliminate this exposure pathway.

FAQ - Risk Assessment

R1. Should PFCs automatically be included in the risk assessment?

PFCs should only be sampled for if the CSM suggests evidence of a historical release of these chemicals. If the CSM supports environmental sampling for PFCs, then these sampling results should be used to make remedial decisions as would analytical results for any other chemical. For the majority of sites, this will include a quantitative risk assessment. However, it should be noted in the uncertainty section that Tier 3 toxicity values were used for these ECs.

R2. What human health risk assessment screening levels are available?

As always, screening levels may be developed through partnering relationships between the RPM and regulatory agencies. Ordinarily, the USEPA Regional Screening Level (RSL) tables would

be a good place to start. However, at the time of this FAQ release, the RSL table does not include PFOA and PFOS since chronic toxicity values are not available for these chemicals. If this continues to be true, then alternate sources of screening levels will need to be considered. The potential screening levels presented below were calculated based on the RSL residential and industrial worker exposure scenarios and the Tier 3 subchronic toxicity values developed by the EPA Office of Water (EPA 2009). Before relying on this table, please contact your NAVFAC Risk Assessment Workgroup (RAW) representative to verify if it is still current.

Screening Level Scenario	**Groundwater (µg/L)**		**Soil (mg/kg)**	
	PFOA	**PFOS**	**PFOA**	**PFOS**
Residential exposure*	**4.0**	**1.6**	**12**	**4.9**
Industrial worker exposure*	**NA**	**NA**	**165**	**66**

*Values calculated using the reference doses derived by the EPA in their Short-term Provisional Health Advisory (2009) and the exposure assumptions used to calculate EPA Regional Screening Levels in May 2014.
NA means that currently these values are not applicable.

R3. What human health toxicity values are available?

Currently there are no toxicity values for any PFCs available from a Tier 1 (EPA's Integrated Risk Information System [IRIS]) or Tier 2 (EPA's Provisional Peer-Reviewed Toxicity Value [PPRTV]) source. Tier 3 non-cancer toxicity values are available for PFOA and PFOS for the ingestion route of exposure (i.e., reference doses [RfDs]) (EPA 2009). These RfDs are for subchronic exposures, as opposed to the chronic exposures periods typically evaluated in CERCLA human health risk assessments (HHRAs). Although Tier 3 toxicity values are appropriate for use in CERCLA HHRAs per (EPA 2009), there is always increased uncertainty associated with the use of Tier 3 toxicity values since their level of peer review and acceptance in the scientific community are not as rigorous as for Tier 1 and Tier 2 toxicity values. Recently the U.S. EPA Office of Water released draft Health Effects Documents for review and comment for both PFOA (EPA 2014b) and PFOS (EPA 2014c), but these documents have not been finalized. These draft values should be carefully considered when there is an impacted drinking water source.

R4. What exposure pathways should be included in a human health risk assessment?

Currently the only toxicity values available are for ingestion of PFOA and PFOS. As such, if the CSM dictates, the ingestion exposure route can be estimated for human health. For many chemicals, it is possible to estimate the potential toxic effects from dermal exposure by adjusting the oral toxicity value. EPA has determined that the only chemicals with current Tier 3 toxicity values (i.e., PFOA and PFOS), should not be evaluated for dermal exposure due to high uncertainty (EPA 2004). The only toxicity values currently available for PFCs are for ingestion exposure, and therefore the inhalation route cannot be quantified. Therefore, the only exposure pathway that can be quantified with any confidence at this time is the ingestion of environmental media containing PFCs.

R5. Do PFCs need to be considered in the ecological risk assessment?

Yes, only if the CSM includes complete exposure pathways for ecological receptors and there are accepted screening values provided in accordance with R6.

R6. What ecological risk assessment screening levels are available?

Several scientific papers have been published that try to start establishing potential values for ecotoxicity of some PFCs. However, at this time there are no ecological screening levels available. If regulators provide or recommend ecological screening levels for any PFCs, it is recommended to check with a Navy ecological risk assessor to vet those values.

FAQ – Remedial Response Considerations

RR1. If sampling indicates presence of PFCs, is response warranted?

A decision regarding whether a response is warranted is based on a risk determination. Risk is evaluated based on risk assessments, and if there is unacceptable risk, potential chemical-specific applicable or relevant and appropriate requirements (ARARs) should be evaluated (See, for example, OSWER Directive 9355.0-30.) Note that the USEPA drinking water short-term provisional health advisory (PHA) values for PFOA (0.4 µg/L) and PFOS (0.2 µg/L) are not promulgated and do not qualify as potential federal ARARs. However, if a site includes a current drinking water source, these PHA values may be used to evaluate protectiveness of the drinking water and may provide the basis for determining if a site warrants a response action. If your state identifies a potential state requirement, it is important that you contact your environmental counsel for a legal interpretation of whether the requirement is accepted as a potential ARAR, to be considered (TBC), and/or a risk-based value for evaluating protectiveness.

RR2. How should cleanup levels be established for PFCs?

If potentially unacceptable risks are identified in the baseline HHRA, these toxicity values can be used to develop site-specific risk-based cleanup goals. However, as with any other Tier 3 toxicity

values, RPMs should be cognizant of the potentially significant uncertainty inherent in these values. As noted in R3, draft toxicity values that are still being reviewed by the scientific community are not recommended for use in determining cleanup levels.

RR3. If PFCs are the only risk driver, does it drive a CERCLA response?

Yes. If the concentrations of PFCs are sufficiently elevated such that all parties agree that action is necessary for ECs, the team should evaluate remedial alternatives for PFCs.

If the team agrees on the cleanup level(s) then a remedy can be implemented. However, if the team disagrees on the PFC cleanup level(s), then one or more interim response actions may be appropriate until consensus risk-based values are identified by the team (e.g., plume migration control, provision of drinking water, monitoring, land use controls).

If the team agrees that there is no actual or potential future exposure, it may be possible to delay further action until there is a greater certainty over the risk (e.g., more complete toxicity information). Alternately, the team may wish to make a risk management decision.

At a minimum, the team should seek to delineate and/or monitor the extent of contamination until there is greater certainty regarding the potential risk and/or remedial technologies. If the team agrees to delay further action until risk-based values are identified, the DON may want to note the area of contamination on their Base Master Plan or other appropriate documents.

RR4. What if other contaminants are not present at levels requiring action and it is unclear that PFCs are present at levels that would warrant action?

If PFCs are present but regulators and DON cannot agree that exposure poses an unacceptable risk then the team should seek to agree on whether one or more interim response actions may be appropriate until consensus risk-based values are identified (e.g., monitoring, land use controls, plume migration control, provision of drinking water).

If the team agrees that there is no actual or potential future exposure (for example, there is no current pathway and human receptor), it may be possible to delay further action until there is a greater certainty over the risk (e.g., more complete toxicity information). Alternately, the team may wish to make a risk management decision.

At a minimum, the team should seek to delineate and/or monitor the extent of contamination until there is greater certainty regarding the potential risk and/or remedial technologies. If the team agrees to delay further action until risk-based values are identified, the DON may want to note the area of contamination on their Base Master Plan or other appropriate documents.

RR5. What if other contaminants are present at levels requiring action and it is unclear if PFCs are present at levels that would warrant action?

If PFCs are detected but regulators and DON cannot agree that they pose an unacceptable risk, then the team should consider if there are remedial alternatives for the other contaminants which may also address PFCs. If so, and agreement can be reached on the PFC cleanup level by the team, a remedy should be implemented.

If the team disagrees on the ultimate cleanup level for PFCs, one or more interim response actions may be appropriate until risk-based values are identified (e.g., monitoring, land use controls, plume migration control, provision of drinking water).

If the remedial alternatives for other contaminants do not address PFCs and the team agrees that there is no actual or potential future exposure (for example, there is no current pathway and human receptor), it may be possible to delay further action until there is a greater certainty over the risk (e.g., more complete toxicity information). When selecting a remedy for other contaminants, the team should consider if the remedy has the potential to adversely impact the PFCs. Alternately, the team may wish to make a risk management decision.

At a minimum, the team should seek to delineate and/or monitor the extent of contamination until there is greater certainty regarding the potential risk and/or remedial technologies. In these instances, it may be necessary to sample for additional PFCs as opposed to just PFOA and PFOS since there may be uncertainties regarding how the remedial actions for the other contaminants could impact the fate and transport of the PFCs. If the team agrees to delay further action until risk-based values are identified, the DON may want to note the area of contamination on their Base Master Plan or other appropriate documents.

RR6. What if other contaminants are present at levels requiring action and it is likely that PFCs are present at levels that would warrant action?

When the concentrations of PFCs are sufficiently elevated such that all parties agree that action is necessary, then it is possible that the remedial alternatives for other contaminants may address PFCs. However when remedial alternatives for other contaminants do not address PFCs, then an alternate remedy will need to be evaluated. When selecting a remedy for other contaminants, the team should consider if the remedy has the potential to adversely impact the PFCs.

If there is agreement on the PFC cleanup level by the parties, then there does not need to be a delay in implementing a remedy. However if the team disagrees on the cleanup level for PFCs, one or more interim response actions may be appropriate until consensus risk-based values are identified. If the team agrees that there is no actual or potential future exposure (for example, there is no current pathway and human receptor), it may be possible to delay further action until there is a greater certainty over the risk (e.g., more complete toxicity information). Alternately, the team may wish to make a risk management decision in consultation with regulatory agencies.

At a minimum, the team should seek to delineate and/or monitor the extent of contamination until there is greater certainty regarding the potential risk and/or remedial technologies. If the team agrees to delay further action until risk-based values are identified, the DON may want to note the area of contamination on their Base Master Plan or other appropriate documents.

RR7. What treatment technologies are available for PFCs?

Before implementing any active remedy for these emerging contaminants the RPM should contact NAFVAC Headquarters. Currently, the leading technologies are activated carbon, reverse osmosis and nano-filtration. However, these treatment processes are further impaired by other groundwater contaminants in addition to the high costs of operation. Ex-situ filtration is optimized for specific chemicals, which can result in non-targeted chemicals passing through. Thus, if there are additional unidentified PFCs in the plume, ex-situ filtration with release to the

surface, may unintentionally result in the release and spread of other PFCs to surface water bodies. Because the toxicity of these other PFCs is not well defined at this time, the potential impact of their release to surface water is unknown.

Research is beginning to provide the potential for alternative strategies. There have been some promising bench scale studies that suggest oxidation-based technologies may have the capacity to break down these recalcitrant chemicals. The research is in the early stages of development but there is hope that alternative technologies are possible. However, in-situ treatment is expected to increase the amount of smaller-chained PFCs in the plume, as a byproduct of the oxidation. Because the relative toxicity of smaller chained PFCs has not been defined, this alternative runs the risk of potentially increasing the toxicity of the plume. Thus, treatment which breaks down the PFOA and PFOS to smaller chained PFCs should be avoided until such time that there is a better understanding of the relative toxicity of these chemicals.

FAQ – Land Use Controls (LUCs)

LUC1. Should land use controls (LUCs) be considered when PFCs are present?

Yes, LUCs can be a helpful risk management tool for ECs such as PFCs, which is consistent with DoD EC Instruction 4715.18. LUCs can be considered for sources of drinking water (i.e., a complete exposure pathway) that contain PFOA and PFOS above risk-based concentrations.

FAQ - Five-Year Review Issues

FY1. Should PFCs be considered during 5-Year Reviews?

PFCs should be considered during 5-year reviews if (1) it was a contaminant of concern in accordance with the DON 5-year Review Policy (DON 2011), or (2) it was not previously considered but the conceptual site model (CSM) indicates historical releases have occurred.

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