ASSISTANT SECRETARY OF DEFENSE
3400 DEFENSE PENTAGON
WASHINGTON, DC 20301-3400

ENERGY, INSTALLATIONS,
AND ENVIRONMENT

7/14/23

MEMORANDUM FOR ASSISTANT SECRETARY OF THE ARMY (INSTALLATIONS, ENERGY AND ENVIRONMENT)
ASSISTANT SECRETARY OF THE NAVY (ENERGY, INSTALLATIONS AND ENVIRONMENT)
ASSISTANT SECRETARY OF THE AIR FORCE (INSTALLATIONS, ENVIRONMENT AND ENERGY)
DIRECTOR, NATIONAL GUARD BUREAU (JOINT STAFF, J8)
DIRECTOR, DEFENSE LOGISTICS AGENCY (INSTALLATION MANAGEMENT)

SUBJECT: Guidance on Incineration of Materials Containing Per- and Polyfluoroalkyl Substances

This memorandum provides guidance for the incineration of materials containing Per- and Polyfluoroalkyl Substances (PFAS) within the Department of Defense (DoD). This memorandum cancels the Assistant Secretary of Defense for Energy, Installations, and Environment (ASD(EI&E)) memorandum, *Temporary Prohibition on Incineration of Materials Containing Per- and Polyfluoroalkyl Substances (PFAS)*, April 26, 2022 (Attachment 1).

On July 11, 2023, the PFAS Task Force issued, *Interim Guidance on Destruction or Disposal of Materials Containing Per- and Polyfluoroalkyl Substances in the United States*, which fulfills Section 343 of the National Defense Appropriations Act for Fiscal Year 2022 (Attachment 2). While incineration is included as an option within this guidance, additional planning and coordination time is necessary before incineration operations resume. The DoD Components are prohibited from resuming incineration of PFAS containing materials until authorized by memorandum from this office. No authorization to resume incineration of PFAS containing materials is forthcoming from this office for at least 45 days from date of signature.

The point of contact for this guidance is Ms. Alexandria Long, at 703-380-3245 or alexandria.d.long.civ@mail.mil.

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Brendan M. Owens

Attachments:
As stated

OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE
3400 DEFENSE PENTAGON
WASHINGTON, DC 20301-3400

ENERGY, INSTALLATIONS,
AND ENVIRONMENT

MEMORANDUM FOR ASSISTANT SECRETARY OF THE ARMY (INSTALLATIONS, ENERGY AND ENVIRONMENT)
ASSISTANT SECRETARY OF THE NAVY (ENERGY, INSTALLATIONS AND ENVIRONMENT)
ASSISTANT SECRETARY OF THE AIR FORCE (INSTALLATIONS, ENVIRONMENT AND ENERGY)
DIRECTOR, DEFENSE LOGISTICS AGENCY (INSTALLATION MANAGEMENT)

SUBJECT: Temporary Prohibition on Incineration of Materials Containing Per- and Polyfluoroalkyl Substances (PFAS)

Section 343 of the Fiscal Year (FY) 2022 National Defense Authorization Act (NDAA) requires DoD to prohibit the incineration of DoD PFAS materials after April 26, 2022, until DoD issues guidance implementing the U.S. Environmental Protection Agency (EPA) interim guidance on the destruction and disposal of PFAS, and section 330 of the FY 2020 NDAA. DoD is in the final stages of issuing this guidance and expects to finalize and issue that guidance in the near future.

Because DoD has not yet finalized the guidance required under Section 343, DoD Components must immediately discontinue contracting activities for the incineration of any PFAS material, including Aqueous Film Forming Foam (AFFF) concentrate, rinsate, and water mixture, and including any PFAS-containing media recovered during DoD's cleanup processes. Contracting activities subject to this temporary prohibition include issuances of new contracts and issuance of task orders on existing contracts.

DoD will lift this temporary prohibition upon issuance of guidance documents that comply with Section 343 of the FY 2022 NDAA. The point of contact for this guidance is Ms. Alexandria Long, at 703-380-3245 or alexandria.d.long.civ@mail.mil.

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Paul D. Cramer
Performing the Duties of Assistant Secretary of Defense for Energy, Installations, and Environment

Attachment 2

ASSISTANT SECRETARY OF DEFENSE
3400 DEFENSE PENTAGON
WASHINGTON, DC 20301-3400

ENERGY, INSTALLATIONS,
AND ENVIRONMENT

7/11/23

MEMORANDUM FOR ASSISTANT SECRETARY OF THE ARMY (INSTALLATIONS, ENERGY AND ENVIRONMENT)
ASSISTANT SECRETARY OF THE NAVY (ENERGY, INSTALLATIONS AND ENVIRONMENT)
ASSISTANT SECRETARY OF THE AIR FORCE (INSTALLATIONS, ENVIRONMENT AND ENERGY)
DIRECTOR, DEFENSE LOGISTICS AGENCY (LOGISTICS OPERATIONS)

SUBJECT: Interim Guidance on Destruction or Disposal of Materials Containing Per- and Polyfluoroalkyl Substances in the United States

The DoD Per- and Polyfluoroalkyl Substances (PFAS) Task Force issues this interim guidance to help DoD make informed decisions in the evaluation of existing destruction and disposal options, and to comply with section 343 of the FY 2022 National Defense Authorization Act (NDAA). Section 343 requires DoD to prohibit the incineration of covered DoD PFAS-containing materials[1] until DoD issues guidance implementing the U.S. Environmental Protection Agency (EPA) "Interim Guidance on the Destruction and Disposal of Perfluoroalkyl and Polyfluoroalkyl Substances and Materials Containing Perfluoroalkyl and Polyfluoroalkyl Substances," December 18, 2020 (hereinafter referred to as the EPA guidance), and section 330 of the FY 2020 NDAA.

Concurrent with its compliance with these requirements on PFAS destruction and disposal, DoD is transitioning to a PFAS-free firefighting agent for land-based applications over the next few years. DoD has determined that this transition, which requires the removal of PFAS-containing firefighting foam (i.e., Aqueous Film Forming Foam (AFFF)) from installation fire protection inventories, will generate large quantities of PFAS-containing concentrate and rinsate for which DoD must find a safe disposal solution. In addition, quantities of PFAS-containing material are generated from DoD's nationwide cleanup program, and recovery of emergency use discharges or spills of AFFF. Given these combined quantities, DoD's long-term storage capabilities will be exceeded and thus DoD requires a comprehensive destruction and disposal strategy.

In choosing among disposal options, one of the most significant factors for DoD was the additional oversight and controls provided at disposal and destruction facilities with

[1] PFAS-containing materials covered under this guidance includes all "covered material" under Section 343 of the FY 2022 NDAA, which means "any [Aqueous Film Forming Foam] AFFF formulation containing PFAS, material contaminated by AFFF release, or spent filter or other PFAS-contaminated material resulting from site remediation or water filtration that—

(A) has been used by the Department of Defense or a military department;
(B) is being discarded for disposal by the Department of Defense or a military department; or
(C) is being removed from sites or facilities owned or operated by the Department of Defense."

environmental permits. In issuing this guidance to comply with section 343 of the FY 2022 NDAA, DoD continues to recognize the statutory authority and responsibility of the EPA and State environmental regulatory agencies to regulate the disposal of wastes that may threaten human health or the environment.

Based on the analysis contained in Attachment 1 and consistent with the EPA guidance, DoD has identified the following four commercially available options to destroy or dispose of DoD PFAS-containing materials, in the order of consideration:

- Carbon reactivation units with environmental permits (for used granular activated carbon only).
- Hazardous waste landfills with environmental permits.
- Solid waste landfills with environmental permits that have composite liners, and gas and leachate collection and treatment systems.
- Hazardous waste incinerators with environmental permits.

In addition to these four DoD-wide options, the DoD Components are directed to consider onsite hazardous waste storage on a site-specific basis, for storage over ninety days. The DoD Components may also consider underground injection control on a site-specific basis. Third, the DoD Components, upon notification to the Office of the Assistant Secretary of Defense for Energy, Installations, and Environment (OASD(EI&E)), may also consider other existing and developing PFAS treatment or destruction technologies that are accepted/permitted by the appropriate State or Federal regulator, instead of utilizing hazardous waste incinerators, on a site-specific basis. The DoD Components, when selecting one of the options above for the destruction or disposal of PFAS-containing materials, including AFFF, must continue to make informed, fact-based decisions to mitigate the risk of PFAS releases to the environment for the protection of human health, consistent with the attached guidance and decision tree.

DoD continues to evaluate existing and developing PFAS destruction and disposal technologies, monitor studies on those technologies' effectiveness and potential environmental effects, and collaborate Administration-wide on best practices.For example, DoD's Strategic Environmental Research and Development Program has ongoing projects to develop an improved understanding of the effectiveness and sustainability of thermal destruction technologies for treatment of PFAS-containing materials. Of particular interest is the assessment of the fate and behavior of PFAS throughout the thermal treatment process. DoD also anticipates that EPA will be updating its guidance by December 2023. OASD(EI&E) will update this guidance annually to reflect changes as technologies mature, EPA updates its guidance, and additional data becomes available. The point of contact for this guidance is Ms. Alexandria Long, OASD(EI&E), at 703-571-9061 or alexandria.d.long.civ@mail.mil.

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Brendan M. Owens

Attachments:
As stated

Attachment 1 — DoD Guidance on Options for the Destruction and Disposal of PFAS-Containing Materials and Implementation of Section 343 of the FY 2022 NDAA

1. *DoD Implementation of the EPA's "Interim Guidance on the Destruction and Disposal of Perfluoroalkyl and Polyfluoroalkyl Substances and Materials Containing Perfluoroalkyl and Polyfluoroalkyl Substances," December 18, 2020*

The EPA issued the "Interim Guidance on the Destruction and Disposal of Perfluoroalkyl and Polyfluoroalkyl Substances and Materials Containing Perfluoroalkyl and Polyfluoroalkyl Substances," on December 18, 2020, (referred to as "the EPA guidance" in this document).[2] In the EPA guidance, EPA evaluated destruction and disposal technologies that are commercially available and have the potential to control the migration of PFAS to the environment and identified three destruction or disposal options: landfilling, thermal treatment, and underground injection. DoD reviewed the EPA guidance and is implementing that guidance through this interim policy. Specifically, DoD is using the EPA guidance to help DoD make informed decisions in the evaluation of existing destruction and disposal options, including the relative uncertainty associated with each technology's capability to control releases to the environment for the protection of human health. DoD is also implementing EPA's guidance on environmental justice considerations in disposal and destruction of PFAS-containing materials.

A. EPA Interim Guidance on Destruction and Disposal of PFAS and Materials Containing PFAS

EPA's guidance recognizes that interim storage is not a destruction or disposal method, but asserts that storage "may be an option" if the immediate destruction or disposal of PFAS-containing materials is "not imperative."[3] EPA defines "interim storage" as storage "estimated to be anywhere from 2 to 5 years."[4] EPA does not define the term "imperative." DoD finds that multi-year storage of large quantities of PFAS-containing materials is not a viable option, from either a safety, environmental, logistical, or economic perspective.[5] Thus, in general, DoD assesses that, due to the volume of PFAS-containing materials at issue, DoD will need to implement actual destruction or disposal solutions for those materials.

DoD is currently conducting cleanup investigations and response actions at over 700 military installations and State Guard facilities. These investigations and response actions generate PFAS-containing materials (e.g., granular activated carbon, soils, investigation-derived wastes). If DoD had to plan for, locate, and secure storage of all PFAS-containing materials at

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[2] "Interim PFAS Destruction and Disposal Guidance (Notice of Availability for Public Comment)." 85 Federal Register 83554 (Dec. 22, 2020).

[3] "Interim Guidance on the Destruction and Disposal of Perfluoroalkyl and Polyfluoroalkyl Substances and Materials Containing Perfluoroalkyl and Polyfluoroalkyl Substances," pp. 5. Environmental Protection Agency, 18 Dec. 2020, https://www.epa.gov/pfas/interim-guidance-destroying-and-disposing-certain-pfas-and-pfas-containing-materials-are-not. *Referred to as "EPA Interim PFAS Disposal Guidance (Dec. 2020)" in later footnotes.*

[4] EPA Interim PFAS Disposal Guidance (Dec. 2020), page 5.

[5] EPA's proposed PFAS National Primary Drinking Water Regulation similarly states: "As part of this rulemaking, EPA considered that in drinking water treatment, large volumes of spent [granular activated carbon] and ion exchange resin must be removed which does not lend itself to on-site storage over time. The disposal options identified in the Interim Guidance (US EPA, 2020b) are landfill disposal and thermal treatment." 88 Federal Register at 18686 (Mar. 29, 2023).

applicable DoD/Guard facilities, these storage requirements would affect the pace of this necessary cleanup. In addition, the storage would generate its own risks of release to the environment.

DoD is also required to transition to a new firefighting agent for land-based applications and remove existing AFFF. The volume of AFFF that requires disposal is estimated to be over 2 million gallons. DoD does not have the warehouse capacity to properly and safely store this AFFF and associated rinsate at individual bases. DoD also is concerned with the risks of release to the environment from storage and believes that secondary containment would be needed to contain releases of PFAS. Storage areas at individual military installations or Guard facilities, where these PFAS-containing materials could potentially be stored if space was available, are not likely to have secondary containment. Building additional storage capacity, to include the necessary contracting actions, would negatively affect the pace of these required cleanup and AFFF replacement activities. While DoD believes it does not have the capacity to properly store all PFAS-containing materials at its facilities, and thus disposal or destruction of those materials is imperative, the DoD Components are directed to consider if onsite hazardous waste storage capacity exists for storage over ninety days at an individual military installation.

DoD next considered all the existing destruction and disposal options identified in the EPA guidance to identify options that are protective of human health and the environment. EPA identified several factors to consider in determining how to destroy or dispose of PFAS-containing materials:

- The relative uncertainty associated with the technologies' capabilities to control migration of PFAS,
- Whether it is imperative to destroy or dispose of these materials versus storing it and waiting for uncertainties to be reduced,
- The cost and availability of destruction and disposal options,
- The type of waste materials,
- The concentrations of PFAS in the waste, and
- Health risks from PFAS releases, especially for potentially vulnerable populations [6]

The first option DoD considered was deep well injection. EPA acknowledged deep well injection has the capability to control migration of PFAS to the environment, and the limited number of these wells currently receiving PFAS "may significantly limit the practicability of this disposal option."[7] Because of the limited availability of deep well injection locations, use for only liquid materials, and the volume of disposal required for DoD PFAS-containing materials, DoD believes this disposal option will rarely be an available option for DoD. DoD, however, has identified deep well injection as a disposal option that maximizes reduction of PFAS releases or emissions to the environment and human health exposures, and the DoD Components may consider whether deep well injection is an available and cost-effective option at an individual military installation.

[6] EPA Interim PFAS Disposal Guidance (Dec. 2020), pages 5 and 83.
[7] EPA Interim PFAS Disposal Guidance (Dec. 2020), pages 5-6.

Consistent with the EPA guidance, DoD next considered permitted hazardous waste landfills. Hazardous waste landfills "have the most stringent environmental controls in place and higher potential capacity to manage the migration of PFAS into the environment."[8] Hazardous waste landfills are "more effective at minimizing PFAS migration into the environment than other landfill types."[9] Because "permitted hazardous waste landfills employ the most extensive set of environmental controls (e.g., double liner systems with leachate collection and leak detection) and practices (e.g., extensive record keeping) that are currently available for the containment of PFAS waste," DoD has identified these landfills as an available disposal option that maximizes reduction of PFAS releases or emissions to the environment and human health exposures.[10]

DoD next considered solid waste landfills. The EPA guidance identifies a variety of solid waste landfills: municipal solid waste, ash monofill, industrial, and construction and demolition landfills.[11] Because environmental controls can vary at landfills, EPA evaluated the viability of landfilling as a means of containing PFAS. Modern solid waste landfills "when constructed with appropriate controls (e.g., liner system and leachate and gas collection and management systems), can also control the migration of PFAS into the environment."[12] DoD has identified solid waste landfills with these controls in place (composite liner and gas and leachate collection and management) as an available disposal option that maximizes reduction of PFAS releases or emissions to the environment and human health exposures. Any solid waste landfill DoD uses for PFAS-containing materials must have a composite liner, gas and leachate collection and management systems, and an environmental permit.

The DoD Components, consistent with the Decision Tree in Attachment 2, will need to consider the type of PFAS-containing materials when considering the use of both hazardous waste and solid waste landfills. For example, liquids must be solidified to remove any free liquids before disposal in a landfill, which may increase the volume significantly (e.g., threefold).[13] The cost and availability of all destruction and disposal options are additional considerations that need evaluation.

DoD next considered thermal treatment technologies, recognizing that these options have higher levels of uncertainties regarding their capacity to control the migration of PFAS into the environment. Thermal treatment technologies include a wide-variety of technologies and controls, including hazardous waste combustors (e.g., incinerators, cement kilns, lightweight aggregate kilns), as well as other thermal treatment (e.g., carbon reactivation units, sewage sludge incinerators, municipal waste combustors, thermal oxidizers).[14] EPA, notwithstanding its acknowledgment of uncertainties with PFAS thermal treatment technologies, recognized that the subset of permitted hazardous waste combustors "may operate under conditions more conducive to destroying PFAS and controlling related [products of incomplete combustion] PICs relative to

[8] EPA Interim PFAS Disposal Guidance (Dec. 2020), page 5.
[9] EPA Interim PFAS Disposal Guidance (Dec. 2020), page 6.
[10] EPA Interim PFAS Disposal Guidance (Dec. 2020), page 6.
[11] EPA Interim PFAS Disposal Guidance (Dec. 2020), page 56.
[12] EPA Interim PFAS Disposal Guidance (Dec. 2020), page 55.
[13] https://www.geoengineer.org/education/web-class-projects/cee-549-geoenvironmental-engineering-winter-2013/assignments/stabilization-solidification ("Volume of the treated wastes usually increases significantly")
[14] EPA Interim PFAS Disposal Guidance (Dec. 2020), page 6.

thermal treatment units that do not have both [Resource Conservation and Recovery Act] RCRA and [Clean Air Act] CAA permits."[15] EPA also recognized that permitted hazardous waste incinerators "are designed to optimize temperatures, residence times, turbulence, and other parameters" to "maximize organic destruction and minimize the formation of PICs."[16] These controls include pollution control devices which can remove hydrogen fluoride and other products of combustion.[17] After considering the latest studies and additional information[18] presented in the next section of this guidance on implementation of section 330 of the FY 2020 NDAA, DoD has identified hazardous waste incinerators as an available destruction option that maximizes reduction of PFAS releases or emissions to the environment and human health exposures.

Because DoD, and others, have widely utilized granular activated carbon (GAC) to remove PFAS from drinking water and groundwater, and "GAC reactivation is economically favored over replacement with virgin carbon,"[19] DoD also considered carbon reactivation units.[20] While carbon reactivation units "use high temperatures to thermally desorb contaminants from GAC, which allows for the carbon to be used again,"[21] they are not "incinerators" and instead are a form of recycling/preserving virgin materials. While there are about seventeen commercial carbon reactivation units across the country, currently only four "operate under RCRA permits and applicable air permits" which "provide additional regulatory oversight and include operating requirements and emission limitations to safely and effectively treat the hazardous contaminants."[22] Due to these additional safeguards, RCRA-permitted carbon reactivation units "may operate under conditions more conducive to destroying PFAS and controlling related PICs."[23] Therefore, DoD has identified RCRA permitted carbon reactivation units as an available destruction option to address PFAS-containing GAC that maximizes reduction of PFAS releases or emissions to the environment and human health exposures.

B. EPA Guidance on Environmental Justice

DoD also considered section 4 of the EPA guidance, which addresses environmental justice and impacts on vulnerable communities. The recent April 2023 Executive Order on "Revitalizing Our Nation's Commitment to Environmental Justice for All",[24] emphasizes that every person has a right to breathe clean air, drink clean water, and live in a healthy community. Under Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations", Federal agencies are directed to identify and address,

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[15] EPA Interim PFAS Disposal Guidance (Dec. 2020), page 35.
[16] EPA Interim PFAS Disposal Guidance (Dec. 2020), page 35.
[17] EPA Interim PFAS Disposal Guidance (Dec. 2020), pages 33-35.
[18] Several of those studies post-date EPA's December 2020 Guidance and its findings on relative uncertainty.
[19] EPA Interim PFAS Disposal Guidance (Dec. 2020), page 95.
[20] EPA's proposed PFAS National Primary Drinking Water Regulation similarly states: "At present, the most likely management option for spent materials containing PFAS is reactivation for GAC and incineration for spent IX resin." 88 Federal Register at 18686 (Mar. 29, 2023).
[21] EPA Interim PFAS Disposal Guidance (Dec. 2020), page 36.
[22] EPA Interim PFAS Disposal Guidance (Dec. 2020), page 36.
[23] EPA Interim PFAS Disposal Guidance (Dec. 2020), page 36.
[24] "Executive Order 14096 of April 21, 2023, Revitalizing Our Nation's Commitment to Environmental Justice for All," *Federal Register* 88, no. 80 (April 26, 2023): 25251-25261. https://www.govinfo.gov/content/pkg/FR-2023-04-26/pdf/2023-08955.pdf.

as appropriate, "disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations."[25] In Executive Order 14008, "Tackling the Climate Crisis at Home and Abroad," Federal agencies shall "develop programs, policies, and activities to address the disproportionately high and adverse human health, environmental, climate-related and other cumulative impacts on disadvantaged communities, as well as the accompanying economic challenges of such impacts."[26] DoD is also a signatory to a Memorandum of Understanding on Environmental Justice, and a member of the Environmental Justice Interagency Council under these Executive Orders. DoD considered these White House documents, as well as the EPA guidance, in determining what currently available disposal and destruction options should be included in this interim guidance.

As the EPA guidance notes, certain communities "may be highly exposed to environmental contaminants because they live or work near the sources of release or presence in the environment."[27] This includes "those living near and using PFAS-contaminated environments (e.g., drinking water, fishing, hunting, and recreation)."[28] DoD acknowledges that many of the communities surrounding our military installations are communities with environmental justice concerns. We have prioritized our cleanup program to address the highest risks first, regardless of the community demographics, and address exposures (e.g., drinking water) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, also known as Superfund). Environmental justice principles are incorporated into CERCLA through public participation in the cleanup process, as well as the additional public outreach and engagement that DoD conducts (e.g., Restoration Advisory Boards). It is this cleanup program that addresses high exposures to PFAS that generates a large volume of PFAS-containing materials for disposal. Impact on vulnerable communities is thus addressed primarily in our cleanup program, and we support the Superfund Community Involvement Toolkit referenced in the EPA guidance. DoD is working on improving its public outreach and community dialogue for our PFAS cleanups through expanded public outreach at both senior leadership and local levels, a more user-friendly DoD PFAS website, and updating our Restoration Advisory Board guidance. We also note that EPA's Office of Land and Emergency Management is working with DoD and State representatives to develop "approaches to characterizing communities adjacent to three federal facility [National Priority List] NPL sites, to identify those with [Environmental Justice] EJ concerns."[29] When completed, these projects will inform EPA's understanding of best practices and be publicly shared. DoD supports this approach.

We also considered the vulnerable communities that exist near landfills and hazardous waste incinerators. We found this to be more complex in helping to choose among existing

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[25] "Executive Order 12898 of February 11, 1994, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," *Code of Federal Regulations,* title 3 (1994): 1-101, https://www.archives.gov/files/federal-register/executive-orders/pdf/12898.pdf.
[26] "Executive Order 14008 of January 27, 2021, Tackling the Climate Crisis at Home and Abroad," *Federal Register* 86, no. 19 (February 1, 2021): 7619-7633, https://www.govinfo.gov/content/pkg/FR-2021-02-01/pdf/2021-02177.pdf.
[27] EPA Interim PFAS Disposal Guidance (Dec. 2020), page 87.
[28] EPA Interim PFAS Disposal Guidance (Dec. 2020), page 87.
[29] EPA Office of Land and Emergency Management, "EJ Action Plan. Building Up Environmental Justice in EPA's Land Protection and Cleanup Programs (Sept. 2022), page 25.

disposal and destruction options. For example, studies have identified that a disproportionate number of landfills and other hazardous waste facilities, such as incinerators, are located in communities with environmental justice concerns. DoD also used EPA's Environmental Justice Screening and Mapping Tool ("EJScreen")[30] to identify potentially impacted communities living near PFAS destruction or disposal sites identified in this guidance, as well as communities surrounding our military installations where PFAS cleanups are ongoing and AFFF will be replaced. DoD also considered the relative risk between its top priority of addressing elevated levels of PFAS in drinking water from DoD activities versus indirect potential PFAS exposures from destruction and disposal facilities.

In choosing among disposal options, however, one of the most significant factors for DoD was the additional oversight and controls provided at disposal and destruction facilities with environmental permits. We recognize the statutory authority and responsibility of the EPA and State environmental regulatory agencies to regulate the disposal of wastes that may threaten human health or the environment, and to issue environmental permits that are protective of human health and the environment. Section 4 of the EPA guidance thus focuses on considering vulnerable populations and community engagement in the regulatory siting or permitting processes for destruction and disposal facilities. DoD acknowledges that more work is needed to ensure that the impacts associated with the operation of destruction and disposal facilities are equitable. While DoD does not have a regulatory role, we encourage regulators and disposal facilities to consider PFAS in these regulatory processes. In addition, to facilitate engagement with communities near our military installations, as well as possibly adjacent to PFAS destruction and disposal facilities, we have developed a DoD PFAS Disposal Fact Sheet that will be posted on our DoD PFAS website (https://www.acq.osd.mil/eie/eer/ecc/pfas/index.html). This fact sheet summarizes this DoD PFAS disposal guidance, provides background information on PFAS and potential health effects based on EPA and the Agency for Toxic Substances and Disease Registry statements, and provides information on how DoD is incorporating environmental justice principles when addressing PFAS. DoD will also explore new partnership opportunities with EPA and other federal agencies to advance environmental justice issues in accordance with Executive Order 14096.

C. DoD Implementation

DoD is therefore identifying the following options, **in order of priority**, for the DoD Components to utilize for the destruction or disposal of PFAS-containing materials, including AFFF, that are not hazardous wastes:[31]

- **Carbon reactivation units with environmental permits (for used GAC only).** GAC is a common PFAS water treatment technique where PFAS attaches to the

[30] See https://www.epa.gov/ejscreen.

[31] Hazardous waste is regulated pursuant to RCRA authority. See 42 U.S.C. § 6903. The regulatory definition of hazardous waste is found in 40 CFR § 261.3. PFAS is currently not a listed or characteristic hazardous waste, but a PFAS-containing material may meet the regulatory definition of hazardous waste if PFAS is mixed with a listed hazardous waste or if a PFAS-containing mixture exhibits a hazardous characteristic (e.g., ignitability). Materials that qualify as a RCRA hazardous waste must follow RCRA storage and disposal requirements and are outside of the scope of this guidance.

carbon until the carbon is full. Carbon reactivation units use high temperatures to thermally treat contaminants collected in GAC, which allows for the carbon to be used again. Carbon reactivation units permitted under RCRA and the CAA have additional regulatory oversight and include operating requirements and emission limitations to safely and effectively treat hazardous contaminants.

- **Hazardous waste landfills with environmental permits.** These landfills have stringent environmental controls in place to manage the migration of PFAS into the environment. Permitted hazardous waste landfills employ the most extensive set of environmental controls (e.g., double liner systems with leachate collection and leak detection) and practices (e.g., extensive record keeping) that are currently available for the containment of PFAS waste.
- **Solid waste landfills with environmental permits that have composite liners, and gas and leachate collection and treatment systems.** Modern municipal solid waste landfills, when constructed with appropriate controls (e.g., liner system, leachate and gas collection and management systems, permits), can also control the migration of PFAS into the environment.
- **Hazardous waste incinerators with environmental permits**. These high temperature incinerators have stringent regulatory controls on temperature and other operating parameters to achieve a 99.99 percent destruction efficiency for other (non-PFAS) organic chemicals, and evidence suggests that a similar destruction efficiency may apply to PFAS-containing materials (see below). Currently, thermal treatment is the only commercially available technology that has the potential capability to destroy PFAS, rather than contain it.

In addition to these four DoD-wide options, the DoD Components are directed to consider onsite hazardous waste storage on a site-specific basis, for storage over ninety days. The DoD Components may also consider underground injection control, on a site-specific basis. Third, the DoD Components, upon notification to OASD(EI&E), may also consider other existing and developing PFAS treatment or destruction technologies that are accepted/permitted by the appropriate State or Federal regulator, *instead of* utilizing hazardous waste incinerators, on a site-specific basis. For example, at one site with a large volume of PFAS-impacted soils, where landfills were not an option in that State, OASD(EI&E) was notified that a State permitted thermal desorption unit would be considered rather than hazardous waste incineration. The DoD Components, when selecting one of the options above for the destruction or disposal of PFAS-containing materials, must continue to make informed decisions consistent with this guidance and the Decision Tree.

2. DoD Implementation of Section 330 of the FY 2020 NDAA

Section 330 of the FY 2020 NDAA requires DoD to ensure that when PFAS-containing materials or AFFF are disposed:

> "(1) all incineration is conducted at a temperature range adequate to break down PFAS chemicals while also ensuring the maximum degree of reduction in emission of PFAS, including elimination of such emissions where achievable;
> (2) all incineration is conducted in accordance with Clean Air Act (42 USC 7401 et seq.), including controlling hydrogen fluoride;

(3) any materials containing PFAS that are designated for disposal are stored in accordance with the requirement under part 264 of title 40, Code of Federal Regulations; and
(4) all incineration is conducted at a facility that has been permitted to receive waste regulated under [the Resource Conservation and Recovery Act][32] (42 USC 6921 et seq.)."

This guidance addresses the second, third, and fourth criteria together, followed by the first criterion.

The second criterion in section 330 requires that all incineration of PFAS-containing materials is conducted in accordance with CAA requirements. The third criterion in section 330 requires that PFAS-containing materials stored at hazardous waste combustors prior to incineration be stored in accordance with RCRA requirements. The fourth criterion in section 330 requires that incineration is conducted at a RCRA-permitted hazardous waste facility. **Based upon the review of these three criteria, if a DoD Component chooses to incinerate PFAS-containing materials in its custody, the DoD Component must send those PFAS-containing materials, including AFFF, only to RCRA- and CAA-permitted Hazardous Waste Incinerators (HWIs)**. RCRA-permitted HWIs with CAA Title V permits operate under conditions that represent the maximum commercially available destruction efficiencies for PFAS, including the control of hydrogen fluoride and other PICs. Additionally, RCRA- and CAA-permitted HWIs have experience in the proper storage of regulated hazardous wastes and must comply with part 264 of title 40, Code of Federal Regulations, concerning storage of material at their facilities. Therefore, the DoD Components will implement the CAA and RCRA permit and storage criteria in section 330 by ensuring that the HWIs utilized for the incineration of PFAS-containing materials, including AFFF, have valid RCRA and CAA operating permits.

The first criterion in section 330 requires that if DoD sends PFAS-containing materials to incinerators, the incinerators utilize a temperature range adequate to break down PFAS while also minimizing emissions of PFAS. Because the second, third, and fourth criterion in section 330 require incineration at permitted HWIs and because these permitted facilities are required to maintain minimum temperature thresholds, DoD used those minimum thresholds in determining whether it can reasonably conclude that its candidate HWIs will achieve the requirements of the first criterion in section 330.

A. Relevant RCRA and CAA permitting requirements

The regulatory requirements for RCRA- and CAA-permitted HWIs are summarized as follows:

RCRA-permitted HWIs must follow stringent regulatory requirements and are required by EPA to conduct testing to determine a Destruction and Removal Efficiency (DRE). The key factors in achieving a high DRE are time in the incinerator (residence time), high temperature, and turbulence (i.e., mixing). The purpose of DRE testing is to demonstrate that virtually all the molecules of a surrogate compound are destroyed in the incinerator.

[32] The Solid Waste Disposal Act of 1965 is commonly referred to as the Resource Conservation and Recovery Act (RCRA), which significantly amended the Solid Waste Disposal Act, in 1976.

For HWIs, EPA requires a minimum DRE of 99.99%. During DRE testing, a surrogate compound is fed into the incinerator that represents classes of compounds that are extremely difficult to destroy. EPA has developed a system of ranking these surrogate compounds, based on their difficulty to destroy. After a 99.99% DRE is achieved, EPA or the delegated State, issues a CAA Title V permit that includes requirements for operation. This includes a high temperature range and other parameters that are continuously monitored, and if not complied with, the incinerator will stop the flow of materials to the combustion unit automatically and immediately.

While there are several operating conditions specified in a HWI permit, the first criterion in section 330 focuses on a temperature range adequate to break down PFAS. DoD reviewed minimum temperatures specified in nine existing HWI permits to achieve their DRE and found their permits require a minimum temperature in the kiln that range from 1200°F to 1824°F. At these facilities, the kiln is followed by an afterburner/secondary combustion chamber to maximize organic destruction and their permits require a minimum temperature in the afterburner/secondary combustion chamber that ranges from 1488°F to 2026°F. Based on the studies and information described below, HWIs at their permitted temperature range will be adequate to break down detectable PFAS chemicals.

B. Existing Data on Destruction Capabilities of Incinerators

EPA's guidance contains the following findings on the destruction capabilities of HWIs:

HWIs are designed to optimize temperatures, residence times, turbulence, and other parameters to ensure compliance with organic DRE requirements. Most commercial HWIs use rotary kilns…that maintain high temperatures. Typically, solids retention time in the kiln is 0.5 to 1.5 hours, while gas residence time through the kiln is usually around two seconds. Kiln flame/solids temperatures range from 650°C to 1,650°C (1,200°F to 3,000°F). The rotary kiln is followed by an afterburner where additional high-heating-value gaseous and liquid wastes, and auxiliary fuels are added. The afterburner is typically operated at about 1,100°C to 1,370°C (2,000°F to 2,500°F) with a gas residence time from 1 to 3 seconds to maximize organic destruction and minimize the formation of PICs.[33]

Studies and information on PFAS destruction indicate that the temperature ranges used in these types of HWIs are effective in destroying the 50 PFAS that can currently be detected in air emissions through an EPA methodology:

- In 2021, EPA began conducting pilot-scale PFAS incineration studies using its "Rainbow" furnace, which allows EPA to conduct incineration experiments under controlled conditions.[34] This research identified fluorocarbon tracer gases (surrogates) that could potentially be used to monitor destruction efficiencies during incineration, and then began experiments. The first publication from these

[33] EPA Interim PFAS Disposal Guidance (Dec. 2020), page 35.
[34] "Combustion of C_1 and C_2 PFAS: Kinetic Modeling and Experiments," Krug et al., *Journal of the Air & Waste Management Association*. 2022, 72:3, 256-270. Published Feb. 11, 2022.

experiments suggests that PFAS can be destroyed when subjected to aggressive thermal environments above 1100°C. EPA is also conducting experiments to understand the incineration of PFAS present in AFFF.[35]

- In 2021, the New York State Department of Environmental Conservation (NYSDEC) announced that it had completed a study to determine if the thermal treatment of PFAS-containing materials at the Norlite facility in Cohoes, New York, resulted in soil and surface water contamination. The Norlite facility is a RCRA- and CAA-permitted hazardous waste combustor that had treated AFFF over a number of years. This NYSDEC study found no clearly discernible pattern of aerial deposition of PFAS that could be traced to Norlite's operations. Sampling identified low-level detections of PFAS compounds in all soil samples collected at upwind, downwind, and at background locations, consistent with emerging research on the prevalence of PFAS in urban, suburban, and rural environments. Concentrations of PFAS found in soils in the vicinity of the facility were below guidance values NYSDEC developed, indicating that the facility successfully destroyed the PFAS material and did not emit traceable amounts of PFAS during combustion.[36]
- In 2021, a commercial RCRA- and CAA permitted HWI conducted a PFAS-specific study. In this study, AFFF was added in high concentrations to a waste feed, and sampled at various times throughout the incineration process. A 99.9999% DRE was obtained for Perfluorooctanesulfonic Acid, Perfluorooctanoic Acid, Perfluorohexane Sulfonic Acid, and hexafluoropropylene oxide dimer acid (otherwise known as Gen-X) at a temperature of 1800 °F. The study determined that the 50 specific PFAS that can currently be measured were turned into hydrogen fluoride, which was trapped in the air pollution control system.[37] To measure PFAS air emissions, this study utilized EPA test method OTM-45, published in 2021, for stack gas sampling of PFAS air emissions during this testing program. This study has undergone EPA and peer review, and became publicly available in August 2022.[38]
- In 2022, a literature review covering 163 published works on thermal treatment of PFAS was published.[39] This paper suggests that "complete combustion of PFAS will likely be most successful in incinerators that employ a two-stage process. In these, the waste is first fed into the primary combustion chamber where PFAS desorb and partially degrade. The gaseous byproducts are sent to a secondary chamber (the afterburner) that operates in excess air (stoichiometric excess of oxygen) at high

[35] Shields, E. "ER21-1288: Multi-Scale Evaluation of PFAS Thermal Destruction Requirements." Strategic Environmental Research and Development Program In-Progress Review Meeting, Aug. 17, 2022 (Virtual).
[36] *Norlite Environmental Sampling Report*, pp 25-26. New York State Department of Environmental Conservation, March 2021, https://www.dec.ny.gov/docs/materials_minerals_pdf/norlitesamplingfull0321.pdf.
[37] EPA's Interim PFAS Disposal Guidance (Dec. 2020), page 34, recognizes that hydrogen fluoride is a break-down product of PFAS destruction, and is captured in air pollution control devices. ("…PFAS destruction is defined as the complete severing of all carbon-fluorine bonds in a PFAS molecule. Severing all carbon-fluorine bonds results in conversion to carbon dioxide, hydrogen fluoride (HF), and other compounds. HF and some of the other products of combustion can be removed in pollution control devices.").
[38] http://cleanharbors.dev-cleanharbors.acsitefactory.com/services/industrial-field-services/field-services/PFAS-PFOA-PFOS-Remediation
[39] "Critical Review of Thermal Decomposition of Per- and Polyfluoroalkyl Substances: Mechanisms and Implications for Thermal Treatment Processes," Wang et al., *Environ. Sci. Technol*. 2022, 56, 5355-5370. Published April 21, 2022.

> temperature (>950 °C) and short residence times (1-3 seconds)."[40] DoD notes that HWIs employ this two-stage process. This paper also stated that the "general consensus across these lab-scale studies is that even the most stable PFAS (e.g., long-chain sulfonates) desorb at temperatures less than 1000°C, and they are destroyed in the gas phase at temperatures greater than 1000°C."[41]

DoD acknowledges that the studies mentioned above and the EPA guidance identified uncertainties regarding PFAS thermal treatment. According to the EPA guidance:

> Key uncertainties include the lack of PFAS-specific information on these facilities. EPA currently has no emission characterizations from these sources when they burn PFAS, and is working to develop measurement methodologies as well as gather information to conclude whether potential [PICs] are adequately controlled. EPA recognizes that PICs are formed (even for nonfluorinated compounds); however, based on the unique characteristics of fluorine combustion chemistry, it needs to be determined whether thermal treatment devices and their associated post-combustion control devices are controlling fluorinated PICs.[42]

EPA, notwithstanding its general finding that there are uncertainties with PFAS thermal treatment technologies, recognized that there is less uncertainty for the permitted facilities that DoD will use for incineration if other disposal options are not deemed viable. According to EPA, the subset of permitted HWIs "may operate under conditions more conducive to destroying PFAS and controlling related PICs relative to thermal treatment units that do not have both RCRA and CAA permits." [43] EPA also recognized that permitted HWIs "are designed to optimize temperatures, residence times, turbulence, and other parameters" to "maximize organic destruction and minimize the formation of PICs." [44] These controls include pollution control devices which can remove hydrogen fluoride and other products of combustion.[45]

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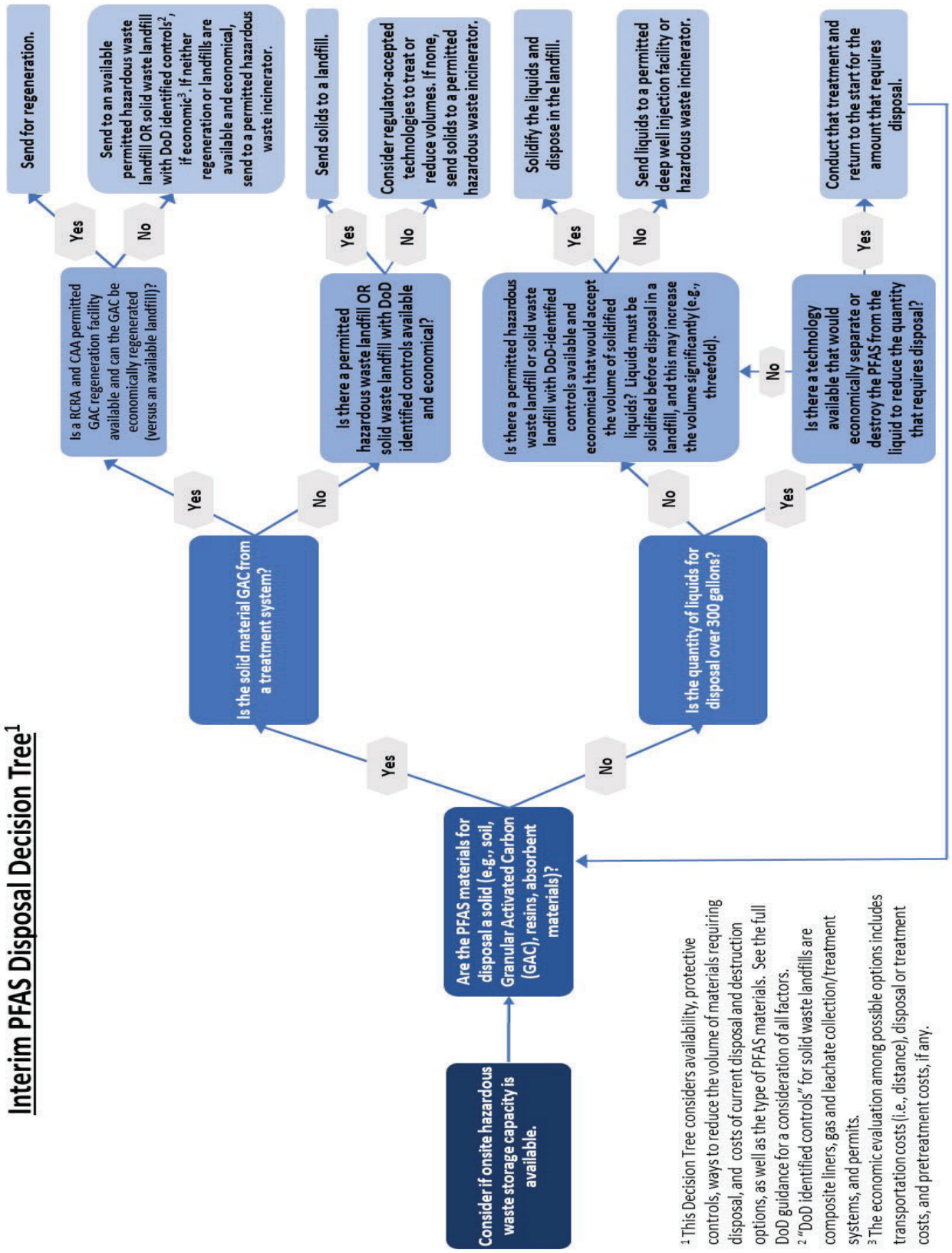
[40] *Id.* at page 5363.
[41] *Id.* at page 5363.
[42] EPA Interim PFAS Disposal Guidance (Dec. 2020), page 6.
[43] EPA Interim PFAS Disposal Guidance (Dec. 2020), page 35.
[44] EPA Interim PFAS Disposal Guidance (Dec. 2020), page 35.
[45] EPA Interim PFAS Disposal Guidance (Dec. 2020), pages 33-35, 42-43.

3. DoD's Finding

In light of the 2021 PFAS air emission methodology and studies identified above, including at a full-scale RCRA- and CAA-permitted HWI, DoD finds that incineration at these facilities at their permitted temperature range will be adequate to break down detectable PFAS chemicals while also ensuring the maximum degree of reduction in emission of detectable PFAS. Based on the above studies and information that show HWI permits specify a temperature range and other operating parameters to achieve a 99.99% DRE, and HWIs are required to have air emission control devices, RCRA- and CAA permitted HWIs meet section 330's requirements for an adequate temperature range to break down PFAS that currently can be detected in air emissions and meet emission reduction requirements. Additional research is underway, and DoD will update this guidance annually to reflect changes as technologies mature, EPA updates its guidance, and additional data, including air emission detection methods, becomes available.

Attachment 2 –DoD PFAS Disposal Decision Tree