

ENVIRONMENTAL PROTECTION AGENCY**40 CFR Part 82**

[EPA-HQ-OAR-2015-0663; FRL-9952-18-OAR]

RIN 2060-AS80

Protection of Stratospheric Ozone: New Listings of Substitutes; Changes of Listing Status; and Reinterpretation of Unacceptability for Closed Cell Foam Products Under the Significant New Alternatives Policy Program; and Revision of Clean Air Act Section 608 Venting Prohibition for Propane**AGENCY:** Environmental Protection Agency (EPA).**ACTION:** Final rule.

SUMMARY: Pursuant to the U.S. Environmental Protection Agency's (EPA) Significant New Alternatives Policy program, this action lists certain substances as *acceptable, subject to use conditions*; lists several substances as *unacceptable*; and changes the listing status for certain substances from *acceptable* to *acceptable, subject to narrowed use limits*, or to *unacceptable*. This action also exempts propane in certain refrigeration end-uses from the Clean Air Act section 608 prohibition on venting, release, or disposal. In addition, this action applies unacceptability determinations for foam-blowing agents to closed cell foam products and products containing closed cell foam that are manufactured or imported using these foam blowing agents.

DATES: This rule is effective January 3, 2017. The incorporation by reference of certain publications listed in the rule is approved by the Director of the Federal Register as of January 3, 2017.

ADDRESSES: EPA has established a docket for this action under Docket ID No. EPA-HQ-OAR-2015-0663. All documents in the docket are listed on the <http://www.regulations.gov> Web site. Although listed in the index, some information is not publicly available, e.g., confidential business information (CBI) or other information whose disclosure is restricted by statute. Certain other material, such as copyrighted material, is not placed on the Internet and will be publicly available only in hard copy form. Publicly available docket materials are available electronically through <http://www.regulations.gov> or in hard copy at the Air and Radiation Docket, EPA/DC, EPA West, Room 3334, 1301 Constitution Avenue NW., Washington, DC The Public Reading Room is open

from 8:30 a.m. to 4:30 p.m., Monday through Friday, excluding legal holidays. The telephone number for the Public Reading Room is (202) 566-1744, and the telephone number for the Air and Radiation Docket is (202) 566-1742.

FOR FURTHER INFORMATION CONTACT: Chenise Farquharson, Stratospheric Protection Division, Office of Atmospheric Programs (Mail Code 6205T), Environmental Protection Agency, 1200 Pennsylvania Ave. NW., Washington, DC 20460; telephone number: 202-564-7768; email address: Farquharson.chenise@epa.gov. Notices and rulemakings under EPA's Significant New Alternatives Policy program are available on EPA's Stratospheric Ozone Web site at <https://www.epa.gov/snap/snap-regulations>.

SUPPLEMENTARY INFORMATION:**Table of Contents**

- I. General Information
 - A. Executive Summary
 - B. Does this action apply to me?
 - C. What acronyms and abbreviations are used in the preamble?
- II. How does the SNAP program work?
 - A. What are the statutory requirements and authority for the SNAP program?
 - B. What are EPA's regulations implementing CAA section 612?
 - C. How do the regulations for the SNAP program work?
 - D. What are the guiding principles of the SNAP program?
 - E. What are EPA's criteria for evaluating substitutes under the SNAP program?
 - F. How are SNAP determinations updated?
 - G. What does EPA consider in deciding whether to add a substance to or remove a substance from one of the SNAP lists?
 - H. Where can I get additional information about the SNAP program?
- III. What actions and information related to greenhouse gases have bearing on this action?
- IV. How does this action relate to the Climate Action Plan and petitions received requesting a change in listing status for HFCs?
 - A. Climate Action Plan
 - B. Summary of Petitions
- V. How does EPA regulate substitute refrigerants under CAA section 608?
 - A. What are the statutory requirements concerning venting, release, or disposal of refrigerants and refrigerant substitutes under CAA section 608?
 - B. What are EPA's regulations concerning venting, release, or disposal of refrigerant substitutes?
- VI. What is EPA finalizing in this action?
 - A. Refrigeration and Stationary Air Conditioning
 1. Acceptable Listing of Propane in New Commercial Ice Machines, Water Coolers, and Very Low Temperature Refrigeration Equipment
 2. Exemption for Propane from the Venting Prohibition Under CAA Section 608 for the End-Uses in the New SNAP Listing

3. Unacceptable Listing of Certain Flammable Refrigerants for Retrofits in Unitary Split AC Systems and Heat Pumps
4. Unacceptable Listing of Propylene and R-443A in New Residential and Light Commercial AC and Heat Pumps, Cold Storage Warehouses, and Centrifugal and Positive Displacement Chillers
5. Change of Listing Status for Certain HFC Refrigerants for New Centrifugal Chillers and for New Positive Displacement Chillers
6. Change of Listing Status for Certain HFC Refrigerants for New Cold Storage Warehouses
7. Change of Listing Status for Certain HFC Refrigerants for New Retail Food Refrigeration (Refrigerated Food Processing and Dispensing Equipment)
8. Change of Listing Status for Certain HFC Refrigerants for New Household Refrigerators and Freezers
- B. Motor Vehicle Air Conditioning
 1. Background
 2. What is EPA's final decision?
 3. How is EPA responding to comments?
- C. Foam Blowing Agents
 1. Change of Listing Status for Certain HFC Foam Blowing Agents for Rigid PU Spray Foam
 2. Revision to Change of Status Date for Narrowed Use Limits for Space- and Aeronautics-Related Foam Applications
 3. Change of Listing Status for Methylene Chloride in Foams
 4. Closed Cell Foam Products
 - D. Fire Suppression and Explosion Protection
 1. Acceptable Listing of 2-BTP for Total Flooding and Streaming
 2. Change of Listing Status for Certain Perfluorocarbons for Total Flooding
 3. Removal of Use Conditions for Powdered Aerosol D
- VII. How is EPA responding to other public comments?
 - A. General Comments
 1. Proposed Status Listing Changes
 2. Proposed Status Change Dates
 - B. Authority
 1. General Authority
 2. GWP Considerations
 3. SNAP Review Criteria and Guiding Principles
 4. Petitions
 5. Application of Criteria for Review of Alternatives
 - C. Cost and Economic Impacts
 1. Costs of Rule
 2. EPA's Cost Analysis and Small Business Impacts Screening Analysis
 - D. Environmental Impacts of Status Changes
 1. General Comments
 2. EPA's Climate Benefits Analysis
 3. Energy Efficiency
 - E. Interactions With Other Rules
 - F. Other Suggestions or Requests
- VIII. Statutory and Executive Order Reviews
 - A. Executive Order 12866: Regulatory Planning and Review and Executive Order 13563: Improving Regulation and Regulatory Review
 - B. Paperwork Reduction Act
 - C. Regulatory Flexibility Act

- D. Unfunded Mandates Reform Act
 - E. Executive Order 13132: Federalism
 - F. Executive Order 13175: Consultation and Coordination With Indian Tribal Governments
 - G. Executive Order 13045: Protection of Children From Environmental Health and Safety Risks
 - H. Executive Order 13211: Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use
 - I. National Technology Transfer and Advancement Act (NTTAA) and 1 CFR Part 51
 - J. Executive Order 12898: Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations
 - K. Congressional Review Act
- IX. References

I. General Information

A. Executive Summary

Under section 612 of the Clean Air Act (CAA), EPA is required to evaluate substitutes¹ to ozone-depleting substances (ODS) for their risks to human health and the environment. EPA reviews substitutes within a comparative risk framework. More specifically, section 612 provides that EPA must prohibit the use of a substitute where EPA has determined that there are other available alternatives that pose less overall risk to human health and the environment. Thus, EPA's Significant New Alternatives Policy (SNAP) program, which implements section 612, does not provide a static list of alternatives. Instead, the list evolves as EPA makes decisions informed by our overall understanding of the environmental and human health impacts as well as our current knowledge about other alternatives. In the more than twenty years since the initial SNAP rule was promulgated, EPA has modified the SNAP lists many times, most often by expanding the list of acceptable substitutes. However, in some cases, EPA has modified the SNAP list by listing a substitute as unacceptable for one or more end-uses or by restricting the use of a previously listed substitute by changing its status for a particular end-use to unacceptable, acceptable subject to use conditions, or acceptable subject to narrowed use.

Over the past twenty years, the SNAP program has played an important role in assisting with a continuous smooth transition to safer alternatives. Since the first SNAP framework rule published in 1994, which provided confidence and certainty by identifying safer alternatives in key consumer and

industrial uses, the SNAP program has ensured that businesses and consumers have access to information about suitable alternatives. The SNAP program works with many stakeholders, domestically and abroad, to continuously evaluate and provide updates on safer alternatives and new technologies. Thanks to these efforts and the work of individuals, businesses, and organizations, the transitions generally have been successful.

When reviewing a substitute, EPA compares the risk posed by that substitute to the risks posed by other alternatives and determines whether that specific substitute under review poses significantly more risk than other available or potentially available alternatives for the same use. EPA recently has begun to review the lists in a broader manner to determine whether substitutes added to the lists early in the program pose significantly more risk than substitutes that have more recently been added. As with initial listing decisions, EPA bases decisions to change the status of an already listed alternative on the same comparative risk framework.

In this action, EPA is listing a number of substances as acceptable, subject to use conditions; listing several substances as unacceptable; and changing the listing status for certain substances from acceptable to acceptable, subject to narrowed use limits or to unacceptable. We performed a comparative risk analysis, based on our criteria for review, with other alternatives for the relevant end-uses. For the substances addressed in this action, EPA found significant potential differences in risk as compared to other available or potentially available substitutes with respect to one or more specific criteria, such as flammability, toxicity, or local air quality. In some cases, those risks could be addressed through use conditions and EPA is listing several substitutes as acceptable, subject to use conditions. In other cases, the risks could not be adequately mitigated through use conditions and, in those cases, EPA is listing several new substitutes and changing the status of several existing substitutes to unacceptable. In a few instances, EPA established narrowed use limits for certain substitutes over a limited period of time for specific military or space-and-aeronautics-related applications in the refrigeration and air conditioning (AC), and foam blowing sectors, on the basis that other acceptable alternatives would not be available for those specific applications within broader end-uses, but acceptable alternatives were expected to become available over time.

EPA is also applying unacceptability determinations for foam blowing agents to closed cell foam products and products containing closed cell foam. See section VI.C.4 for the details of this action. Additionally, EPA is exempting propane as a refrigerant in new self-contained commercial ice machines, in new water coolers, and in new very low temperature refrigeration equipment from the venting prohibition under CAA section 608(c)(2). See section VI.A.2.c for the details of this action.

Per the guiding principles of the SNAP program, this action does not specify that any alternative is acceptable or unacceptable across all sectors and end-uses. Instead, in all cases, EPA considered the intersection between the specific alternative and the particular end-use and the availability of substitutes for those particular end-uses. In the case of refrigeration and AC, we consider new equipment to be a separate end-use from retrofitting existing equipment with a different refrigerant from that for which the equipment was originally designed. EPA is not setting a "risk threshold" for any specific SNAP criterion, such that the only acceptable substitutes pose risk below a specified level of risk. Because the substitutes available and the types of risk they may pose vary by sector and end-use, our review focuses on the specific end-use and the alternatives for that end-use, including the other risks alternatives might pose. Thus, there is no bright line that can be established to apply to all sectors and end-uses. Also, EPA recognizes that there are a range of substitutes with various uses that include both fluorinated (*e.g.*, hydrofluorocarbons (HFCs) and hydrofluoroolefins (HFOs)) and non-fluorinated (*e.g.*, hydrocarbons (HCs) and carbon dioxide (CO₂)) substitutes that may pose lower overall risk to human health and the environment. Consistent with CAA section 612 as we have historically interpreted it under the SNAP program, this rule includes both initial listings and certain modifications to the current lists based on our evaluation of the substitutes addressed in this action using the SNAP criteria for evaluation and considering the current suite of other alternatives for the specific end-use at issue.

The following is a summary of the actions taken in this rule.

1. Acceptable Alternatives, With Use Conditions, by End-Use (Initial Listings)

(1) For refrigeration, EPA is listing as acceptable, subject to use conditions, as of January 3, 2017:

- Propane in new commercial ice machines, new water coolers, and new

¹ The terms "alternatives" and "substitutes" are used interchangeably in this document.

very low temperature refrigeration equipment.

(2) For motor vehicle air conditioning (MVAC) systems, EPA is listing, as acceptable, subject to use conditions, as of January 3, 2017:

- HFO-1234yf in newly manufactured medium-duty passenger vehicles (MDPVs), heavy-duty (HD) pickup trucks, and complete HD vans.

(3) For fire suppression and explosion protection end-uses, EPA is listing as acceptable, subject to use conditions, as of January 3, 2017:

- 2-bromo-3,3,3-trifluoroprop-1-ene (2-BTP) as a total flooding agent for use in engine nacelles and auxiliary power units (APUs) on aircraft; and
- 2-BTP as a streaming agent for use in handheld extinguishers in aircraft.

2. Unacceptable Alternatives by End-Use (Initial Listings)

(1) For retrofit residential and light commercial AC and heat pumps—unitary split AC systems and heat pumps, EPA is listing as unacceptable, as of January 3, 2017:

- All refrigerants identified as flammability Class 3 in American National Standards Institute (ANSI)/American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 34–2013; and

- All refrigerants meeting the criteria for flammability Class 3 in ANSI/ASHRAE Standard 34–2013. These include, but are not limited to, refrigerant products sold under the names R-22a, 22a, Blue Sky 22a refrigerant, Coolant Express 22a, DURACOL-22a, EC-22, Ecofreeez EF-22a, EnviroSAFE 22a, ES-22a, Frost 22a, HC-22a, Maxi-Fridge, MX-22a, Oz-Chill 22a, Priority Cool, and RED TEK 22a.

(2) For new residential and light commercial AC and heat pumps, cold storage warehouses, centrifugal chillers, and positive displacement chillers, EPA is listing as unacceptable, as of January 3, 2017:

- Propylene and R-443A.

3. Unacceptable Alternatives by End-Use (Change of Listing Status)

(1) For new centrifugal chillers, EPA is listing as unacceptable, except as otherwise allowed under a narrowed use limit, as of January 1, 2024:

- FOR12A, FOR12B, HFC-134a, HFC-227ea, HFC-236fa, HFC-245fa, R-125/134a/600a (28.1/70/1.9), R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407C, R-410A, R-410B, R-417A, R-421A, R-422B, R-422C, R-422D, R-423A, R-424A, R-434A, R-438A, R-507A, RS-44 (2003 composition), and THR-03.

(2) For new positive displacement chillers, EPA is listing as unacceptable,

except as otherwise allowed under a narrowed use limit, as of January 1, 2024:

- FOR12A, FOR12B, HFC-134a, HFC-227ea, KDD6, R-125/134a/600a (28.1/70/1.9), R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407C, R-410A, R-410B, R-417A, R-421A, R-422B, R-422C, R-422D, R-424A, R-434A, R-437A, R-438A, R-507A, RS-44 (2003 composition), SP34E, and THR-03.

(3) For new centrifugal chillers, EPA is listing as acceptable, subject to narrowed use limits, as of January 1, 2024:

- HFC-134a for military marine vessels and HFC-134a and R-404A for human-rated spacecraft and related support equipment

(4) For new positive displacement chillers, EPA is listing as acceptable, subject to narrowed use limits, as of January 1, 2024:

- HFC-134a for military marine vessels and HFC-134a and R-404A for human-rated spacecraft and related support equipment

(5) For new cold storage warehouses, EPA is listing as unacceptable, as of January 1, 2023:

- HFC-227ea, R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407A, R-407B, R-410A, R-410B, R-417A, R-421A, R-421B, R-422A, R-422B, R-422C, R-422D, R-423A, R-424A, R-428A, R-434A, R-438A, R-507A, and RS-44 (2003 composition).

(6) For new retail food refrigeration (refrigerated food processing and dispensing equipment), EPA is listing as unacceptable, as of January 1, 2021:

- HFC-227ea, KDD6, R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407A, R-407B, R-407C, R-407F, R-410A, R-410B, R-417A, R-421A, R-421B, R-422A, R-422B, R-422C, R-422D, R-424A, R-428A, R-434A, R-437A, R-438A, R-507A, RS-44 (2003 formulation).

(7) For new household refrigerators and freezers, EPA is listing as unacceptable, as of January 1, 2021:

- FOR12A, FOR12B, HFC-134a, KDD6, R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407C, R-407F, R-410A, R-410B, R-417A, R-421A, R-421B, R-422A, R-422B, R-422C, R-422D, R-424A, R-426A, R-428A, R-434A, R-437A, R-438A, R-507A, RS-24 (2002 formulation), RS-44 (2003 formulation), SP34E, and THR-03.

(8) For rigid polyurethane (PU) high-pressure two-component spray foam, EPA is listing as unacceptable for all uses, except military or space- and aeronautics-related applications, as of January 1, 2020; as acceptable, subject to narrowed use limits, for military or space- and aeronautics-related applications, as of January 1, 2020; and

as unacceptable for military or space- and aeronautics-related applications as of January 1, 2025:

- HFC-134a, HFC-245fa, and blends thereof; blends of HFC-365mfc with at least four percent HFC-245fa, and commercial blends of HFC-365mfc with seven to 13 percent HFC-227ea and the remainder HFC-365mfc; and Formacel TI.²

(9) For rigid PU low-pressure two-component spray foam, EPA is listing as unacceptable for all uses, except military or space- and aeronautics-related applications, as of January 1, 2021; as acceptable, subject to narrowed use limits, for military or space- and aeronautics-related applications, as of January 1, 2021; and as unacceptable for military or space- and aeronautics-related applications as of January 1, 2025:

- HFC-134a, HFC-245fa, and blends thereof; blends of HFC-365mfc with at least four percent HFC-245fa, and commercial blends of HFC-365mfc with seven to 13 percent HFC-227ea and the remainder HFC-365mfc; and Formacel TI.³

(10) For rigid PU one-component foam sealants, EPA is listing as unacceptable, as of January 1, 2020:

- HFC-134a, HFC-245fa, and blends thereof; blends of HFC-365mfc with at least four percent HFC-245fa, and commercial blends of HFC-365mfc with seven to 13 percent HFC-227ea and the remainder HFC-365mfc; and Formacel TI.⁴

(11) For all foam blowing end-uses except for rigid PU spray foam, EPA is listing as unacceptable, as of January 1, 2025:

- HFCs and HFC blends previously listed as unacceptable as of January 1, 2022, for space- and aeronautics-related applications.

(12) For flexible PU foam applications, EPA is listing as unacceptable, as of January 3, 2017:

- Methylene chloride.

While EPA proposed and requested comments on listing certain perfluorocarbons (PFCs) as unacceptable in fire suppression total flooding uses, EPA is not finalizing that change in this rulemaking.

4. Other Changes

(1) For all foam blowing end-uses, EPA is prohibiting the use of closed cell

² Closed cell foam products and products containing closed cell foams manufactured on or before January 1, 2020, may be used after that date.

³ Closed cell foam products and products containing closed cell foams manufactured on or before January 1, 2021, may be used after that date.

⁴ Closed cell foam products and products containing closed cell foams manufactured on or before January 1, 2020, may be used after that date.

foam products and products that contain closed cell foam manufactured with an unacceptable foam blowing agent on or after the later of (A) December 1, 2017 or (B) the date of the unacceptability listing.

(2) For fire suppression total flooding uses, EPA is clarifying the listing for Powdered Aerosol D (Stat-X®), which was previously listed as both “acceptable” and “acceptable, subject to use conditions,” by removing the listing

as “acceptable, subject to use conditions,” as of January 3, 2017.

B. Does this action apply to me?

Potential entities that may be affected by this rule include:

TABLE 1—POTENTIALLY REGULATED ENTITIES BY NORTH AMERICAN INDUSTRIAL CLASSIFICATION SYSTEM (NAICS) CODE

Category	NAICS code	Description of regulated entities
Construction	238210	Alarm System (e.g., Fire, Burglar), Electric, Installation Only.
Industry	238220	Plumbing, Heating, And Air Conditioning Contractors.
Industry	325199	All Other Basic Organic Chemical Manufacturing.
Industry	325412	Pharmaceutical Preparation Manufacturing.
Industry	325520	Adhesive Manufacturing.
Industry	325998	All Other Miscellaneous Chemical Product and Preparation Manufacturing.
Industry	326150	Urethane and Other Foam Product (Except Polystyrene) Manufacturing.
Manufacturing ...	332919	Nozzles, Firefighting, Manufacturing.
Industry	333415	Manufacturers of Refrigerators, Freezers, and Other Refrigerating or Freezing Equipment, Electric or Other (NESOI); Heat Pumps Not Elsewhere Specified or Included; and Parts Thereof.
Industry	333415	Air Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing.
Manufacturing ...	334290	Fire Detection and Alarm Systems Manufacturing.
Industry	335222	Household Refrigerator and Home Freezer Manufacturing.
Industry	336120	Heavy-Duty Truck Manufacturing.
Industry	336211	Motor Vehicle Body Manufacturing.
Industry	3363	Motor Vehicle Parts Manufacturing.
Industry	3364	Aerospace Product and Parts Manufacturing.
Manufacturing ...	336411	Aircraft Manufacturing.
Manufacturing ...	336413	Other Aircraft Parts and Auxiliary Equipment Manufacturing.
Industry	336992	Military Armored Vehicle, Tank, and Tank Component Manufacturing.
Industry	339113	Surgical Appliance and Supplies Manufacturing.
Manufacturing ...	339999	Fire Extinguishers, Portable, Manufacturing.
Retail	423620	Household Appliances, Electric Housewares, and Consumer Electronics Merchant Wholesalers.
Retail	423740	Refrigeration Equipment and Supplies Merchant Wholesalers.
Retail	423930	Recyclable Material Merchant Wholesalers.
Retail	443111	Appliance Stores: Household-Type.
Retail	44511	Supermarkets and Other Grocery (Except Convenience) Stores.
Retail	445110	Supermarkets and Other Grocery (Except Convenience) Stores.
Retail	445120	Convenience Stores.
Retail	44521	Meat Markets.
Retail	44522	Fish and Seafood Markets.
Retail	44523	Fruit and Vegetable Markets.
Retail	445291	Baked Goods Stores.
Retail	445292	Confectionary and Nut Stores.
Retail	445299	All Other Specialty Food Stores.
Retail	4453	Beer, Wine, and Liquor Stores.
Retail	446110	Pharmacies and Drug Stores.
Retail	44711	Gasoline Stations With Convenience Stores.
Retail	452910	Warehouse Clubs and Supercenters.
Retail	452990	All Other General Merchandise Stores.
Services	72111	Hotels (Except Casino Hotels) and Motels.
Services	72112	Casino Hotels.
Retail	72241	Drinking Places (Alcoholic Beverages).
Retail	722513	Limited-Service Restaurants.
Retail	722514	Cafeterias, Grill Buffets, and Buffets.
Retail	722515	Snack and Nonalcoholic Beverage Bars.
Services	81119	Other Automotive Repair and Maintenance.
Services	811412	Appliance Repair and Maintenance.
Services	922160	Fire Protection.

This table is not intended to be exhaustive, but rather provides a guide for readers regarding entities likely to be regulated by this action. This table lists the types of entities that EPA is now aware could potentially be regulated by this action. Other types of entities not listed in the table could also be regulated. To determine whether your entity is regulated by this action, you

should carefully examine the applicability criteria found in 40 CFR part 82. If you have questions regarding the applicability of this action to a particular entity, consult the person listed in the **FOR FURTHER INFORMATION CONTACT** section.

C. What acronyms and abbreviations are used in the preamble?

Below is a list of acronyms and abbreviations used in the preamble of this document:

AC—Air Conditioning
 AAC—American Automotive Council
 ACGIH—American Conference of Governmental Industrial Hygienists
 AEGL—Acute Emergency Guideline Limits

AHIA—American Industrial Hygiene Association
 AHRI—Air Conditioning, Heating and Refrigeration Institute
 AIRAH—Australian Institute of Refrigeration, Air Conditioning and Heating
 ANSI—American National Standards Institute
 APU—Auxiliary Power Unit
 ASHRAE—American Society of Heating, Refrigerating and Air-Conditioning Engineers
 ASRAC—Appliance Standards and Rulemaking Federal Advisory Committee
 ASTM—American Society for Testing and Materials
 BTU—British Thermal Units
 CAA—Clean Air Act
 CAP—Climate Action Plan
 CAS Reg. No.—Chemical Abstracts Service Registry Identification Number
 CBI—Confidential Business Information
 CFC—Chlorofluorocarbon
 CFR—Code of Federal Regulations
 CH₄—Methane
 CMAQ—Community Multiscale Air Quality
 CO₂—Carbon Dioxide
 CO₂eq—Carbon Dioxide Equivalent
 CRP—Cooperative Research Programs
 CSA—Canadian Standards Association
 CUAC—Commercial Unitary Air Conditioner
 CUHP—Commercial Unitary Heat Pump
 DoD—United States Department of Defense
 DOE—United States Department of Energy
 DX—Direct Expansion
 EEAP—Environmental Effects Assessment Panel
 EIA—Environmental Investigation Agency
 EO—Executive Order
 EPA—United States Environmental Protection Agency
 EU—European Union
 FMEA—Failure Mode and Effects Analysis
 FAA—Federal Aviation Administration
 FCA—Fiat Chrysler Automobiles
 FR—Federal Register
 FTA—Fault Tree Analysis
 g—Gram
 GHG—Greenhouse Gas
 GtCO₂eq—Gigatonnes of Carbon Dioxide Equivalent
 GWP—Global Warming Potential
 GVWR—Gross Vehicle Weight Rating
 HBFC—Hydrobromofluorocarbon
 HC—Hydrocarbon
 HCFC—Hydrochlorofluorocarbon
 HD—Heavy-Duty
 HD GHG—Heavy-Duty Greenhouse Gas
 HF—Hydrogen Fluoride
 HFC—Hydrofluorocarbon
 HFO—Hydrofluoroolefin
 IBC—International Building Code
 ICAO—International Civil Aviation Organization
 ICC—International Code Council
 ICF—ICF International, Inc.
 IDLH—Immediately Dangerous to Life and Health
 IEC—International Electrochemical Commission
 IGSD—Institute for Governance and Sustainable Development
 IIAR—Institute of Ammonia Refrigeration
 IPCC—Intergovernmental Panel on Climate Change
 IPLV—Integrated Part-Load Value

IPR—Industrial Process Refrigeration
 kPa—Kilopascal
 kW—Kilowatt
 LD—Light-Duty
 LD GHG—Light-Duty Greenhouse Gas
 LFL—Lower Flammability Limit
 LOAEL—Lowest Observed Adverse Effect Level
 MAC Directive—Directive on Mobile Air Conditioning
 MACT—Maximum Achievable Technology
 MDPV—Medium-Duty Passenger Vehicle
 MIR—Maximum Incremental Reactivity
 MMTCO₂eq—Million Metric Tons of Carbon Dioxide Equivalent
 MVAC—Motor Vehicle Air Conditioning
 MY—Model Year
 N₂O—Nitrous Oxide
 NAAQS—National Ambient Air Quality Standards
 NAICS—North American Industrial Classification System
 NESHA—National Emission Standards for Hazardous Air Pollutants
 NFPA—National Fire Protection Association
 NHTSA—National Highway Traffic Safety Administration
 NIK—Not-In-Kind
 NIOSH—National Institute for Occupational Safety and Health
 NOAEL—No-Observed-Adverse-Effect-Level
 NPRM—Notice of Proposed Rulemaking
 NRDC—Natural Resource Defense Council
 OEM—Original Equipment Manufacturer
 ODP—Ozone Depletion Potential
 ODS—Ozone-Depleting Substance
 OMB—United States Office of Management and Budget
 OSHA—United States Occupational Safety and Health Administration
 PEL—Permissible Exposure Limit
 PFC—Perfluorocarbon
 PMS—Pantone Matching System
 ppb—Parts Per Billion
 PPE—Personal Protective Equipment
 ppm—Parts Per Million
 PSM—Process Safety Management
 PTAC—Packaged Terminal Air Conditioners
 PTHP—Packaged Terminal Heat Pumps
 PU—Polyurethane
 RCRA—Resource Conservation and Recovery Act
 REL—Recommended Exposure Limit
 RfC—Reference Concentration
 RMP—Risk Management Plan
 RSES—Refrigeration Service Engineers Society
 RTOC—Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee
 SARPS—Standards and Recommended Practices
 SAE ICC—SAE International's Interior Climate Control Committee
 SAP—Scientific Assessment Panel
 SF₆—Sulfur Hexafluoride
 SIP—State Implementation Plan
 SISNOSE—significant economic impact on a substantial number of small entities
 SNAP—Significant New Alternatives Policy
 SRES—Special Report on Emissions Scenarios
 STEL—Short-term Exposure Limit
 SUV—Sport Utility Vehicles
 TEAP—Technical and Economic Assessment Panel
 TFA—Trifluoroacetic Acid

TLV—Threshold Limit Value
 TWA—Time Weighted Average
 UNFCCC—United Nations Framework Convention on Climate Change
 UL—Underwriters Laboratories, Inc.
 UMRA—Unfunded Mandates Reform Act
 UNEP—United Nations Environmental Programme
 VOC—Volatile Organic Compound
 WEEL—Workplace Environmental Exposure Limit

II. How does the SNAP program work?

A. What are the statutory requirements and authority for the SNAP program?

CAA section 612 requires EPA to develop a program for evaluating alternatives to ODS. This program is known as the SNAP program. The major provisions of section 612 are:

1. Rulemaking

Section 612(c) requires EPA to promulgate rules making it unlawful to replace any class I (chlorofluorocarbon (CFC), halon, carbon tetrachloride, methyl chloroform, methyl bromide, hydrobromofluorocarbon (HBFC), and chlorobromomethane) or class II hydrochlorofluorocarbon (HCFC)) substance with any substitute that the Administrator determines may present adverse effects to human health or the environment where the Administrator has identified an alternative that (1) reduces the overall risk to human health and the environment and (2) is currently or potentially available.

2. Listing of Unacceptable/Acceptable Substitutes

Section 612(c) requires EPA to publish a list of the substitutes that it finds to be unacceptable for specific uses and to publish a corresponding list of acceptable substitutes for specific uses. The list of “acceptable” substitutes is found at www.epa.gov/ozone/snap/substitutes-sector and the lists of “unacceptable,” “acceptable, subject to use conditions,” and “acceptable, subject to narrowed use limits” substitutes are found in the appendices to 40 CFR part 82 subpart G.

3. Petition Process

Section 612(d) grants the right to any person to petition EPA to add a substance to, or delete a substance from, the lists published in accordance with section 612(c). The Agency has 90 days to grant or deny a petition. Where the Agency grants the petition, EPA must publish the revised lists within an additional six months.

4. 90-Day Notification

Section 612(e) directs EPA to require any person who produces a chemical substitute for a class I substance to

notify the Agency not less than 90 days before new or existing chemicals are introduced into interstate commerce for significant new uses as substitutes for a class I substance. The producer must also provide the Agency with the producer's unpublished health and safety studies on such substitutes.

5. Outreach

Section 612(b)(1) states that the Administrator shall seek to maximize the use of federal research facilities and resources to assist users of class I and II substances in identifying and developing alternatives to the use of such substances in key commercial applications.

6. Clearinghouse

Section 612(b)(4) requires the Agency to set up a public clearinghouse of alternative chemicals, product substitutes, and alternative manufacturing processes that are available for products and manufacturing processes which use class I and II substances.

B. What are EPA's regulations implementing CAA section 612?

On March 18, 1994, EPA published the initial SNAP rule (59 FR 13044) which established the process for administering the SNAP program and issued EPA's first lists identifying acceptable and unacceptable substitutes in major industrial use sectors (40 CFR part 82 subpart G). These sectors include the following: Refrigeration and AC; foam blowing; solvents cleaning; fire suppression and explosion protection; sterilants; aerosols; adhesives, coatings and inks; and tobacco expansion. These sectors comprise the principal industrial sectors that historically consumed the largest volumes of ODS.

C. How do the regulations for the SNAP program work?

Under the SNAP regulations, anyone who produces a substitute to replace a class I or II ODS in one of the eight major industrial use sectors listed previously must provide the Agency with notice and the required health and safety information on the substitute at least 90 days before introducing it into interstate commerce for significant new use as an alternative (40 CFR 82.176(a)). While this requirement typically applies to chemical manufacturers as the person likely to be planning to introduce the substitute into interstate commerce,⁵ it

may also apply to importers, formulators, equipment manufacturers, or end users⁶ when they are responsible for introducing a substitute into interstate commerce. The 90-day SNAP review process begins once EPA receives the submission and determines that the submission includes complete and adequate data (40 CFR 82.180(a)). The CAA and the SNAP regulations, 40 CFR 82.174(a), prohibit use of a substitute earlier than 90 days after a complete submission has been provided to the Agency.

The Agency has identified four possible decision categories for substitute submissions: Acceptable; acceptable, subject to use conditions; acceptable, subject to narrowed use limits; and unacceptable (40 CFR 82.180(b)).⁷ Use conditions and narrowed use limits are both considered "use restrictions" and are explained later in this action. Substitutes that are deemed acceptable without use conditions can be used for all applications within the relevant sector end-uses and without limits under SNAP on how they may be used. Substitutes that are acceptable, subject to use restrictions may be used only in accordance with those restrictions. Substitutes that are found to be unacceptable may not be used after the date specified in the rulemaking adding them to the list of unacceptable substitutes.⁸

After reviewing a substitute, the Agency may determine that a substitute is acceptable only if certain conditions in the way that the substitute is used are met to ensure risks to human health and

state, territory, possession or the District of Columbia, or the sale, use or manufacture of any product in more than one state, territory, possession or District of Columbia. The entry points for which a product is introduced into interstate commerce are the release of a product from the facility in which the product was manufactured, the entry into a warehouse from which the domestic manufacturer releases the product for sale or distribution, and at the site of United States Customs clearance.

⁶ As defined at 40 CFR 82.172, "end-use" means processes or classes of specific applications within major industrial sectors where a substitute is used to replace an ODS.

⁷ The SNAP regulations also include "pending," referring to submissions for which EPA has not reached a determination, under this provision.

⁸ As defined at 40 CFR 82.172, "use" means any use of a substitute for a class I or class II ozone-depleting compound, including but not limited to use in a manufacturing process or product, in consumption by the end-user, or in intermediate uses, such as formulation or packaging for other subsequent uses. This definition of use encompasses manufacturing process of products both for domestic use and for export. Substitutes manufactured within the United States exclusively for export are subject to SNAP requirements since the definition of use in the rule includes use in the manufacturing process, which occurs within the United States.

the environment are not significantly greater than other substitutes. EPA describes such substitutes as "acceptable, subject to use conditions." Entities that use these substitutes without meeting the associated use conditions are in violation of CAA section 612 and EPA's SNAP regulations (40 CFR 82.174(c)).

For some substitutes, the Agency may permit a narrow range of use within an end-use or sector. For example, the Agency may limit the use of a substitute to certain end-uses or specific applications within an industry sector. The Agency generally requires a user of a substitute subject to narrowed use limits to demonstrate that no other acceptable substitutes are available for their specific application.⁹ EPA describes these substitutes as "acceptable, subject to narrowed use limits." A person using a substitute that is acceptable, subject to narrowed use limits in applications and end-uses that are not consistent with the narrowed use limit is using these substitutes in violation of CAA section 612 and EPA's SNAP regulations (40 CFR 82.174(c)).

The section 612 mandate for EPA to prohibit the use of a substitute that may present risk to human health or the environment where a lower risk alternative is available or potentially available¹⁰ provides EPA with the authority to change the listing status of a particular substitute if such a change is justified by new information or changed circumstance. The Agency publishes its SNAP program decisions in the **Federal Register**. EPA uses notice and comment rulemaking to place any alternative on the list of prohibited substitutes, to list a substitute as acceptable only subject to use conditions or narrowed use limits, or to

⁹ In the case of the July 20, 2015, final rule, EPA established narrowed use limits for certain substitutes over a limited period of time for specific MVAC and foam applications, on the basis that other acceptable alternatives would not be available for those specific applications within broader end-uses, but acceptable alternatives were expected to become available over time, e.g., after military qualification testing for foam blowing agents in military applications or after development of improved servicing infrastructure in a destination country for MVAC in vehicles destined for export.

¹⁰ In addition to acceptable commercially available alternatives, the SNAP program may consider potentially available alternatives. The SNAP program's definition of "potentially available" is "any alternative for which adequate health, safety, and environmental data, as required for the SNAP notification process, exist to make a determination of acceptability, and which the Agency reasonably believes to be technically feasible, even if not all testing has yet been completed and the alternative is not yet produced or sold." (40 CFR 82.172)

⁵ As defined at 40 CFR 82.104, "interstate commerce" means the distribution or transportation of any product between one state, territory, possession or the District of Columbia, and another

remove a substitute from either the list of prohibited or acceptable substitutes.

In contrast, EPA publishes “notices of acceptability” to notify the public of substitutes that are deemed acceptable with no restrictions. As described in the preamble to the rule initially implementing the SNAP program (59 FR 13044; March 18, 1994), rulemaking procedures are not necessary to list substitutes that are acceptable without restrictions because such listings neither impose any sanction nor prevent anyone from using a substitute.

Many SNAP listings include “comments” or “further information” to provide additional information on substitutes. Since this additional information is not part of the regulatory decision, these statements are not binding for use of the substitute under the SNAP program. However, regulatory requirements so listed are binding under other regulatory programs (e.g., worker protection regulations promulgated by the U.S. Occupational Safety and Health Administration (OSHA)). The “further information” classification does not necessarily include all other legal obligations pertaining to the use of the substitute. While the items listed are not legally binding under the SNAP program, EPA encourages users of substitutes to apply all statements in the “further information” column in their use of these substitutes. In many instances, the information simply refers to sound operating practices that have already been identified in existing industry and/or building codes or standards. Thus, many of the statements, if adopted, would not require the affected user to make significant changes in existing operating practices.

D. What are the guiding principles of the SNAP Program?

The seven guiding principles of the SNAP program, elaborated in the preamble to the initial SNAP rule and consistent with section 612, are discussed in this section.

1. Evaluate Substitutes Within a Comparative Risk Framework

The SNAP program evaluates the risk of alternative compounds compared to available or potentially available substitutes to the ozone-depleting compounds which they are intended to replace. The risk factors that are considered include ozone depletion potential (ODP) as well as flammability, toxicity, occupational health and safety, and contributions to climate change and other environmental factors.

2. Do Not Require That Substitutes Be Risk Free To Be Found Acceptable

Substitutes found to be acceptable must not pose significantly greater risk than other substitutes, but they do not have to be risk free. A key goal of the SNAP program is to promote the use of substitutes that minimize risks to human health and the environment relative to other alternatives. In some cases, this approach may involve designating a substitute acceptable even though the compound may pose a risk of some type, provided its use does not pose significantly greater risk than other alternatives.

3. Restrict Those Substitutes That Are Significantly Worse

EPA does not intend to restrict a substitute if it has only marginally greater risk. Drawing fine distinctions would be extremely difficult. The Agency also does not want to intercede in the market's choice of substitutes by listing as unacceptable all but one substitute for each end-use, and does not intend to restrict substitutes on the market unless a substitute has been proposed or is being used that is clearly more harmful to human health or the environment than other alternatives.

4. Evaluate Risks by Use

Central to SNAP's evaluations is the intersection between the characteristics of the substitute itself and its specific end-use application. Section 612 requires that substitutes be evaluated by use. Environmental and human health exposures can vary significantly depending on the particular application of a substitute. Thus, the risk characterizations must be designed to represent differences in the environmental and human health effects associated with diverse uses. This approach cannot, however, imply fundamental tradeoffs with respect to different types of risk to either the environment or to human health.

5. Provide the Regulated Community With Information as Soon as Possible

The Agency recognizes the need to provide the regulated community with information on the acceptability of various substitutes as soon as possible. To do so, EPA issues notices or determinations of acceptability and rules identifying substitutes as unacceptable; acceptable, subject to use conditions; or acceptable, subject to narrowed use limits, in the **Federal Register**. In addition, we maintain lists of acceptable and unacceptable alternatives on our Web site, www.epa.gov/ozone/snap.

6. Do Not Endorse Products Manufactured by Specific Companies

The Agency does not issue company-specific product endorsements. In many cases, the Agency may base its analysis on data received on individual products, but the addition of a substitute to the acceptable list based on that analysis does not represent an endorsement of that company's products.

7. Defer to Other Environmental Regulations When Warranted

In some cases, EPA and other federal agencies have developed extensive regulations under other sections of the CAA or other statutes that address potential environmental or human health effects that may result from the use of alternatives to class I and class II substances. For example, use of some substitutes may in some cases entail increased use of chemicals that contribute to tropospheric air pollution. The SNAP program takes existing regulations under other programs into account when reviewing substitutes.

E. What are EPA's criteria for evaluating substitutes under the SNAP program?

EPA applies the same criteria for determining whether a substitute is acceptable or unacceptable. These criteria, which can be found at § 82.180(a)(7), include atmospheric effects and related health and environmental effects, ecosystem risks, consumer risks, flammability, and cost and availability of the substitute. To enable EPA to assess these criteria, we require submitters to include various information including ODP, global warming potential (GWP), toxicity, flammability, and the potential for human exposure.

When evaluating potential substitutes, EPA evaluates these criteria in the following groupings:

1. Atmospheric effects—The SNAP program evaluates the potential contributions to both ozone depletion and climate change. The SNAP program considers the ODP and the 100-year integrated GWP of compounds to assess atmospheric effects.

2. Exposure assessments—The SNAP program uses exposure assessments to estimate concentration levels of substitutes to which workers, consumers, the general population, and the environment may be exposed over a determined period of time. These assessments are based on personal monitoring data or area sampling data if available. Exposure assessments may be conducted for many types of releases including:

- Releases in the workplace and in homes;
- Releases to ambient air and surface water;
- Releases from the management of solid wastes.

3. *Toxicity data*—The SNAP program uses toxicity data to assess the possible health and environmental effects of exposure to substitutes. We use broad health-based criteria such as:

- Permissible Exposure Limits (PELs) for occupational exposure;
- Inhalation reference concentrations (RfCs) for non-carcinogenic effects on the general population;
- Cancer slope factors for carcinogenic risk to members of the general population.

When considering risks in the workplace, if OSHA has not issued a PEL for a compound, EPA then considers Recommended Exposure Limits (RELs) from the National Institute for Occupational Safety and Health (NIOSH), Workplace Environmental Exposure Limits (WEELs) set by the American Industrial Hygiene Association (AIHA), or threshold limit values (TLVs) set by the American Conference of Governmental Industrial Hygienists (ACGIH). If limits for occupational exposure or exposure to the general population are not already established, then EPA derives these values following the Agency's peer review guidelines. Exposure information is combined with toxicity information to explore any basis for concern. Toxicity data are used with existing EPA guidelines to develop health-based limits for interim use in these risk characterizations.

4. *Flammability*—The SNAP program examines flammability as a safety concern for workers and consumers. EPA assesses flammability risk using data on:

- Flash point and flammability limits (e.g., ASHRAE flammability/combustibility classifications);
- Data on testing of blends with flammable components;
- Test data on flammability in consumer applications conducted by independent laboratories; and
- Information on flammability risk mitigation techniques.

5. *Other environmental impacts*—The SNAP program also examines other potential environmental impacts like ecotoxicity and local air quality impacts. A compound that is likely to be discharged to water may be evaluated for impacts on aquatic life. Some substitutes are volatile organic compounds (VOCs). EPA also notes whenever a potential substitute is considered a hazardous or toxic air

pollutant (under CAA sections 112(b) and 202(l)) or hazardous waste under the Resource Conservation and Recovery Act (RCRA) subtitle C regulations.

EPA's consideration of cost in listing decisions is limited to evaluating the cost of the substitute under review pursuant to § 82.180(a)(7)(vii). This is distinct from consideration of costs associated with the use of other alternatives to which the substitute is being compared. *See Honeywell v. EPA*, 374 F.3d 1363 (D.C. Cir. 2004) at 1,378 (J. Rogers, concurring in part and dissenting in part) ("While the SNAP regulations make the 'cost and availability of the substitute' an element of acceptability . . . that concern is limited to whether EPA 'has . . . reason to prohibit its use,' not to whether cleaner alternatives for the substance are already 'currently or potentially available'. . . . Consideration of transition costs is thus precluded by the SNAP regulations as currently written, irrespective of whether it might be permitted under CAA § 612(c) . . .").

Over the past twenty years, the menu of substitutes has become much broader and a great deal of new information has been developed on many substitutes. Because the overall goal of the SNAP program is to ensure that substitutes listed as acceptable do not pose significantly greater risk to human health and the environment than other substitutes, the SNAP criteria continue to be informed by our current overall understanding of environmental and human health impacts and our experience with and current knowledge about alternatives. Over time, the range of substitutes reviewed by SNAP has changed, and at the same time, scientific approaches have evolved to more accurately assess the potential environmental and human health impacts of these chemicals and alternative technologies.

F. How are SNAP determinations updated?

Three mechanisms exist for modifying the list of SNAP determinations. First, under section 612(d), the Agency must review and either grant or deny petitions to add or delete substances from the SNAP list of acceptable or unacceptable substitutes. That provision allows any person to petition the Administrator to add a substance to the list of acceptable or unacceptable substitutes or to remove a substance from either list. The second means is through the notifications which must be submitted to EPA 90 days before introduction of a substitute into interstate commerce for significant new

use as an alternative to a class I or class II substance. These 90-day notifications are required by CAA section 612(e) for producers of substitutes to class I substances for new uses and, in all other cases, by EPA regulations issued under sections 114 and 301 of the Act to implement section 612(c).

Finally, since the inception of the SNAP program, we have interpreted the section 612 mandate to find substitutes acceptable or unacceptable to include the authority to act on our own to add or remove a substance from the SNAP lists (59 FR 13044, 13047; March 18, 1994). In determining whether to add or remove a substance from the SNAP lists, we consider whether there are other alternatives that pose lower overall risk to human health and the environment. In determining whether to modify a listing of a substitute we undertake the same consideration, but do so in the light of new data that may not have been available at the time of our original listing decision, including information on substitutes that was not included in our comparative review at the time of our initial listing decision and new information on substitutes previously reviewed.

G. What does EPA consider in deciding whether to add a substance to or remove a substance from one of the SNAP lists?

As described in this document and elsewhere, including in the initial SNAP rule published in the **Federal Register** on March 18, 1994 (59 FR 13044), CAA section 612 requires EPA to list as unacceptable any substitute substance where it finds that there are other alternatives that reduce overall risk to human health and the environment. The initial SNAP rule included submission requirements and presented the environmental and health risk factors that the SNAP program considers in the comparative risk framework it uses to determine whether there are other alternatives that pose significantly lower risk than the substitute under review. EPA makes decisions based on the particular end-use where a substitute is to be used. EPA has, in many cases, found certain substitutes acceptable only for limited end-uses or subject to use restrictions. In the decades since ODS were first invented in the 1920s, American consumers relied on products using ODS for diverse uses including aerosols, air conditioning, insulation, solvent cleaning, and fire protection. The agreement by governments to phase out production of ODS under the *Montreal Protocol on Substances that Deplete the Ozone Layer* led to inevitable questions about whether suitable alternatives could be found in

all cases, and in the larger sense, about how to limit negative impacts on society from use of alternatives.

It has now been over twenty years since the initial SNAP rule was promulgated. When the SNAP program began, the number of substitutes available for consideration was, for many end-uses, somewhat limited. Thus, while the SNAP program's initial comparative assessments of overall risk to human health and the environment were rigorous, often there were few substitutes upon which to apply the comparative assessment. The immediacy of the class I phaseout often meant that EPA listed class II ODS (*i.e.*, HCFCs) as acceptable, recognizing that they too would be phased out and, at best, could offer an interim solution. Other Title VI provisions such as the section 610 Nonessential Products Ban and the section 605 Use Restriction made clear that a listing under the SNAP program could not convey permanence.

Since EPA issued the initial SNAP rule in 1994, the Agency has issued 20 rules and 31 notices that generally expand the menu of options for the various SNAP sectors and end-uses. Thus, comparisons today apply to a broader range of alternatives—both chemical and non-chemical—than at the inception of the SNAP program. Industry experience with these substitutes has also grown during the history of the program.

In addition to an expanding menu of substitutes, developments over the past 20 years have improved our understanding of global environmental issues. With regard to that information, our review of substitutes in this action includes comparative assessments that consider our evolving understanding of a variety of factors. For example, GWPs and climate effects are not new elements in our evaluation framework, but as is the case with all of our review criteria, the amount of information has expanded and the quality has improved.

To the extent possible, EPA's ongoing management of the SNAP program considers new information, including new substitutes, and improved understanding of the risk to the environment and human health. EPA previously has taken several actions revising listing determinations from acceptable or acceptable with use conditions to unacceptable. On January 26, 1999, EPA listed the refrigerant blend known by the trade name MT-31 as unacceptable for all refrigeration and AC end-uses for which EPA had previously listed this blend as an acceptable substitute (62 FR 30275; June 3, 1997). EPA based this decision on

new information about the toxicity of one of the chemicals in the blend.

Another example of EPA revising a listing determination occurred in 2007, when EPA listed HCFC-22 and HCFC-142b as unacceptable for use in the foam sector (72 FR 14432; March 28, 2007). These HCFCs, which are ozone-depleting and subject to a global production phaseout, were initially listed as acceptable substitutes since they had a lower ODP than the substances they were replacing and there were no other alternatives that posed lower overall risk at the time of EPA's listing decision. HCFCs offered a path forward for some sectors and end-uses at a time when the number of substitutes was far more limited. In light of the expanded availability of other alternatives with lower overall risk to human health and the environment in specific foam end-uses, and taking into account the 2010 class II ODS phase down step, EPA changed the listing for these HCFCs in relevant end-uses from acceptable to unacceptable. In that rule, EPA noted that continued use of these HCFCs would contribute to unnecessary depletion of the ozone layer and delay the transition to substitutes that pose lower overall risk to human health and the environment. EPA established a change of status date that recognized that existing users needed time to adjust their manufacturing processes to safely accommodate the use of other substitutes.

GWP is one of several criteria EPA considers in the overall evaluation of the alternatives under the SNAP program. The President's June 2013 Climate Action Plan (CAP)¹¹ states, "To reduce emissions of HFCs, the United States can and will lead both through international diplomacy as well as domestic actions." Furthermore, the CAP states that EPA will "use its authority through the Significant New Alternatives Policy Program to encourage private sector investment in low-emissions technology by identifying and approving climate-friendly chemicals while prohibiting certain uses of the most harmful chemical alternatives." On July 20, 2015 (80 FR 42870), EPA issued a final regulation that was our first effort to take a broader look at the SNAP lists, where we focused on those listed substitutes that have a high GWP relative to other alternatives in specific end-uses, while

otherwise posing comparable levels of risk.

In the July 2015 rule, various HFCs and HFC-containing blends that were previously listed as acceptable under the SNAP program were listed as unacceptable in various end-uses in the aerosols, foam blowing, and refrigeration and AC sectors where there are other alternatives that pose lower overall risk to human health and the environment for specific uses. The July 2015 rule also changed the status from acceptable to unacceptable for certain HCFCs being phased out of production under the Montreal Protocol and CAA section 605(a). Per the guiding principles of the SNAP program, the July 2015 rule did not specify that any HFCs or HCFCs are unacceptable across all sectors and end-uses. Instead, in all cases, EPA considered the intersection between the specific substitute and the particular end-use and the availability of substitutes for those particular end-uses when making its determinations.

H. Where can I get additional information about the SNAP program?

For copies of the comprehensive SNAP lists of substitutes or additional information on SNAP, refer to EPA's Web site at <https://www.epa.gov/snap>. For more information on the Agency's process for administering the SNAP program or criteria for evaluation of substitutes, refer to the initial SNAP rule published March 18, 1994 (59 FR 13044), codified at 40 CFR part 82 subpart G. A complete chronology of SNAP decisions and the appropriate citations are found at <https://www.epa.gov/snap/snap-regulations>.

III. What actions and information related to greenhouse gases have bearing on this action?

GWP is one of several criteria EPA considers in the overall evaluation of alternatives under the SNAP program. During the past two decades, the general science on climate change and the potential contributions of greenhouse gases (GHGs) such as HFCs to climate change have become better understood.

On December 7, 2009, at 74 FR 66496, the Administrator issued an endangerment finding determining that, for purposes of CAA section 202(a), elevated atmospheric concentrations of the combination of six key well-mixed GHGs in the atmosphere—CO₂, methane (CH₄), nitrous oxide (N₂O), HFCs, PFCs, and sulfur hexafluoride (SF₆)—may reasonably be anticipated to endanger

¹¹ The White House, 2013, President's Climate Action Plan. This document is accessible at <https://www.whitehouse.gov/sites/default/files/image/president27climateactionplan.pdf>.

the public health and the public welfare of current and future generations.¹²

Like the ODS they replace, HFCs are potent GHGs.¹³ Although they represent a small fraction of the current total volume of GHG emissions, their warming impact per kilogram is very strong. While GHGs such as CO₂ and CH₄ are unintentional byproducts from energy production, industrial and agricultural activities, and mobile sources, HFCs are intentionally produced chemicals.¹⁴ The most commonly used HFC is HFC-134a. HFC-134a has a GWP of 1,430, which means it traps 1,430 times as much heat per kilogram as CO₂ does over 100 years. Because of their role in replacing ODS, both in the United States and globally, and because of the increasing use of refrigeration and AC, HFC emissions are projected to increase substantially and at an increasing rate over the next several decades if their production is left uncontrolled. In the United States, emissions of HFCs are increasing more quickly than those of any other GHGs, and globally they are increasing 10–15 percent annually.¹⁵ At that rate, emissions are projected to double by 2020 and triple by 2030.¹⁶ HFCs are also rapidly accumulating in the atmosphere. The atmospheric concentration of HFC-134a has increased by about ten percent per year from 2006 to 2012, and the concentrations of HFC-143a and HFC-125, which are components of commonly used refrigerant blends, have risen over 13 percent and 16 percent per year from 2007–2011, respectively.¹⁷

Without action, annual global emissions of HFCs are projected to rise to about 6.4 to 9.9 gigatons of CO₂

equivalent (GtCO₂eq) in 2050,¹⁸ which is comparable to the drop in annual GHG emissions from ODS of 8.0 GtCO₂eq between 1988 and 2010.¹⁹ By 2050, the buildup of HFCs in the atmosphere is projected to increase radiative forcing in the range of 0.22 to 0.25 W m⁻². This increase may be as much as one-fifth to one-quarter of the expected increase in radiative forcing due to the buildup of CO₂ since 2000, according to the Intergovernmental Panel on Climate Change's (IPCC's) Special Report on Emissions Scenarios (SRES).²⁰ To appreciate the significance of the effect of projected HFC emissions within the context of all GHGs, HFCs would be six to nine percent of the CO₂ emissions in 2050 based on the IPCC's highest CO₂ emissions scenario and equivalent to 27 to 69 percent of CO₂ emissions based on the IPCC's lowest CO₂ emissions pathway.^{21 22} Additional information concerning the peer-reviewed scientific literature and emission scenarios is available in the docket for this rulemaking (EPA-HQ-OAR-2015-0663).

PFCs are potent GHGs and have very long atmospheric lifetimes. PFCs are produced as a byproduct of various industrial processes associated with aluminum production and the manufacturing of semiconductors, then captured for intentional use or manufactured for use in various industrial applications. PFCs have had limited use in the eight sectors regulated under SNAP. While status changes for certain PFCs in fire suppression total flooding uses were proposed, no final action on PFCs in this end-use is being taken in this action.

IV. How does this action relate to the Climate Action Plan and petitions received requesting a change in listing status for HFCs?

A. Climate Action Plan

This action is consistent with a provision in the President's CAP announced June 2013:

Moving forward, the Environmental Protection Agency will use its authority through the Significant New Alternatives Policy Program to encourage private sector investment in low-emissions technology by identifying and approving climate-friendly chemicals while prohibiting certain uses of the most harmful chemical alternatives.

The CAP further states, "To reduce emissions of HFCs, the United States can and will lead both through international diplomacy as well as domestic actions." This action is consistent with that call for leadership through domestic actions. Regarding international leadership, for the past seven years, the United States, Canada, and Mexico have proposed an amendment to the Montreal Protocol to phase down the production and consumption of HFCs. Adopting the North American proposal would reduce cumulative HFC emissions by more than 90 GtCO₂eq through 2050.

Throughout our discussions with the regulated community, we have sought to convey our understanding of the role that certainty plays in enabling the robust development and uptake of alternatives. As noted above, some of the key strengths of the SNAP program, such as its substance and end-use specific consideration, its multi-criteria basis for action, and its petition process, counters measures some have advocated could provide more certainty, such as setting specific numerical criteria for environmental evaluations (e.g., all compounds with GWP greater than 150). That said, this action provides additional certainty in the specific cases addressed. In addition, we remain committed to continuing to actively seek stakeholder views and to share our thinking at the earliest moment practicable on any future actions, as part of our commitment to provide greater certainty to producers and consumers in SNAP-regulated industrial sectors.

B. Summary of Petitions

EPA received two petitions on October 6, 2015, requesting the Agency to modify certain acceptability listings of high-GWP substances in various end-uses. The first was submitted by the Natural Resource Defense Council (NRDC) and the Institute for Governance and Sustainable Development (IGSD) and the second by the Environmental

¹² EPA, 2009a. Technical Support Document for Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act. December, 2009. This document is accessible at: http://www3.epa.gov/climatechange/Downloads/endangerment/Endangerment_TSD.pdf.

¹³ IPCC/TEAP, 2005. Special Report: Safeguarding the Ozone Layer and the Global Climate System: Issues Related to Hydrofluorocarbons and Perfluorocarbons. Cambridge Univ Press, New York. This document is accessible at: https://www.ipcc.ch/pdf/special-reports/sroc/sroc_full.pdf.

¹⁴ HFC-23 is an exception; it is produced as a byproduct during the production of HCFC-22 and other chemicals.

¹⁵ UNEP, 2011. HFCs: A Critical Link in Protecting Climate and the Ozone Layer, A UNEP Synthesis Report. November, 2011. This document is accessible at: www.unep.org/dewa/portals/67/pdf/HFC_report.pdf.

¹⁶ Akerman, 2013. Hydrofluorocarbons and Climate Change: Summaries of Recent Scientific and Papers. 2013.

¹⁷ Montzka, 2012. HFCs in the Atmosphere: Concentrations, Emissions and Impacts. ASHRAE/NIST Conference 2012. This document is accessible at: ftp://ftp.cmdl.noaa.gov/hats/papers/montzka/2012_pubs/Montzka_ASHRAE_2012.pdf.

¹⁸ Velders, G.J.M., D.W. Fahey, J.S. Daniel, M. McFarland, S.O. Andersen (2009). "The large contribution of projected HFC emissions to future climate forcing." Proceedings of the National Academy of Sciences USA 106: 10949–10954.

¹⁹ UNEP, 2011. HFCs: A Critical Link in Protecting Climate and the Ozone Layer, A UNEP Synthesis Report. November, 2011. This document is accessible at: www.unep.org/dewa/portals/67/pdf/HFC_report.pdf.

²⁰ Ibid.

²¹ Velders, Guus JM, et al. "Future atmospheric abundances and climate forcings from scenarios of global and regional hydrofluorocarbon (HFC) emissions." *Atmospheric Environment* 123 (2015): 200–209.

²² IPCC, 2013: Annex II: Climate System Scenario Tables [Prather, M., G. Flato, P. Friedlingstein, C. Jones, J.-F. Lamarque, H. Liao and P. Rasch (eds.)]. In: *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. This document is accessible at: <http://www.ipcc.ch/report/ar5/wg1/>.

Investigation Agency (EIA).^{23 24} The NRDC/IGSD petition requests that EPA change the listing status of certain high-GWP chemicals they believe are used most frequently in the United States in various end-uses in the refrigeration and AC, foam blowing, and fire suppression and explosion protection sectors. The EIA petition requests that EPA list additional high-GWP HFCs as unacceptable or acceptable, subject to use restrictions, in a number of end-uses in the refrigeration and AC, and fire suppression and explosion protection sectors. In support of their petitions, the petitioners identified other alternatives they claim are available for use in the specified end-uses and present lower risks to human health and environment. These petitions are more fully described in the notice of proposed rulemaking (NPRM) and are available in the docket for this rulemaking. While EPA has not found these petitions complete at this time, EPA possesses sufficient information to finalize action on some of the end-uses covered by the petitions. This action is responsive to certain aspects of the petitions that relate to the refrigeration and AC, and foam blowing sectors; EPA is changing the listing from acceptable to unacceptable for:

- HFC-134a in new centrifugal chillers, new positive displacement chillers, new household refrigerators and freezers, and rigid PU spray foam;
- R-404A, R-410A, R-410B, and R-507A in new centrifugal chillers, new positive displacement chillers, new household refrigerators and freezers, and new cold storage warehouses;
- R-407A in new cold storage warehouses;
- R-421A, R-422B, R-422C, R-422D, R-424A, and R-434A in new centrifugal chillers and new positive displacement chillers;
- HFC-227ea in new cold storage warehouses, new centrifugal chillers, and new positive displacement chillers;
- HFC-245fa, HFC-365mfc, and HFC-227ea in rigid PU spray foam;
- HFC-245fa and HFC-227ea in new centrifugal chillers and new positive displacement chillers; and
- a number of refrigerant blends with higher GWPs in certain new refrigeration and AC equipment.

Parts of two other SNAP petitions previously submitted by the same three organizations are also relevant to this

rulemaking. In a petition EIA submitted to EPA on April 26, 2012, EIA stated that “in light of the comparative nature of the SNAP program’s evaluation of substitutes and given that other acceptable substitutes are on the market or soon to be available,” EPA should “remove HFC-134a and HFC-134a blends from the list of acceptable substitutes for any ozone-depleting substance in any non-essential uses under EPA’s SNAP program.” Additionally, NRDC, EIA, and IGSD filed a petition on April 27, 2012, requesting that EPA remove HFC-134a from the list of acceptable substitutes in household refrigerators and freezers, and stand-alone retail food refrigerators and freezers, among other end-uses. On August 7, 2013, EPA found both petitions to be incomplete. While EPA has not found these petitions complete at this time, EPA possesses sufficient information to finalize action on some of the end-uses covered by the petitions. Similar to the October 2015 petitions, this action is responsive to certain aspects of the petitions that relate to the refrigeration and AC and foam blowing sectors.

V. How does EPA regulate substitute refrigerants under CAA section 608?

A. What are the statutory requirements concerning venting, release, or disposal of refrigerants and refrigerant substitutes under CAA section 608?

To briefly summarize the primary requirements of CAA section 608, that section requires, among other things, that EPA establish regulations governing the use and disposal of ODS used as refrigerants, such as certain CFCs and HCFCs, during the service, repair, or disposal of appliances and industrial process refrigeration (IPR). Section 608(c)(1) provides that it is unlawful for any person, in the course of maintaining, servicing, repairing, or disposing of an appliance (or IPR), to knowingly vent, or otherwise knowingly release or dispose of any class I or class II substance used as a refrigerant in that appliance (or IPR) in a manner which permits the ODS to enter the environment.

Section 608(c)(1) exempts *de minimis* releases associated with good faith attempts to recapture and recycle or safely dispose of such a substance from this prohibition. EPA, as set forth in its regulations, interprets releases to meet the criteria for exempted *de minimis* releases if they occur when the recycling and recovery requirements of specified regulations issued under sections 608 and 609 are followed (40 CFR 82.154(a)(2)).

Section 608(c)(2) extends the prohibition in section 608(c)(1) to any substitutes for class I or class II substances used as refrigerants. This prohibition applies to all refrigerant substitutes unless the Administrator determines that the venting, releasing, or disposing of the substitute does not pose a threat to the environment. Thus, section 608(c) provides EPA authority to promulgate regulations to interpret and enforce this prohibition on venting, releasing, or disposing of class I or class II substances and their refrigerant substitutes, which this action refers to as the “venting prohibition.” EPA’s authority under section 608(c) includes authority to exempt certain refrigerant substitutes for class I or class II substances from the venting prohibition under section 608(c)(2) when the Administrator determines that such venting, release, or disposal does not pose a threat to the environment. EPA’s authority to promulgate some of the regulatory revisions in this action is thus based in part on CAA section 608.

B. What are EPA’s regulations concerning venting, releasing, or disposal of refrigerant substitutes?

Regulations issued under CAA section 608, published on May 14, 1993 (58 FR 28660), established a recycling program for ozone-depleting refrigerants recovered during the servicing and maintenance of refrigeration and AC appliances. These regulations are codified at 40 CFR part 82, subpart F. In the same 1993 rule, EPA also issued regulations implementing the section 608(c) prohibition on knowingly venting, releasing, or disposing of class I or class II substances. These regulations were designed to substantially reduce the use and emissions of ozone-depleting refrigerants.

EPA issued rules on March 12, 2004 (69 FR 11946) and April 13, 2005 (70 FR 19273) clarifying how the venting prohibition in section 608(c) applies to substitutes for CFC and HCFC refrigerants (e.g., HFCs and PFCs) during the maintenance, service, repair, or disposal of appliances. In part, they provide that no person maintaining, servicing, repairing, or disposing of appliances may knowingly vent or otherwise release into the environment any refrigerant or substitute from such appliances, with the exception of the specified substitutes in the specified end-uses, as provided in 40 CFR 82.154(a).

As explained in an earlier EPA rulemaking concerning refrigerant substitutes, EPA had not, at the time of that rulemaking, issued regulations

²³ NRDC/IGSD, 2015. Petition for Change of Status of HFCs under Clean Air Act Section 612 (Significant New Alternatives Policy). Submitted October 6, 2015.

²⁴ EIA, 2015. Petition requesting EPA to modify the status under the Significant New Alternatives Policy Program, of certain high-GWP chemicals in various end-uses. Submitted October 6, 2015.

requiring certification of refrigerant recycling/recovery equipment intended for use with substitutes to date (70 FR 19275; April 13, 2005). However, as EPA has noted, the lack of a current regulatory provision should not be considered as an exemption from the venting prohibition for substitutes that are not expressly exempted in § 82.154(a) (80 FR 69466, 69478).

The Administrator signed final regulations to require certification of refrigerant recovery and/or recycling equipment for use with refrigerants that are not exempt from the venting prohibition. For information on the final 608 rule, see the docket for the rulemaking (EPA-HQ-OAR-2015-0453).

On May 23, 2014 (79 FR 29682), EPA exempted from the venting prohibition three HC refrigerant substitutes listed as acceptable, subject to use conditions, in the following end-uses: Isobutane and R-441A in household refrigerators, freezers, and combination refrigerators and freezers; and propane in retail food refrigerators and freezers (stand-alone units only). Similarly, on April 10, 2015 (80 FR 19453), EPA exempted from the venting prohibition four HC refrigerant substitutes listed as acceptable, subject to use conditions, in the following end-uses: Isobutane and R-441A in retail food refrigerators and freezers (stand-alone units only); propane in household refrigerators, freezers, and combination refrigerators and freezers; ethane in very low temperature refrigeration equipment and equipment for non-mechanical heat transfer; R-441A, propane, and isobutane in vending machines; and propane and R-441A in self-contained room air conditioners for residential and light commercial AC and heat pumps. Those regulatory exemptions do not apply to blends of HCs with other refrigerants or containing any amount of any CFC, HCFC, HFC, or PFC.

In those 2014 and 2015 actions, EPA determined that for the purposes of CAA section 608(c)(2), the venting, release, or disposal of such HC refrigerant substitutes in the specified end-uses does not pose a threat to the environment, considering both the inherent characteristics of these substances and the limited quantities used in the relevant applications. EPA further concluded that other authorities, controls, or practices that apply to such refrigerant substitutes help to mitigate environmental risk from the release of those HC refrigerant substitutes.

VI. What is EPA finalizing in this action?

EPA is listing certain newly submitted alternatives as acceptable, subject to use conditions, and other newly submitted alternatives as unacceptable. EPA is also modifying current listings from acceptable to acceptable, subject to narrowed use limits, or to unacceptable for certain alternatives in various end-uses in the refrigeration and AC and foam blowing sectors. In each instance where EPA is listing a newly submitted substitute as unacceptable or is changing the status of a substitute from acceptable to unacceptable, EPA has determined that there are other alternatives that pose lower overall risk to human health and the environment. In a few instances, EPA established narrowed use limits for certain substitutes for specific military or space- and aeronautics-related applications in the refrigeration and AC, and foam blowing sectors, on the basis that other acceptable alternatives would not be available for those specific applications within broader end-uses, but acceptable alternatives were expected to become available over time. This action also applies unacceptability determinations for foam blowing agents to closed cell foam products and products containing closed cell foam. Additionally, EPA is exempting propane as a refrigerant in new self-contained commercial ice machines, in new water coolers, and in new very low temperature refrigeration equipment from the venting prohibition under CAA section 608(c)(2). This action also clarifies the listing for Powdered Aerosol D (Stat-X®), which was previously listed as both *acceptable* and *acceptable, subject to use conditions*, by removing the listing as *acceptable subject to use conditions*. The emissions that will be avoided from the changes of status in this action are estimated to be up to approximately 6.6 Million Metric Tons of Carbon Dioxide Equivalent (MMTCO₂eq) in 2025 and up to approximately 11.3 MMTCO₂eq in 2030.²⁵

Change of Listing Status

In determining whether to modify the previous listing decisions for substitutes based on whether other alternatives are available that pose lower risk to human health and the environment, we considered, among other things: Comments to the proposed rule of April 18, 2016, scientific findings, information provided by the Technology and Economic Assessment Panel (TEAP) that supports the Montreal Protocol,

journal articles, submissions to the SNAP program, the regulations and supporting dockets for other EPA rulemakings, presentations and reports presented at domestic and international conferences, and materials from trade associations and professional organizations. The materials on which we have relied are in the docket for this rulemaking (EPA-HQ-OAR-2015-0663). Key references are highlighted in section VIII of this action.

Change of Status Dates

The change of status dates are based upon EPA's understanding of the availability of alternatives, considering factors such as commercial availability and supply of alternatives, time required to work through technical challenges with using alternatives, and time required to meet other federal regulatory requirements with redesigned equipment or formulations. As discussed in previous actions, as part of our consideration of the availability of alternatives, we consider "all available information, including information provided during the public comment period, and information claimed as confidential and provided during meetings, regarding technical challenges that may affect the time at which the alternatives can be used safely and used consistent with other requirements such as testing and code compliance obligations" (80 FR 42873; July 20, 2015).

Consideration of Costs and Benefits

Under the SNAP criteria for review in 40 CFR 82.180(a)(7), consideration of cost is limited to cost of the substitute under review, and that consideration does not include the cost of transition when a substitute is found unacceptable. EPA requires information on cost and availability of substitutes as part of SNAP submissions to judge how widely a substitute might be used and, therefore, what its potential environmental and health effects might be. The SNAP criteria do not identify other cost considerations and thus we have not historically used cost information independent of environmental and health effects to determine the acceptability of substitutes under review—that is, we have never determined a substitute under review to be unacceptable or acceptable on the basis of its cost. When considering a change of status for substitutes already listed as acceptable, the SNAP program has not considered the costs of transition away from HFCs, HFC blends, PFCs, and other alternatives affected by the changes of status as part of determining the status

²⁵ EPA, 2016a. Climate Benefits of the SNAP Program Status Change Rule. March, 2016.

of the substitute or the availability of other alternatives for the same uses.

We are not addressing in this rulemaking whether to revise the regulatory criteria to include an expanded role for the consideration of costs in SNAP listing decisions. We have simply applied the existing regulatory criteria in determining whether to change the listing status of the substitutes addressed in this action.

Nevertheless, EPA has estimated the costs of the changes of status in this action to provide information to the public and to meet various statutory and executive order requirements. We have estimated costs for applicable NAICS codes in a document titled, “Cost Analysis for Regulatory Changes to the Listing Status of High-GWP Alternatives used in Refrigeration and Air Conditioning, Foams, and Fire Suppression.”²⁶ Using a seven percent discount rate, total annualized compliance costs across the roughly 100 affected businesses are estimated to range from \$59.2 million–\$71.3 million. Using a three percent discount rate, total annualized compliance costs are estimated to range from \$58.8 million–\$70.6 million.²⁷

In addition, we have analyzed costs and impacts on small businesses in a document titled, “Economic Impact Screening Analysis for Regulatory Changes to the Listing Status of High-GWP Alternatives used in Refrigeration and Air Conditioning, Foams, and Fire Suppression.”²⁸ The screening analysis finds that the rulemaking can be presumed to have no significant economic impact on a substantial number of small entities (SISNOSE). Roughly 89 small businesses could be subject to the rulemaking. Total annualized compliance costs across affected small businesses are estimated at approximately \$11.8–\$14.4 million at a seven percent discount rate, or \$11.5–\$14.0 million at a three percent discount rate.²⁹ Based upon these analyses, EPA

does not expect this action to have major economic impacts (greater than \$100 million per year) or to have a significant impact on a substantial number of small entities.

A. Refrigeration and Stationary AC

1. Acceptable Listing of Propane in New Self-Contained Commercial Ice Machines, Water Coolers, and Very Low Temperature Refrigeration Equipment

a. Background

This section, and other “background” sections that follow in the rule, provide information on the end-uses relevant to this decision, available alternatives, and other applicable regulations relevant to these end-uses.

Commercial ice machines are used in commercial establishments, such as hotels, restaurants, and convenience stores to produce ice. Many commercial ice machines are self-contained units, while some have the condenser separated from the portion of the machine making the ice and have refrigerant lines running between the two. This action applies only to self-contained commercial ice machines.

Water coolers are self-contained units providing chilled water for drinking. They may or may not feature detachable containers of water.

Very low temperature refrigeration equipment is intended to maintain temperatures considerably lower than for refrigeration of food—generally, -80°C (-170°F) or lower. In some cases, very low temperature refrigeration equipment may use a refrigeration system with two refrigerant loops containing different refrigerants or with a direct expansion (DX) refrigeration loop coupled with an alternative refrigeration technology (e.g., Stirling cycle).

The U.S. Department of Energy (DOE) has established energy conservation standards for automatic commercial ice machines which apply to the self-contained commercial ice machines in this listing.³⁰ DOE does not have an energy conservation standard that would apply to water coolers or to very low temperature refrigeration equipment. For further information on the relationship between this action and

approximately 14 percent possibly incurring costs in excess of three percent of annual sales.

³⁰ See https://www1.eere.energy.gov/buildings/appliance_standards/standards_test_procedures.html. “Automatic commercial ice machines” are defined as “a factory-made assembly (not necessarily shipped in 1 package) that—(1) consists of a condensing unit and ice-making section operating as an integrated unit, with means for making and harvesting ice; and (2) may include means for storing ice, dispensing ice, or storing and dispensing ice.”

other federal rules, see section VI.A.1.f of the proposed rule (81 FR 22830; April 18, 2016).

b. What is EPA’s final decision?

As proposed, EPA is listing propane (R-290) as acceptable, subject to use conditions, as a refrigerant in new self-contained commercial ice machines, in new water coolers, and in new very low temperature refrigeration equipment. The use conditions include conditions requiring conformity with industry standards, limits on charge size, and requirements for warnings and markings on equipment. The use conditions are detailed in section VI.A.1.b.ii.

i. How does propane compare to other refrigerants for these end-uses with respect to SNAP criteria?

EPA has listed a number of alternatives as acceptable in the commercial ice machine, water cooler, and very low temperature refrigeration end-uses. In the proposed rule (81 FR at 22824; April 18, 2016), EPA provided information on the environmental and health properties of propane and the various substitutes in these end-uses. Additionally, EPA’s risk assessments for propane and a technical support document³¹ that provides the **Federal Register** citations concerning data on the SNAP criteria (e.g., ODP, GWP, VOC, toxicity, flammability) for acceptable alternatives in the relevant end-uses are available in the docket for this rulemaking (EPA–HQ–OAR–2015–0663).

(a) Environmental Impacts

Propane has an ODP of zero.³² The most commonly used substitutes in the commercial ice machine, water cooler, and very low temperature refrigeration end-uses also have an ODP of zero (e.g., R-404A and R-134a). Some less common alternatives for these end-uses, such as R-401A, R-403B, R-414A and other blends containing HCFC-22 or HCFC-142b,³³ have ODPs ranging from 0.01 to 0.047. Thus, propane has an ODP lower

²⁶ ICF, 2016a. Cost Analysis for Regulatory Changes to the Listing Status of High-GWP Alternatives used in Refrigeration and Air Conditioning, Foams, and Fire Suppression. September, 2016.

²⁷ In terms of the distribution of the estimated total annualized costs by sectors: Refrigeration and air conditioning is about 97–98 percent, foams is about two to three percent and fire suppression is about zero percent.

²⁸ ICF, 2016b. Economic Impact Screening Analysis for Regulatory Changes to the Listing Status of High-GWP Alternatives used in Refrigeration and Air Conditioning, Foams, and Fire Suppression. September, 2016.

²⁹ Of those 89 small businesses, roughly 76 percent would be expected to incur compliance costs that are estimated to be less than one percent of annual sales. Roughly 24 percent could incur costs in excess of one percent of annual sales with

³¹ EPA, 2016b. Tables of Alternatives for End-Uses Considered in the Final Rule, Protection of Stratospheric Ozone: Listing Modifications for Certain Substitutes under the Significant New Alternatives Policy Program. September, 2016.

³² We assume that substitutes containing no chlorine, bromine, or iodine have an ODP of zero.

³³ Under EPA’s phaseout regulations, virgin HCFC-22, HCFC-142b, and blends containing HCFC-22 or HCFC-142b may only be used to service existing appliances. Consequently, virgin HCFC-22, HCFC-142b and blends containing HCFC-22 or HCFC-142b may not be used to manufacture new pre-charged appliances or appliance components or to charge new appliances assembled onsite.

than or identical to the ODPs of other alternatives in these end-uses.³⁴

The GWP is a means of quantifying the potential integrated climate forcing of various GHGs relative to a value of one for CO₂. Propane has a low GWP of three.³⁵ For comparison, some other commonly used acceptable refrigerants in these end-uses are R-134a and R-

404A, with GWPs of about 1,430 and 3,920, respectively. As shown in Table 2, the GWPs for acceptable refrigerants in commercial ice machines ranges from zero for ammonia vapor compression, ammonia absorption, and the not-in-kind (NIK) Stirling cycle technology to approximately 3,990 for R-507A. For water coolers, acceptable substitutes

have GWPs ranging from 31 for THR-02 to approximately 3,990 for R-507A.³⁶ For very low temperature refrigeration, the GWPs for acceptable substitutes range from one for CO₂ to 14,800 for HFC-23. Propane's GWP is comparable to or significantly lower than those of other alternatives in these end-uses.

TABLE 2—GWP, ODP, AND VOC STATUS OF PROPANE COMPARED TO OTHER REFRIGERANTS IN NEW COMMERCIAL ICE MACHINES, WATER COOLERS, AND VERY LOW TEMPERATURE REFRIGERATION EQUIPMENT ^{1 2}

Refrigerants	GWP	ODP	VOC	Listing status
Propane	3	0	Yes	Acceptable, subject to use conditions.
Commercial Ice Machines				
Ammonia, HFC-134a, R-404A, R-407A, R-407B, R-407C, R-407F, R-410A, R-410B, R-421A, R-421B, R-424A, R-426A, R-437A, R-448A, R-449A, R-450A, R-507A, R-513A.	0-3,990	0	No	Acceptable.
FOR12A, FOR12B, IKON A, IKON B, R-125/R-290 /R-134a/ R-600a (55.0/1.0/ 42.5/1.5), 417A, R-422A, R-422B, R-422C, R-422D, 428A, R-434A, R-438A, RS-24 (2002 formulation), RS-44 (2003 formulation), THR-02, THR-03.	30-3,610	0—Not public ³	Yes ⁴	Acceptable.
Water Coolers				
HFC-134a, R-404A, R-407A, R-407C, R-410A, R-410B, R-417A, R-421A, R-426A, R-437A, R-450A, R-507A, R-513A.	0-3,990	0	No	Acceptable.
FOR12A, FOR12B, IKON B, R-125/R-290 /R-134a /R-600a (55.0/ 1.0 /42.5/1.5), R-422B, R-422C, R-422D, R-438A, RS-24 (2002 formulation), SP34E, THR-02.	30-3,090	0—Not public ³	Yes ⁴	Acceptable.
Very Low Temperature Refrigeration Equipment				
CO ₂ , HFC-23, HFC-245fa, HFE-7000, HFE-7100, HFE-7200, R-170 (ethane), R-404A, R-407C, R-410A, R-410B, R-507A, R-508A, R-508B.	1-14,800	0	No	Acceptable.
ISCEON 89, R-125/R-290/R-134a/R-600a (55.0/1.0/42.5/1.5), R-422B, R-422C, PFC-1102HC, PFC-662HC, PFC-552HC, and FLC-15.	2,530-8,500	0	Yes ⁴	Acceptable.

¹ The table does not include not-in-kind technologies listed as acceptable for the stated end-use.

² HCFC-22 and several blends containing HCFCs are also listed as acceptable but their use is severely restricted by the phasedown in HCFC production and consumption.

³ The ODP of one or more alternatives is not published here in order to avoid disclosing information that is claimed as confidential business information.

⁴ One or more constituents of the blend are VOCs.

In assessing the overall climate impacts associated with use of these refrigerants, we focus on the “direct” emissions, which are emissions from releases of the refrigerants over the full lifecycle of refrigerant-containing products.³⁷ In contrast, “indirect” emissions are associated with electricity consumption. We do not have a practice in the SNAP program of evaluating indirect impacts in the overall risk analysis because such considerations are linked not only to the specific

alternative used but also to the design of specific pieces of equipment and equipment design changes from year-to-year. Thus, indirect impacts do not provide a reasonable metric for the SNAP evaluation, which occurs at a fixed point in time and considers other alternatives reviewed previously. Instead, our overall assessment of climate impacts considers issues such as technical needs for energy efficiency (e.g., to meet DOE conservation standards) as part of our consideration

of whether alternatives are “available.” We recognize that the energy efficiency of any given piece of equipment is in part affected by the choice of refrigerant and the particular thermodynamic and thermophysical properties of that refrigerant, as well as other factors. For example, appliances that are optimized for a specific refrigerant will operate more efficiently. While theoretical efficiency of any given Rankine cycle is not dependent on the refrigerant used, the refrigerant, the design of the

³⁴ Propane's ODP is also lower than the ODP of the ozone-depleting substances historically used in these end-uses: CFC-12 (ODP = 1.0); HCFC-22 (ODP = 0.055); R-13B1/halon 1301 (ODP = 10) and R-502 (ODP = 0.334).

³⁵ Unless otherwise stated, GWPs stated in this document are 100-year integrated time horizon

values taken from IPCC, 2007. Climate Change 2007: The Physical Science Basis.

³⁶ The GWPs of the ODS historically used in these end-uses are: CFC-12 (GWP = 10,900); HCFC-22 (GWP = 1,810); R-13B1/halon 1301; (GWP = 7,140) and R-502 (GWP = 4,660).

³⁷ RTOC, 2015. 2014 Report of the Refrigeration, Air-Conditioning and Heat Pumps Technical Options Committee. This document is accessible at: <http://ozone.unep.org/sites/ozone/files/documents/RTOC-Assessment-Report-2014.pdf>.

equipment, and other factors will affect the actual energy efficiency achieved in operation. Although we cannot know what energy efficiency will be achieved in future products using propane, or any other specific acceptable refrigerant, both actual equipment and testing results suggest that equipment optimized for propane may improve energy efficiency, and is unlikely to reduce it.^{38 39 40} Further, testing data, peer-reviewed journal articles and other information provided by the submitters for propane in these end-uses indicate that equipment using propane is likely to require a smaller refrigerant charge, have a higher coefficient of performance, and use less energy than equipment currently being manufactured that uses other refrigerants that currently are listed as acceptable under SNAP in these end-uses. Also see section VI.A.1.f of the proposed rule (81 FR 22830) concerning the role of the DOE energy conservation standards in ensuring that overall energy efficiency of equipment will be maintained or improved over time.

In addition to ODP and GWP, EPA evaluated potential impacts of propane and other HC refrigerants on local air quality. Propane meets the definition of VOC under CAA regulations (see 40 CFR 51.100(s)) and is not excluded from that definition for the purpose of developing State Implementation Plans (SIPs) to attain and maintain the National Ambient Air Quality Standards (NAAQS). As described below, EPA estimates that potential emissions of HCs, including propane, when used as refrigerant substitutes in all end-uses in the refrigeration and AC sector, have little impact on local air quality, with the exception of unsaturated HCs such as propylene.⁴¹

EPA analyzed various scenarios to consider the potential impacts on local air quality if HC refrigerants were used widely.⁴² The analysis considered both worst-case and more realistic scenarios. The worst-case scenario assumed that the most reactive HC listed as acceptable (isobutane) was used in all refrigeration and AC uses even though isobutane has not been listed acceptable for use in all refrigeration and AC uses,

and that all refrigerant used was emitted to the atmosphere. In that extreme scenario, the model predicted that the maximum increase in any single 8-hour average ground-level ozone concentration would be 0.72 parts per billion (ppb) in Los Angeles, which is the area with the highest level of ground-level ozone pollution in the United States. Based on this maximum projected increase, EPA determined that the incremental VOC emissions from refrigerant emissions would not cause any area that otherwise would meet the 2008 ozone NAAQS to exceed it.⁴³ Given the potential sources of uncertainty in the modeling, the conservativeness of the assumptions, and the finding that the incremental VOC emissions from refrigerant emissions would not cause any area that otherwise would meet the 2008 ozone NAAQS to exceed it,⁴⁴ we believe that the use of isobutane consistent with the use conditions required in EPA's regulations will not result in significantly greater risk to the environment than other alternatives. Because propane is less reactive at forming ground-level ozone than isobutane, we reach the same conclusion for propane.

In a less conservative analysis of potential impacts on ambient ozone levels, EPA looked at a set of end-uses that would be more likely to use HC refrigerants between now and 2030, including end-uses where HC refrigerants previously have been listed as acceptable and the three end-uses addressed in this rule. For example, we assumed use of propane in water coolers and commercial ice machines and in other end-uses where EPA has already listed propane as acceptable, including room air conditioners and household and retail food refrigeration equipment. We also assumed the use of other HCs in end-uses where they are already listed as acceptable such as isobutane in household and retail food refrigeration equipment and R-441A in room air conditioners and household and retail food refrigeration equipment. For further information on the specific assumptions, see the docket for this rulemaking.⁴⁵ Based on this still conservative but more probable assessment of refrigerant use, we found

that there would be a worst-case impact of a 0.15 ppb increase in ozone for a single 8-hour average concentration in the Los Angeles area, which is the area with the highest level of ground-level ozone in the United States.⁴⁶ In the other cities examined in the analysis, Houston and Atlanta, impacts were smaller (no more than 0.03 and 0.01 ppb for a single 8-hour average concentration, respectively).⁴⁷ For areas in the analysis that were not violating the 2008 ozone NAAQS, the impacts did not cause an exceedance of the 2008 ozone NAAQS. We updated this analysis for the final rule, extending the analysis to 2040 and considering just those uses of hydrocarbon refrigerants already listed as acceptable, subject to use conditions, and the use of propane in the end-uses in this rule. This updated analysis found worst-case impacts for a single 8-hour average concentration in the Los Angeles area of 0.05 ppb and worst-case impacts of less than 0.01 ppb in Houston and Atlanta.

Because of the relatively minimal air quality impacts of propane if it is released to the atmosphere from commercial ice machines, water coolers, and very low temperature refrigeration equipment even in a worst-case scenario, we conclude that propane does not have a significantly greater overall impact on human health and the environment based on its effects on local air quality than other refrigerants listed as acceptable in commercial ice machines, water coolers, and very low temperature refrigeration equipment.

Ecosystem effects from propane, primarily effects on aquatic life, are expected to be small as are the effects of other acceptable substitutes. Propane is highly volatile and typically evaporates or partitions to air, rather than contaminating surface waters, and thus propane's effects on aquatic life are expected to be small. Propane will pose no greater risk of aquatic or ecosystem effects than those of other alternatives for these uses.

⁴⁶ This less conservative analysis included some use of R-443A in room AC units because that substitute was under evaluation for that end-use. Elsewhere in this rule, we find R-443A and propylene unacceptable in residential and light-commercial AC and heat pumps, including room AC units. The propylene in R-443A, representing 12 percent of refrigerant emitted, was responsible for about 75 percent of the 0.15 ppb increase in ozone in this scenario, while all uses of propane, representing 83 percent of refrigerant emitted, was responsible for about 21 percent of the increase of ozone in this scenario. Thus, only 0.03 ppb of the 0.15 ppb observed in Los Angeles would be due to propane and other acceptable HCs.

⁴⁷ ICF, 2014a. Assessment of the Potential Impact of Hydrocarbon Refrigerants on Ground Level Ozone Concentrations. February, 2014.

³⁸ Eppendorf, 2015. SNAP Information Notice for R-170 and R-290 in Very Low Temperature Refrigeration. May, 2015.

³⁹ Manitowoc, 2015. SNAP Information Notice, September, 2013. EPA SNAP Submittal—Revision to Extend R-290 Use to Commercial Ice Machines, Manitowoc Ice, Inc. October, 2015.

⁴⁰ Blupura, 2015. SNAP Information Notice for R-290 in Water Coolers. October, 2015.

⁴¹ ICF, 2014a. Assessment of the Potential Impact of Hydrocarbon Refrigerants on Ground Level Ozone Concentrations. February, 2014.

⁴² Ibid.

⁴³ The analysis described here was conducted prior to finalization of the 2015 ozone NAAQS. EPA has not yet made ozone attainment area designations for the 2015 ozone NAAQS.

⁴⁴ The analysis described here was conducted prior to finalization of the 2015 ozone NAAQS. EPA has not yet made ozone attainment area designations for the 2015 ozone NAAQS.

⁴⁵ ICF, 2014a. Assessment of the Potential Impact of Hydrocarbon Refrigerants on Ground Level Ozone Concentrations. February, 2014.

(b) Flammability

Propane is classified as an A3 refrigerant by ASHRAE Standard 34–2013 and subsequent addenda, indicating that it has low toxicity and high flammability. ANSI/ASHRAE Standard 34–2013 assigns a safety group classification for each refrigerant which consists of two alphanumeric characters (*e.g.*, A2 or B1). The capital letter indicates the toxicity and the numeral denotes the flammability. ASHRAE classifies Class A refrigerants as refrigerants for which toxicity has not been identified at concentrations less than or equal to 400 parts per million (ppm) by volume, based on data used to determine TLV-time weighted average (TWA) or consistent indices. Class B signifies refrigerants for which there is evidence of toxicity at concentrations

below 400 ppm by volume, based on data used to determine TLV-TWA or consistent indices. The refrigerants are also assigned a flammability classification of 1, 2, or 3. Tests are conducted in accordance with ASTM E681 using a spark ignition source at 60 °C and 101.3 kPa.⁴⁸ Figure 1 in ANSI/ASHRAE Standard 15–2013 uses the same safety group but limits its concentration to 3,400 ppm.⁴⁹

The flammability classification “1” is given to refrigerants that, when tested, show no flame propagation. The flammability classification “2” is given to refrigerants that, when tested, exhibit flame propagation, have a heat of combustion less than 19,000 kJ/kg (8,174 British thermal units (BTU)/lb), and have a lower flammability limit (LFL) greater than 0.10 kg/m³. Refrigerants within flammability

classification 2 may optionally be designated in the LFL subclass “2L” if they have a maximum burning velocity of 10 cm/s or lower when tested at 23.0 °C and 101.3 kPa. The flammability classification “3” is given to refrigerants that, when tested, exhibit flame propagation and that either have a heat of combustion of 19,000 kJ/kg (8,174 BTU/lb) or greater or an LFL of 0.10 kg/m³ or lower. Thus, refrigerants with flammability classification “3” are highly flammable while those with flammability classification “2” are less flammable and those with flammability classification “2L” are mildly flammable. For both toxicity and flammability classifications, refrigerant blends are designated based on the worst-case of fractionation determined for the blend.

Figure 1. Refrigerant Safety Group Classification

Safety Group

	Higher Flammability	A3	B3
	Lower Flammability	A2	B2
	No Flame Propagation	A1	B1
		Lower Toxicity	Higher Toxicity

Increasing Toxicity

Increasing Flammability

Propane’s flammability risks are of potential concern because commercial ice machines, water coolers, and very low temperature refrigeration equipment have traditionally used refrigerants that are not flammable. Without appropriate use conditions, the flammability risk posed by propane would be higher than non-flammable refrigerants because individuals may not be aware that their actions could potentially cause a fire.

Because of its flammability, propane could pose a significant safety concern for workers and consumers in the end-uses addressed in this proposal if it is not handled correctly. In the presence of an ignition source (*e.g.*, static electricity spark resulting from closing a door, use of a torch during service, or a short circuit in wiring that controls the motor

of a compressor), an explosion or a fire could occur when the concentration of refrigerant exceeds its LFL. Propane’s LFL is 21,000 ppm (2.1 percent). Therefore, to use propane safely, it is important to minimize the presence of potential ignition sources and to reduce the likelihood that the concentration of propane will exceed the LFL. Under the final listing decision in this action, propane is acceptable for use only in new equipment (self-contained commercial ice machines, water coolers, and very low temperature refrigeration equipment) specifically designed for this refrigerant.

To determine whether flammability would be a concern for service personnel or for consumers, EPA analyzed multiple scenarios, beginning with a plausible worst-case scenario to

model a catastrophic release of propane. Based upon the results of those analyses, we expect there would not be an unacceptable risk of fire or explosion provided that the charge size is limited to 150 g for self-contained ice machines or very low temperature refrigeration equipment or to 60 g for water coolers. EPA also reviewed the submitters’ detailed assessments of the probability of events that might create a fire and approaches to avoid sparking from the refrigeration equipment. Further information on these analyses and EPA’s risk assessments are available in the docket for this rulemaking (EPA–HQ–OAR–2015–0663) and in section VI.A.1.b.ii of the proposed rule (81 FR 22827).

Service personnel or consumers may not be familiar with refrigeration or AC

⁴⁸ ASHRAE, 2013a. ANSI/ASHRAE Standard 34–2013: Designation and Safety Classification of Refrigerants.

⁴⁹ ASHRAE, 2013b. ANSI/ASHRAE Standard 15–2013: Safety Standard for Refrigeration Systems.

equipment containing a flammable refrigerant. Therefore, use conditions are necessary to ensure people handling such equipment are aware that equipment contains a flammable refrigerant and to ensure safe handling. When used in accordance with the use conditions required by this rule, and with equipment specifically designed for its use, propane's flammability hazard is adequately mitigated and its use is not significantly greater than that of other acceptable substitutes in these end-uses.

(c) Toxicity

In evaluating potential toxicity impacts of propane on human health in these end-uses, EPA considered both occupational and consumer risks. In general when evaluating non-cancer toxicity risks of a substitute, we use measured exposure concentrations if available, or modeled exposure concentrations using conservative assumptions appropriate to an end-use, and compare these exposure levels to recommended or required exposure limits for a compound that are intended to protect against adverse health effects. Where measured or modeled exposure levels are below relevant exposure limits for a chemical, we consider toxicity risks to be acceptable. Other acceptable substitutes listed for these end-uses have been evaluated for toxicity in this manner, including ethane for very low temperature refrigeration, ammonia for commercial ice machines, and a number of HFC blends for all three end-uses.

To evaluate the toxicity of propane, EPA estimated the maximum TWA exposure both for a short-term exposure scenario, with a 30-minute TWA exposure, and for an 8-hour TWA that would be more typical of occupational exposure for a technician servicing the equipment or a worker disposing of appliances. The modeling results indicate that both the short-term (30-minute) and long-term (8-hour) worker exposure concentrations would be below the relevant workplace exposure limits.

A similar analysis of asphyxiation risks considered whether a worst-case release of refrigerant in the same room sizes would result in oxygen concentrations of 12 percent or less. This analysis found that impacts on oxygen concentrations were minimal, with oxygen concentrations remaining at approximately 21 percent.

For equipment with which consumers might come into contact, such as water coolers and commercial ice machines, EPA performed a consumer exposure analysis. In this analysis, we examined

potential catastrophic release of the entire charge of the substitute in one minute under a worst-case scenario. We did not examine exposure to consumers in very low temperature refrigeration, as equipment for this end-use would typically be used in the workplace, such as in laboratories, and not in a home or public space. The analysis was undertaken to determine the short term (30-minute TWA) exposure levels for the substitute, which were then compared to the toxicity limit to assess the risk to consumers. The analysis found, even under the highly conservative assumptions used in the consumer exposure modeling, the estimated 30-minute consumer exposures to propane are lower than the relevant toxicity limits.

Based upon our analysis, workplace and consumer exposure to propane when used in these end-uses according to the use conditions is not expected to exceed relevant exposure limits. Thus, propane does not pose significantly greater toxicity risks than other acceptable refrigerants in these end-uses. For further information, including EPA's risk screens and risk assessments as well as information from the submitters of propane as a substitute refrigerant, see docket EPA-HQ-OAR-2015-0663 and section VI.A.1.b.iii of the proposed rule (81 FR 22827-8).

ii. What are the final use conditions?

To ensure that using propane in commercial ice machines, water coolers, and very low temperature refrigeration equipment will not cause greater risk to human health or the environment than other alternatives, we have identified and are establishing use conditions to address flammability and toxicity concerns.

Propane's flammability risks are of potential concern because commercial ice machines, water coolers, and very low temperature refrigeration equipment have traditionally used refrigerants that are not flammable. Propane could pose a significant safety concern for workers and consumers in the end-uses addressed in this action if it is not handled correctly. In the presence of an ignition source (e.g., static electricity spark resulting from closing a door, use of a torch during service, or a short circuit in wiring that controls the motor of a compressor), an explosion or a fire could occur when the concentration of refrigerant exceeds its LFL. Propane's LFL is 21,000 ppm (2.1 percent). Therefore, to use propane safely, it is important to minimize the presence of potential ignition sources and to reduce the likelihood that the concentration of propane will exceed

the LFL. We are establishing use conditions that focus on ensuring that these risks are addressed for both the end user and service personnel. OSHA and building code requirements generally address flammability risks in the workplace, and we presume that the original equipment manufacturers (OEMs), who would be storing large quantities of the refrigerant, are familiar with and will use proper safety precautions to minimize the risk of explosion, consistent with those requirements. Therefore, we are not establishing use conditions to address workplace risk, which would be redundant of existing requirements. We are including recommendations in the **FURTHER INFORMATION** section of the SNAP listings that these facilities be equipped with proper ventilation systems and be properly designed to reduce possible ignition sources. See section VI.A.1.b.ii in this action and section VI.A.1.b.ii of the proposed rule (81 FR 22827) for additional information on the flammability risks posed by propane. Further information on EPA's risk assessments are available in the docket for this rulemaking (EPA-HQ-OAR-2015-0663).

We are finalizing the proposed use conditions, summarized in section VI.A.1.b.ii.(a)–(e), with one change—we are lowering the charge size for water coolers. In response to public comment and for consistency with the Underwriters Laboratories (UL) 399 standard, we are finalizing a charge size of 60 g for water coolers instead of 150 g. The use conditions are consistent with industry standards, limits on charge size, and requirements for warnings and markings on equipment.

(a) For Use in New Equipment Only; Not for Use as a Retrofit Alternative

In the specified end-uses in this action, propane is limited to use only in new equipment⁵⁰ that has been designed and manufactured specifically for use with propane. Propane was not submitted under the SNAP program to be used in retrofitted equipment, and no information was provided on how to mitigate hazards of flammable refrigerants when used in equipment that was not designed for flammable refrigerants. Use of propane in equipment not designed for its use, including existing equipment designed for another refrigerant, is a violation of CAA section 612(c) and the

⁵⁰ This is intended to mean a completely new refrigeration circuit containing a new evaporator, condenser and refrigerant tubing.

corresponding SNAP regulations at 40 CFR part 82, subpart G.

(b) Standards

EPA is requiring that propane be used only in equipment that meets all requirements in the relevant supplements for flammable refrigerants in certain applicable UL standards for refrigeration and AC equipment. Specifically, Supplement SA to the 8th edition of UL 563 standard, dated July 31, 2009, applies to self-contained commercial ice machines using flammable refrigerants.⁵¹ Supplement SB to the 7th edition of UL 399, dated August 22, 2008, applies to water coolers using flammable refrigerants.⁵² Very low temperature refrigeration equipment is sufficiently similar to stand-alone commercial refrigerators that an appropriate standard is Supplement SB to the 10th edition of UL 471, dated November 24, 2010.⁵³

UL has tested equipment for flammability risk in household and retail food refrigeration and in commercial freezers for very low temperature refrigeration. Further, UL has developed acceptable safety standards including requirements for construction, markings, and performance tests concerning refrigerant leakage, ignition of switching components, surface temperature of parts, and component strength after being scratched. These standards were developed in an open and consensus-based approach, with the assistance of experts in the AC and refrigeration industry as well as experts involved in assessing the safety of products. While similar standards exist from other bodies such as the International Electrotechnical Commission (IEC), we are relying on UL standards as those are the standards applicable to and recognized by the U.S. market. This approach is the same as that adopted in our previous rules on flammable refrigerants (76 FR 78832, December 20, 2011; 80 FR 19453, April 10, 2015). EPA acknowledges that international standards exist and believes that UL will likely harmonize with these standards in the future. If UL plans to update ANSI/UL399 to harmonize with IEC-60335-2-89, then referencing an IEC standard in future actions may

allow for a smoother transition. Specifically, the international standard must adequately provide guidelines for use conditions for all equipment types under SNAP review, including refrigerant charge size limits, minimum room sizes for installation, ventilation requirements, and required permanent markings on equipment, system parts, and servicing equipment.

(c) Charge Size

EPA is requiring a charge size not to exceed 150 g in each refrigerant circuit for self-contained commercial ice machines and very low temperature refrigeration equipment and not to exceed 60 g in each refrigerant circuit for water coolers.⁵⁴ These are the charge sizes that reflect the UL 563, UL 399, and UL 471 standards. UL Standards 563 (ice machines) and 471 (commercial stand-alone refrigeration equipment) limit the amount of refrigerant leaked to 150 g (5.29 oz). UL 399 (water coolers) limits the amount of refrigerant leaked to 60 g (2.12 oz) discussed in paragraph (b) of this section, the UL standards are applicable to and recognized by the U.S. market and are developed by a consensus of experts. We note that the charge size limit for propane of 150 g in the UL standards for ice machines and commercial stand-alone commercial refrigeration equipment is in line with the IEC 60335-2-89 standard addressing commercial ice-machines and other commercial refrigeration equipment, which also has a charge size limit of 150 g. These limits will reduce the risk to workers and consumers since under scenarios we analyzed, a leak of refrigerant of these sizes did not result in concentrations of the refrigerant that met or exceeded the LFL.

(d) Color-Coded Hoses and Piping

EPA is requiring that equipment designed for use with propane must have distinguishing color-coded hoses and piping to indicate use of a flammable refrigerant. This will help technicians immediately identify the use of a flammable refrigerant, thereby reducing the risk of using sparking equipment or otherwise having an ignition source nearby. The AC and refrigeration industry currently uses distinguishing colors as means to identify different refrigerants. Likewise, distinguishing coloring has been used elsewhere to indicate an unusual and potentially dangerous situation, for example in the use of orange insulated wires in hybrid electric vehicles. Currently, no industry standard exists

for color-coded hoses or pipes for propane. EPA is requiring that all such refrigerator tubing be colored red Pantone matching system (PMS) #185 to match the red band displayed on the container of flammable refrigerants under the Air Conditioning, Heating and Refrigeration Institute (AHRI) Guideline “N” 2014, “2014 Guideline for Assignment of Refrigerant Container Colors.”⁵⁵ This requirement mirrors the existing use condition for flammable refrigerants in residential and commercial refrigerator-freezers, vending machines, very low temperature refrigeration equipment, non-mechanical heat transfer equipment, and room air conditioners (76 FR 78832, December 20, 2011; 80 FR 19453, April 10, 2015). EPA wants to ensure that there is adequate notice that a flammable refrigerant is being used within a particular piece of equipment or appliance. One way to mark hoses and pipes is to add a colored plastic sleeve or cap to the service tube rather than painting or dyeing the hoses or pipes. This sleeve would be of the same red color (PMS #185) and could also be boldly marked with the flame graphic required by the UL standards to indicate the refrigerant was flammable.

EPA is particularly concerned with ensuring adequate and proper notification for servicing and disposal of appliances containing flammable refrigerants. The use of color-coded hoses, as well as the use of warning labels discussed in the next paragraph, would be consistent with other general industry practices. This approach is consistent with the approach adopted in our previous rules on flammable refrigerants (76 FR 78832, December 20, 2011; 80 FR 19453, April 10, 2015).

(e) Labeling

EPA is requiring labeling of self-contained commercial ice machines, water coolers, and very low temperature refrigeration equipment. EPA is requiring that the warning labels on the equipment contain letters at least 1/4 inch high and that they be permanently affixed to the equipment. Warning label language requirements are as follows:

(1) “DANGER—Risk of Fire or Explosion. Flammable Refrigerant Used. Do Not Use Mechanical Devices To Defrost Refrigerator. Do Not Puncture Refrigerant Tubing.” This marking must be provided on or near any evaporators that can be contacted by the consumer.

⁵¹ UL, 2009. Standard 563—Standard for Ice Makers. A summary of this document is accessible at: <http://ulstandards.ul.com/standard/?id=563>.

⁵² UL, 2008. Standard 399—Standard for Drinking-Water Coolers. A summary of this document is accessible at: <http://ulstandards.ul.com/standard/?id=399>.

⁵³ UL, 2010. Standard 471—Standard for Commercial Refrigerators and Freezers. A summary of this document is accessible at: <http://ulstandards.ul.com/standard/?id=471>.

⁵⁴ To place this in context, a 150 g charge is about five times the charge in a disposable lighter (30 g).

⁵⁵ AHRI, 2014. Guideline N-2014 for Assignment of Refrigerant Container Colors. This document is accessible online at http://www.ahrinet.org/App_Content/ahri/files/Guidelines/AHRI_Guideline_N_2014.pdf.

(2) "DANGER—Risk of Fire or Explosion. Flammable Refrigerant Used. To Be Repaired Only By Trained Service Personnel. Do Not Puncture Refrigerant Tubing." This marking must be located near the machine compartment.

(3) "CAUTION—Risk of Fire or Explosion. Flammable Refrigerant Used. Consult Repair Manual/Owner's Guide Before Attempting To Service This Product. All Safety Precautions Must be Followed." This marking must be located near the machine compartment.

(4) "CAUTION—Risk of Fire or Explosion. Dispose of Properly In Accordance With Federal or Local Regulations. Flammable Refrigerant Used." This marking must be provided on the exterior of the refrigeration equipment.

(5) CAUTION—Risk of Fire or Explosion Due To Puncture Of Refrigerant Tubing; Follow Handling Instructions Carefully. Flammable Refrigerant Used." This marking must be provided near all exposed refrigerant tubing.

The warning label language is similar to or exactly the same as that required in UL standards: For commercial ice machines in UL 563 in section SB6.1, for water coolers in UL 399 in section SA6.1, and for commercial refrigerators and freezers, including very low temperature freezers, in UL 471 in section SB6.1.

It would be difficult to see warning labels with the minimum lettering height requirement of $\frac{1}{8}$ inch in these UL standards. Therefore, as in the requirements in our previous HC refrigerants rules for residential and commercial refrigerator-freezers, vending machines, very low temperature refrigeration equipment, non-mechanical heat transfer equipment, and room air conditioners (76 FR 78832, December 20, 2011; 80 FR 19453, April 10, 2015), EPA is requiring the minimum height for lettering must be $\frac{1}{4}$ inch as opposed to $\frac{1}{8}$ inch. This will make it easier for technicians, consumers, retail storeowners, and first responders to view the warning labels.

iii. What recommendations does EPA have for the safe use of propane?

In addition to establishing regulatory use conditions, which are binding on users of this substitute, EPA is also making recommendations for the use of this substitute. EPA is recommending that only technicians specifically trained in handling flammable refrigerant dispose of or service refrigeration and AC equipment containing these substances. Trained technicians should know how to minimize the risk of fire and the

procedures for using flammable refrigerants safely. Releases of large quantities of flammable refrigerants during servicing and manufacturing, especially in enclosed, poorly ventilated spaces or in areas where large amounts of refrigerant are stored, could cause an explosion if there is an ignition source nearby. For these reasons, technicians should be properly trained to handle flammable refrigerant when maintaining, servicing, repairing, or disposing of water coolers, commercial ice machines, and very low temperature freezers. In addition, EPA recommends that if propane is vented, released, or disposed of (rather than recovered) for these specified end-uses, the release should be in a well-ventilated area, such as outside of a building. Ensuring proper ventilation and avoiding ignition sources are recommended practices, whether venting or recovering a flammable refrigerant.

The Australian Institute of Refrigeration, Air Conditioning and Heating (AIRAH) provides useful guidance on safety precautions technicians can follow when servicing equipment containing flammable refrigerants or when venting refrigerant. One of those practices is to connect a hose to the appliance to allow for venting the refrigerant outside.⁵⁶ This document is included in the docket for this action (EPA-HQ-OAR-2015-0663).

We are aware that at least two organizations in the United States, Refrigeration Service Engineers Society (RSES) and the ESCO Institute, have developed technician training programs in collaboration with refrigeration equipment manufacturers and users that address safe use of flammable refrigerant substitutes. In addition, EPA has reviewed several training programs provided as part of SNAP submissions from persons interested in flammable refrigerant substitutes. The Agency intends to update the test bank for technician certification under CAA section 608, and will consider including additional questions on flammable refrigerants. By adding such questions to the test bank, EPA would supplement but not replace technician training programs currently provided by non-government entities. EPA intends to seek additional information and guidance on how best to incorporate this content through a separate process outside the scope of this final rule.

⁵⁶ AIRAH, 2013. Australian Institute of Refrigeration, Air Conditioning and Heating. Safety Guide: Flammable Refrigerants. 2013. This document is accessible at: <http://www.unep.fr/ozoneaction/information/mmfiles/7681-e-FlammableRefrigerantsGuideAIRAH.pdf>.

iv. When will the listing apply?

EPA is establishing a listing date as of January 3, 2017, the same as the effective date of this regulation, to allow for the safe use of this substitute at the earliest opportunity.

c. How is EPA responding to comments?

EPA received comments from organizations with various interests in commercial refrigeration regarding the proposed listing of propane as acceptable, subject to use conditions, in newly manufactured self-contained commercial ice machines, water coolers, and very low temperature refrigeration equipment. Most commenters supported the proposed listing decision and effective date of 30 days after publication of the rule in the **Federal Register**. Other commenters addressed the environmental impacts of the proposed listing of propane, the proposed use conditions, training for technicians handling flammable refrigerants, and industry codes and standards.

Commenters included Filtrine Manufacturing Company (Filtrine), a manufacturer of drinking fountains, water coolers, and drinking water filtration equipment; the Flexible Packaging Association (FPA); Chemours, a chemical producer; the National Environmental Development Association's Clean Air Project (NEDA/CAP), an organization representing manufacturers of a variety of refrigeration and AC equipment among others; and UL, a safety consulting and certification company.

We have grouped comments together and responded to the issues raised by the comments in the sections that follow, or in a separate Response to Comments document which is included in the docket for this rule (EPA-HQ-OAR-2015-0663).

i. Substitute and End-Uses Proposed

Comment: Filtrine supported the listing of propane in water coolers. Filtrine noted that water cooler units using propane perform as efficiently or more efficiently than other commonly used HFC refrigerants, such as R-134a.

Response: EPA appreciates the comments supporting the decision to list propane as acceptable, subject to use conditions, in commercial ice machines, water coolers, and very low temperature refrigeration equipment. EPA agrees that HCs are already being safely and successfully used in such types of equipment around the world. New designs, along with components and technology will help optimize the performance of these systems, thus improving their efficiency.

ii. SNAP Review Criteria

Comment: FPA commented on the safety concerns regarding the use of a flammable VOC in the three end-uses and expressed the need for technician certification requirements for the use of propane in these equipment. FPA is concerned that the flammability of propane in the workplace will pose both worker safety risks as well as potential environmental hazards. FPA suggested that EPA further assess the safety and health risks of using propane in new uses, and also in existing uses.

Response: EPA evaluated the flammability risks of propane in these three end-uses in the risk screens included in the docket for this rulemaking (EPA-HQ-OAR-2015-0663). EPA's evaluations followed the standard approach for evaluating health and environmental risks that the SNAP program has used over its 20-year history. The results found leaks of propane in commercial ice machines, water coolers, and very low temperature refrigeration equipment resulted in concentrations far below the LFL of 21,000 ppm, showing a lack of flammability risk when charge sizes at or below those established in the use conditions are used. Regarding technician certification requirements for the handling of flammable refrigerants, EPA notes that in recent years, training programs on flammable refrigerants have been developed and are currently available in the United States. The Agency intends to update the test bank for technician certification under CAA section 608 as we have done previously, and will consider including additional questions on flammable refrigerants. By adding such questions to the test bank, EPA would supplement but would not replace technician training programs currently provided by non-government entities. EPA will seek additional information and guidance on how best to incorporate this content through a separate process outside the scope of this final rule.

Comment: NEDA/CAP commented that propane is a VOC and that under worst-case scenarios, the use of propane in new refrigeration and cooling equipment could create an issue for local air pollution control authorities in severe and extreme ozone nonattainment areas. The commenter noted that any VOC (with any reactivity) must be reported to state/local/tribal and federal CAA regulators in biennial emissions inventories and annual permit reports under CAA Titles I and V, respectively. NEDA/CAP suggested that EPA's proposal will trigger a domino effect that will impact state/

local and tribal air permitting authorities which will require immediate planning (and, potentially, permitting) problems with the potential to snowball with each proposed new and existing use for which propane is added. FPA also claims that use of propane could interfere with NAAQS attainment.

Response: EPA disagrees with the commenter that under worst-case scenarios, the use of propane in new refrigeration and cooling equipment could create an issue for local air pollution control authorities in severe and extreme ozone nonattainment areas. The worst-case scenario modeled by EPA was based on use of isobutane in all refrigeration equipment, even though its use has not been approved in all refrigeration equipment. Isobutane is a more reactive VOC than is propane. While that worst-case scenario did indicate an increase up to 0.72 ppb in Los Angeles area, EPA determined that it did not accurately depict the risk of the use of propane in a limited subset of refrigeration equipment. Therefore, EPA evaluated a scenario where propane and three other HC refrigerants were used in a number of end-uses where industry submitters had proposed their use, including those in this rule; in end-uses where EPA had already listed them as acceptable, subject to use condition; or in industries where a UL standard might allow for their use in the future. This scenario considers most end-uses that EPA is likely to address in the next few years. In this scenario, we found the worst-case change in ground-level ozone concentration was 0.15 ppb in 2030 (ICF, 2014a) and 0.44 ppb in 2040 (ICF, 2016l). EPA also examined a scenario that considered only the HC refrigerants being listed as acceptable, subject to use conditions, in this action or previously listed as acceptable, subject to use conditions. This analysis found worst-case impacts of 0.05 ppb in Los Angeles and less than 0.01 ppb in Houston or in Atlanta in 2040. This modeling contained conservative assumptions, such as the assumption that all refrigerant would be released to the environment and the assumption that no refrigerants other than hydrocarbons would be used in these end-uses. When modeling decades into the future, there are many sources of uncertainty that are likely greater in magnitude than the modeled increase in ozone concentrations (e.g., changes in the market, impacts on cloud cover due to climate change). In this analysis that corresponds to the end-uses listed in this rule and previous acceptable listings, the modeled incremental

ground-level ozone concentrations are so low that they are difficult to separate from the impact of all other emissions. Given the conservativeness of the assumptions, the potential sources of uncertainty in the modeling, and the small magnitude of these modeled increases, we consider it highly likely that state and local agencies will be able to meet air quality goals without extensive or repeated new planning.

iii. Use Conditions

Comment: UL suggested that EPA appears to be proposing changes that are outside of, but will have a direct impact on, industry voluntary consensus standards such as those published by UL. They asserted that the proposed rule contrasts with the requirements previously developed and recommended by the Joint Task Group that UL tasked with developing a common technical basis for addressing the safety of flammable refrigerants in various UL standards. UL recommended that EPA work within the framework of the established voluntary consensus standards process for revising and updating safety standards for the refrigeration and AC sector.

Response: With one exception, the use conditions established for propane in the three end-uses are consistent with the UL standards. The one use condition that differs is the condition requiring a larger print size for the warning labels. This approach is consistent with the use conditions EPA has established for use of flammable refrigerants in a variety of refrigeration end uses. EPA believes it is necessary to require a larger print size because it would be difficult to see warning labels with the minimum lettering height requirement of 1/8 inch in the UL standards. To the extent practicable, EPA attempts to rely upon the established voluntary consensus standards process.

Comment: UL noted that EPA misunderstood the charge limit size in the Standard for Safety for Drinking Water Coolers, ANSI/UL 399, covering drinking water coolers using propane as a refrigerant. In accordance with ANSI/UL 399, Supplement SB, Paragraph SB3.2(b), the charge limit is 2.0 oz. (60 g) for refrigerants having an ASHRAE Class 3 flammability classification. UL commented that the proposed rule specified that the charge limit was 150g (5.29 oz).

Response: EPA agrees with the commenter that the charge size in the proposed rule for drinking water coolers was not consistent with the charge limit size in the Standard for Safety for Drinking Water Coolers, ANSI/UL 399. In that standard the charge size limit is

currently set to 60 g. Based upon EPA's risk screen prepared for the proposed rule (EPA-HQ-OAR-2015-0663-0022), a worst-case release of an entire charge of 150 g of propane could result in exceeding the LFL in a small room, as in a small residential kitchen, while release of a charge of 60 g or propane, as per the UL standard, would not result in exceeding the LFL. In that risk screen, we analyzed larger charge sizes of up to 150 g only in the context of use in spaces such as commercial kitchens that are likely to be larger and have better ventilation than in a home; however, EPA cannot guarantee that equipment with larger charge sizes would be used in larger spaces, and 60 g is protective for all spaces in which this type of equipment may be used. EPA's intention was to reference the charge limit in ANSI/UL 399 and EPA is finalizing a charge limit of 60 g for water coolers consistent with ANSI/UL 399.

Comment: UL noted that EPA proposed that a "colored plastic sleeve or cap" be secured to the service tube. The sleeve would be boldly marked with a graphic to indicate that the refrigeration circuit is flammable. UL suggested that the Agency provide more information describing the securement means of the sleeve or cap to the service tube so that it will not likely be removed (or broken off) for other than a servicing operation. Additionally, they suggested EPA provide a more thorough description of the flammable refrigerant "graphic" that is required to be located on the sleeve or cap is necessary.

Response: The discussion of a "colored plastic sleeve or cap" was not a use condition, but rather an additional suggestion on how the use condition for colored markings on tubing could be implemented. An example of a sleeve would be a loop of plastic that completely wraps around the tube or hose at any service port and other parts of the system where service puncturing or other actions creating an opening from the refrigerant circuit to the atmosphere might be expected. The flammable refrigerant graphic referred to is the flame graphic already required by UL standards.

Comment: UL noted that Clause 7.5.1.2 of ANSI/ASHRAE 15-2013 does not permit refrigerated products using refrigerants other than those having a flammability classification of A1 or B1 (i.e., nonflammable refrigerants) to be installed in public corridors and lobbies. Many ice machines and drinking water coolers are currently installed in the hallways and lobbies of hotels and other commercial establishments. This installation

requirement in Clause 7.5.1.2 of ANSI/ASHRAE 15 may make it difficult for ice machines and drinking water cooler manufacturers to transition to propane as a refrigerant.

Response: Our listing of propane as acceptable, subject to use conditions, in self-contained ice machines and drinking water coolers does not negate the need to comply with other requirements. Thus, other requirements might prevent individual end users from choosing equipment that uses propane. EPA understands that the ANSI/ASHRAE 15-2013 is currently being reviewed and thus it is possible that in the future additional refrigerant classifications may be permitted in the areas UL noted as currently limited to A1 or B1 (nonflammable) refrigerants. Industry organizations and the U.S. government are performing additional research on flammable refrigerants with a goal of providing the results to inform and revise ANSI/ASHRAE Standard 15-2013 and other standards as soon as possible, subject to ANSI's consensus process.⁵⁷ For more information on ANSI/ASHRAE Standard 34-2013 and the difference between flammability classes of refrigerants, see section VI.A.3.a.

Comment: Chemours supported the listing of propane as acceptable, subject to use conditions, for commercial ice machines, water coolers, and very low temperature refrigeration equipment provided safe handling practices for flammable refrigerants are incorporated into those use conditions, including, but not limited to technician training, venting prohibitions, and a prohibition of topping off systems with refrigerants different from the original refrigerant. NEDA/CAP also commented on the importance of technician training requirements and certifications for technicians that service propane-filled equipment before finalizing the proposed listing. They stated that although other flammable refrigerant blends have been approved since 2014, EPA proposed to require propane in larger volumes. They stated that as EPA moves toward allowing use of propane in larger new equipment, the technician requirements for inspecting this equipment, leak repair and prevention, and recharging or emptying equipment properly must be in place. Similarly, EPA suggested that EPA address technician training requirements for propane before finalizing the proposed listing.

⁵⁷ AHRI, ASHRAE, DOE Partner to Fund Flammable Refrigerant Research. <http://www.ahrinet.org/News-Events/News-and-Shipping-Releases.aspx?A=1170>. June 2, 2016.

Response: Regarding training needs due to the handling of flammable refrigerants, EPA agrees with the commenter on the importance of such technician training, but does not agree that the training needs to be mandated. The refrigeration industry has been proactive in assuring that technicians are properly trained and, in recent years, a number of training programs on flammable refrigerants have been developed and are currently available in the United States that cover the topics suggested by the commenters. Also, millions of similar appliances around the world have been using HCs over decades with few reported incidents, even with charge sizes of 150 g in some cases. The charge limit of 150 g for self-contained commercial ice machines and very low temperature refrigeration equipment is the same as the charge limit EPA previously set for propane, isobutane, and R-441A in retail food refrigeration-stand-alone units and vending machines and for ethane in very low temperature refrigeration equipment and the charge limit of 60 g for water coolers is close to the 57 g charge limit EPA requires for propane, isobutane, and R-441A in household refrigerators and freezers. Concerning venting prohibitions, see section VI.A.2.c. Concerning Chemours' suggestion to prohibit topping off systems with refrigerants different from the original refrigerant, we proposed that propane may only be used in new equipment designed for use with that refrigerant; we did not propose its use as a retrofit refrigerant. Thus, the use condition prohibits its use to "top off" a system designed for a different refrigerant. If the commenter's concern is that technicians may add a different refrigerant on top of propane already present in equipment designed for propane, we agree that "topping off" with a different refrigerant is inappropriate for any refrigerant. The SNAP regulations for this end-use do not currently address this issue; we will consider whether to propose such a revision in a future rulemaking, and not just for propane.

2. Exemption for Propane From the Venting Prohibition Under CAA Section 608 for Specific End-Uses in the New SNAP Listing

a. Background

Under section 608(c) of the CAA, it is unlawful for any person, in the course of maintaining, servicing, repairing, or disposing of an appliance to knowingly vent or otherwise knowingly release any ODS or substitute refrigerant into the environment. The Administrator may

exempt refrigerant substitutes from this general prohibition if she or he determines under section 608(c)(2) that venting, releasing, or disposing of such substance does not pose a threat to the environment.

For purposes of CAA section 608(c)(2), EPA considers two factors in determining whether or not venting, release, or disposal of a refrigerant substitute during the maintenance, servicing, repairing, or disposal of appliances poses a threat to the environment. See 69 FR 11948, March 12, 2004; 79 FR 29682, May 23, 2014; and 80 FR 19453, April 10, 2015. First, EPA analyzes the threat to the environment due to inherent characteristics of the refrigerant substitute, such as GWP. Second, EPA determines whether and to what extent venting, release, or disposal actually takes place during the maintenance, servicing, repairing, or disposing of appliances, and to what extent such actions are controlled by other authorities, regulations, or practices. To the extent that it determines such releases are adequately controlled by other authorities, EPA generally defers to those authorities.

b. What is EPA's final decision?

EPA has reviewed the potential environmental impacts of propane in the three specific end-uses in this action, as well as the authorities, controls, and practices in place for that substitute. EPA also considered the public comments on the proposal for this action. Based on this review, EPA concludes that propane in these end-uses and subject to these use conditions are not expected to pose a threat to the environment based on the inherent characteristics of these substances and the limited quantities used in the relevant applications. EPA additionally concludes that existing authorities, controls, or practices help mitigate environmental risk from the release of propane in these end-uses and subject to these use conditions.

In light of these conclusions and those described or identified above in this section, EPA is determining that based on current evidence and risk analyses, the venting, release, or disposal of propane in these end-uses during the maintenance, servicing, repairing, or disposing of the relevant appliances does not pose a threat to the environment.

EPA is therefore exempting from the venting prohibition at 40 CFR 82.154(a)(1) these additional end-uses for which propane is being listed as acceptable, subject to use conditions, under the SNAP program.

i. Inherent Characteristics of Propane

EPA evaluated the potential environmental impacts of releasing into the environment propane in water coolers, self-contained commercial ice machines, and very low temperature refrigeration equipment. In particular, we assessed the potential impact of the release of propane on local air quality and its ability to decompose in the atmosphere, its ODP, its GWP, and its potential impacts on ecosystems. EPA also considered propane's flammability and toxicity risks from the end-uses addressed in this rule.

As discussed previously, propane has an ODP of zero and a GWP of three and its effects on aquatic life are expected to be small. As to potential effects on local air quality, propane meets the definition of VOC under CAA regulations (see 40 CFR 51.100(s)) and is not excluded from that definition for the purpose of developing SIPs to attain and maintain the NAAQS. Based on the analysis and modeling results described in section VI.A.1.b.i, EPA concludes that the release of propane from the end-uses in this action, in addition to the HCs previously listed as acceptable, subject to use conditions, for their specific end-uses, is expected to have little impact on local air quality. In this regard, EPA finds particularly noteworthy that even assuming 100 percent market penetration of propane and the other acceptable HCs in the acceptable end-uses, which is a conservative assumption, the highest impact for a single 8-hour average ozone concentration based on this analysis would be 0.05 ppb in Los Angeles compared to both the 2008 ozone NAAQS at 75 ppb and the new, more stringent NAAQS at 70 ppb.

In addition, when examining all HC substitute refrigerants in those uses for which UL currently has standards in place, for which the SNAP program has already listed the uses as acceptable, subject to use conditions, or for which the SNAP program is reviewing a submission, including those in this action, we found that even if all the HC refrigerant substitutes in appliances in end-uses listed acceptable, subject to use conditions in this action and listed as acceptable in previous rules were to be emitted, there would be a worst-case impact of less than 0.15 ppb for ground-level ozone in the Los Angeles area.⁵⁸ The use conditions established in the SNAP listings limit the total amount of propane in each refrigerant circuit to 60 g or less or 150 g or less, depending on

the end-use. Because propane is not listed as acceptable for use in all refrigerant uses, the total amount of propane that could be emitted in the end-uses evaluated is estimated at roughly ten percent of total refrigerant emissions, or less than 16,000 metric tons annually.⁵⁹ Further, there are other substitute refrigerants that are not VOC that may also be used in these end-uses, so our analysis assuming complete market penetration of HCs is conservative.

In light of its evaluation of potential environmental impacts, EPA concludes that propane in the end-uses for which it is listed under SNAP as acceptable, subject to use conditions, in this action is not expected to pose a threat to the environment on the basis of the inherent characteristics of this substance and the limited quantities used in the relevant end-uses. In this regard, EPA finds particularly noteworthy that even assuming 100 percent market penetration of propane and the other acceptable HCs in the end-uses where they are listed as acceptable, subject to use conditions, which is a conservative assumption, the highest impact for a single 8-hour average ozone concentration based on this analysis would be 0.05 ppb in Los Angeles and less than 0.01 ppb in Houston and Atlanta.⁶⁰

ii. Limits and Controls Under Other Authorities, Regulations, or Practices

EPA expects that existing authorities, controls, and/or practices will mitigate environmental risk from the release of propane. Analyses performed for both this rule and prior rules (59 FR 13044, March 17, 1994; 76 FR 78832, December 20, 2011; 79 FR 29682, May 23, 2014; and 80 FR 19453, April 10, 2015) indicate that existing regulatory requirements and industry practices limit and control the emission of propane, or other hydrocarbons, when used as a refrigerant in end-uses similar to this action. EPA notes that other applicable environmental regulatory requirements still apply and are not affected by the determination made in this action. This conclusion is relevant to the second factor mentioned above in the overall determination of whether venting, release, or disposal of a refrigerant substitute poses a threat to the environment.

Propane and other HCs being recovered, vented, released, or otherwise disposed of from commercial

⁵⁹ Ibid.

⁵⁸ ICF, 2014a. Assessment of the Potential Impact of Hydrocarbon Refrigerants on Ground Level Ozone Concentrations. February, 2014.

⁶⁰ ICF, 2016l. Additional Follow-on Assessment of the Potential Impact of Hydrocarbon Refrigerants on Ground Level Ozone Concentrations. September, 2016.

and industrial appliances are likely to be hazardous waste under RCRA (see 40 CFR parts 261 through 270). As discussed in the final rules addressing the venting of ethane, isobutane, propane, and R-441A as refrigerant substitutes in certain end-uses, incidental releases may occur during the maintenance, service, and repair of appliances subject to CAA section 608. Such incidental releases would not be subject to RCRA requirements for the disposal of hazardous waste, as such releases would not constitute disposal of the refrigerant charge as a solid waste, *per se*. Disposal or venting of propane from household appliances used in the home, such as a water cooler, is also generally not considered disposal of a hazardous waste under the existing RCRA regulations and could be vented under the household hazardous waste exemption, assuming other state or local requirements do not prohibit venting. See 40 CFR 261.4(b)(1). However, for commercial and industrial appliances such as self-contained commercial ice machines, very low temperature refrigeration equipment, or water coolers used in an industrial or office setting, it is likely that propane and other flammable HC refrigerant substitutes would be classified as hazardous waste and disposal of propane from such appliances would need to be managed as hazardous waste under the RCRA regulations (40 CFR parts 261 through 270), unless it is subject to a limited exception in those regulations if the ignitable refrigerant is to be recycled. Ignitable refrigerant that has been used and has become contaminated through use would fit the definition of a spent material under RCRA (40 CFR 261.1(c)(1)) if it must be reclaimed prior to its reuse. Spent materials that are reclaimed are solid wastes per section 261.2(c). However, if the hydrocarbon refrigerant is recovered for direct reuse (*i.e.*, no reclamation), it would not be classified as a solid or a hazardous waste (40 CFR 261.2(e)). In most cases, recycling of these materials would require cleaning (*i.e.*, reclamation) before they are reused.

As discussed in section VI.A.1.b.ii of this action and sections VI.A.1.b.ii and VI.A.1.b.iii of the proposed rule (81 FR 22827; April 18, 2016), EPA's SNAP program evaluated the flammability and toxicity risks from propane in the end-uses in this rule. Propane is classified as an A3 refrigerant by ASHRAE Standard 34–2013 and subsequent addenda, indicating that it has low toxicity and high flammability (for a further discussion on ASHRAE safety categories, see section VI.A.1.b.i.(b).

Propane has an LFL of 2.1 percent. In addition, like most refrigerants, HCs at high concentrations can displace oxygen and cause asphyxiation.

To address flammability risks, this action establishes required use conditions and provides voluntary recommendations for its safe use (see section VI.A.1.b.iii). This SNAP listing limits the amount of propane in the refrigerant loop to 150 g in self-contained commercial ice machines and in very low temperature refrigeration equipment and 60 g in water coolers. These charge size limits also reflect the UL 563, UL 399, and UL 471 industry standards, as discussed in the previous section. These use conditions mean that any potential propane emissions from any individual appliance will therefore be small. HC emissions from the three specific end-uses in this rule would be significantly smaller than those emanating from IPR systems, which are controlled by OSHA for safety reasons. Furthermore, it is the Agency's understanding that flammability risks and occupational exposures to HCs are adequately regulated by OSHA and building and fire codes at a local and national level.

The release and/or disposal of propane is also controlled by authorities established by OSHA and NIOSH guidelines, various industry standards, and state and local building codes. To the extent that release during maintaining, repairing, servicing, or disposing of appliances is controlled by regulations and standards of other authorities, these practices and controls for the use of propane are sufficiently protective. These practices and controls mitigate the risk to the environment that may be posed by the venting, release, or disposal of propane during the maintaining, servicing, repairing, or disposing of self-contained commercial ice machines, very low temperature refrigeration equipment, and water coolers.

EPA is aware of equipment that can be used to recover HC refrigerants. To the extent that propane is recovered rather than vented in specific end-uses and equipment, EPA recommends the use of recovery equipment designed specifically for flammable refrigerants in accordance with applicable safe handling practices. See section VI.A.1.b.iii for further discussion.

d. When does the exemption from the venting prohibition apply?

In the provision establishing the exemption from the venting prohibition, EPA is also establishing that the exemption will apply as of January 3, 2017, the same as the effective date of

the SNAP listing of propane in commercial ice machines, water coolers, and very low temperature refrigeration equipment.

e. How is EPA responding to comments?

EPA received comments from organizations and individuals with various interests in the refrigeration industry on the proposal to exempt propane in water coolers, commercial ice machines, and very low temperature freezers from the venting prohibition under section 608. Commenters included the Alliance for Responsible Atmospheric Policy (the Alliance), an industry organization; Chemours and Honeywell, two chemical producers; Hudson Technologies Company (Hudson), a refrigerant reclaimer; NEDA/CAP, an organization representing manufacturers of a variety of refrigeration and AC equipment; and an anonymous citizen.

We have grouped comments together and responded to the issues raised by the comments in the sections that follow, or in a separate Response to Comments document which is included in the docket for this rule (EPA–HQ–OAR–2015–0663).

Comment: Honeywell commented that it does not object to the proposal to exempt propane from the venting prohibition. However, Honeywell urged EPA to consider exempting HFOs in certain end-uses (HFO-1234yf in MVAC systems; HFO-1234ze(E) in centrifugal, reciprocating, screw, and scroll chillers; and HFO-1233zd(E) in centrifugal chillers) based on their zero ODP, low-GWP, and low-VOC reactivity.

Response: EPA interprets this comment as support for exempting propane in the three end-uses described in this rule from the venting prohibition. With regard to exempting certain HFOs in certain end-uses, the Agency takes this comment under advisement and may consider at some later date analyzing whether the release of these refrigerants poses a threat to the environment when vented, released, or disposed of, but has not done so for this rulemaking and thus is not taking final action on the commenter's suggested exemption.

Comment: The Alliance, Hudson, Chemours, and Arkema commented that EPA should not exempt propane from the venting prohibition. A primary concern of the Alliance and Hudson Technologies is that refrigerants should be properly managed. The Alliance was concerned that separate servicing practices for propane could cause confusion and lead to inadvertent venting of HFCs. The Alliance requested that EPA explain why propane should

be treated differently from all other fluids. Hudson commented that the intentional venting of any product to the atmosphere is poor environmental policy, poor service practice and poor product stewardship and was concerned that exempting propane perpetuates the destructive practice of increasing new production to replace vented refrigerant. Arkema stated that they believe that EPA's 608 regulations foster sustainability and good product stewardship, aside from reducing risk from SNAP substances. They indicated, however, that exemptions from the venting prohibition for propane or other HCs can foster only waste and consumption.

Response: EPA agrees that all refrigerants and refrigerant substitutes should be properly managed. However, EPA disagrees that proper management necessarily includes recovery in all cases. The refrigerant management practices in subpart F, including recovery, were designed with the properties of fluorinated refrigerants in mind. Requiring the recovery of refrigerants like water or nitrogen would provide no environmental benefit. For ammonia or chlorine, other regulations address the risks related to those specific compounds (for example, OSHA regulations that address risk to technician safety). Based on the analysis discussed previously, EPA has determined that venting, releasing, or disposing of propane in the end-uses in this rule does not pose a threat to the environment. The venting of propane in certain end-uses may also be the safest option in some situations, considering that such refrigerants are flammable but most existing recovery equipment is not designed and constructed for use with flammable refrigerants (e.g., with spark-proof components). Although it is true that the venting of propane allowed under the exemption may result in some additional waste and consumption, this is still preferable to unsafe recovery practices. Therefore, it is appropriate to treat propane differently from other refrigerant substitutes. EPA has also previously exempted propane from the venting prohibition when used in other specific end-uses, so this action is consistent with prior actions taken by EPA.

EPA can minimize confusion about whether the refrigerant may or may not be vented and can also make technicians and the public aware of the flammability of a refrigerant through the use of red coloration for hoses and labeling use conditions so that they can take appropriate precautions. Together these markings clearly distinguish an appliance containing propane or other

HC refrigerants which may be vented, from HFCs or other refrigerants that may not.

Comment: Hudson commented that EPA has been inconsistent in relying on the lack of recovery equipment designed for recovering HCs as a rationale for exempting flammable refrigerants. Despite past concern about the lack of such equipment, EPA has not exempted HFC-32 or HFO-1234yf, both flammable refrigerants, from the venting prohibition.

Response: The Agency has discretion to determine whether to establish an exemption from the venting prohibition under CAA section 608(c)(2). To make that determination, the Agency analyzes individual refrigerant substitutes, typically in discrete end-uses, to determine whether the venting, releasing, or disposal of that refrigerant substitute from those end-uses will pose a threat to the environment. For this rulemaking, EPA has analyzed the potential environmental threats from venting, releasing, or disposing propane from three end-uses. EPA has provided its justification for allowing the venting of propane from these three end-uses in this action. EPA did not propose to exempt HFOs, such as HFO-1234yf, or HFC-32 from the venting prohibition in this action and thus did not analyze whether the venting, release, or disposal of those substances would pose a threat to the environment for this rule. Though these refrigerants may share the characteristic of flammability with propane, they have other physical characteristics and end-uses than propane. Moreover, the mere fact that the Agency has analyzed some flammable HC refrigerants in some specific end-uses and made the necessary determination to exempt those substances in those end-uses from the venting prohibition does not necessarily mean that such a determination would be appropriate for all flammable HC refrigerant substitutes in all end-uses.

Comment: Hudson commented that propane's low GWP, and the small refrigerant charges involved with the approved uses, does not justify different treatment for this refrigerant, or for any of the previously approved and exempted flammable refrigerants.

Response: The Agency disagrees that these characteristics do not justify different treatment for this refrigerant. GWP, ODP, and total possible usage are some of the characteristics appropriate to consider in determining whether the release of propane from these three end-uses poses a threat to the environment.

Comment: The Alliance commented that the appropriateness of waiving the

venting prohibition for propane requires ongoing consideration and examination, particularly as applications for flammable refrigerants are expanded and charge sizes increase.

Response: EPA analyzes individual refrigerant substitutes, typically in discrete end-uses, to determine whether the venting, releasing, or disposal of those substances in those end-uses will pose a threat to the environment. The exemption that EPA is establishing today applies only to propane and only in three discrete end-uses that are subject to use conditions, including restrictions on charge size. Before establishing an exemption for propane in any other end-uses, EPA would analyze whether the venting, release, or disposal of propane in that end-use would pose a threat to the environment.

Comment: An anonymous commenter noted that due to inconsistencies among overlapping regulations, there is confusion in the regulated community regarding releases of refrigerants which are hazardous wastes but are exempt from the prohibition on venting. The commenter further notes that this issue is not addressed within the regulation itself, which is the information source most of the regulated community will reference routinely in the future. The commenter provided sample language to be added to 82.154(a) to clarify that the exemption from the prohibition on venting provided in 40 CFR part 82, subpart F does not exempt the release of the listed refrigerants and substitutes from other applicable laws and regulations which may prohibit or limit releases into the environment.

Response: One of the criteria EPA considers in determining whether a refrigerant poses a threat to the environment when released is whether such releases are controlled by other authorities, regulations, or practices. For example, HC refrigerant substitutes may be subject to restrictions under RCRA and ammonia may be subject to restrictions under OSHA regulations, and when those RCRA or OSHA requirements apply, they would disallow the release of these respective substances into the environment. EPA is finalizing regulatory text in 82.154(a) that clarifies that the exemption to the venting prohibition is specific to the prohibition under section 608(c).

f. Conclusion

EPA has reviewed the potential environmental impacts of propane in the three specific end-uses in this action, as well as the authorities, controls, and practices in place for that substitute. EPA also considered the public comments on the proposal for

this action. Based on this review, EPA concludes that propane in these end-uses and subject to these use conditions are not expected to pose a threat to the environment based on the inherent characteristics of these substances and the limited quantities used in the relevant applications. EPA additionally concludes that existing authorities, controls, or practices help mitigate environmental risk from the release of propane in these end-uses and subject to these use conditions.

In light of these conclusions and those described or identified above in this section, EPA is determining that based on current evidence and risk analyses, the venting, release, or disposal of propane in these end-uses during the maintenance, servicing, repairing, or disposing of the relevant appliances does not pose a threat to the environment.

EPA is therefore exempting from the venting prohibition at 40 CFR 82.154(a)(1) these additional end-uses for which these HCs are being listed as acceptable, subject to use conditions, under the SNAP program.

3. Unacceptable Listing of Certain Flammable Refrigerants for Retrofits in Unitary Split AC Systems and Heat Pumps

a. Background

Existing unitary split AC systems and heat pumps were not designed to use a flammable refrigerant. People and property have been harmed by the retrofit or so-called 'drop-in' use of certain flammable refrigerants in existing unitary split AC and heat pump equipment designed to use a nonflammable refrigerant. For new room AC equipment, we have listed certain flammable refrigerants as acceptable on the basis that flammability risks can be addressed in designing the equipment and mitigated through use conditions. In contrast, existing equipment has not been designed for flammable refrigerants and we have not identified appropriate use conditions that can manage the flammability risk for retrofits such that these flammable refrigerants would pose similar or lower risk than other available refrigerants in this end-use.

i. What is the affected end-use?

The residential and light commercial AC and heat pumps end-use includes equipment for cooling air in individual rooms, in single-family homes, and sometimes in small commercial buildings. This end-use differs from commercial comfort AC, which uses chillers that cool water that is then used

to cool air throughout a large commercial building, such as an office building or hotel. This rule specifically concerns unitary split AC systems and heat pumps, commonly called central AC. These systems include an outdoor unit with a condenser and a compressor, refrigerant lines, an indoor unit with an evaporator, and ducts to carry cooled air throughout a building. Unitary split heat pumps are similar but offer the choice to either heat or cool the indoor space. This action applies to certain flammable refrigerants for retrofit use in this type of equipment.

ii. What other types of equipment are used for similar applications pumps but are not covered by this section of the rule?

The unacceptability determination for certain flammable refrigerants in this action does not apply to other types of residential and light commercial AC and heat pump equipment, but may do so in the future. Other types of residential and light commercial AC and heat pump equipment not included in this unacceptability determination include:

- Multi-split air conditioners and heat pumps;
- Mini-split air conditioners and heat pumps;
- Packaged outdoor air conditioners and heat pumps;
- Window air conditioners and heat pumps;
- Packaged terminal air conditioners (PTACs) and packaged terminal heat pumps (PTHP); and
- Portable room air conditioners and heat pumps.

For a description of these types of equipment, see section VI.A.3.a.i in the proposed rule (81 FR 22833; April 18, 2016).

b. What is EPA's final decision?

As proposed, EPA is listing the following flammable refrigerants as unacceptable for retrofits in unitary split AC systems and heat pumps:

- All refrigerants identified as flammability Class 3 in ANSI/ASHRAE Standard 34–2013. These include the HCs R-1150 (ethylene), R-170 (ethane), R-1270 (propylene), R-290 (propane), R-50 (methane), R-600 (n-butane), R-600a (isobutane), R-601 (n-pentane), and R-601a (isopentane); the HC blends R-433A, R-433B, R-433C, R-436A, R-436B, R-441A, and R-443A; and the refrigerant blends R-429A, R-430A, R-431A, R-432A, R-435A, and R-511A. All of these refrigerants except R-435A contain HCs, with some also containing the flammable compounds dimethyl ether and HFC-152a.

- All refrigerants meeting the criteria for flammability Class 3 in ANSI/ASHRAE Standard 34–2013. These include, but are not limited to, refrigerant products sold under the names R-22a, 22a, Blue Sky 22a refrigerant, Coolant Express 22a, DURACOL-22a, EC-22, Ecofreeez EF-22a, Envirosafe 22a, ES-22a, Frost 22a, HC-22a, Maxi-Fridge, MX-22a, Oz-Chill 22a, Priority Cool, and RED TEK 22a.

For background on the flammability classes and their criteria in ANSI/ASHRAE Standard 34–2013, see section VI.A.1.b.i.(b).

EPA is aware of a number of situations where companies have sold highly flammable refrigerants for use in residential AC that have not been submitted to SNAP for review. EPA has conducted enforcement actions against companies that have sold such substitutes in violation of EPA's regulations. EPA is also aware of multiple instances where people and property using one of the numerous refrigerants marketed as "22a" in a residential AC system were harmed in explosions and fires, in part because the person servicing the AC system was not aware that the system contained a highly flammable refrigerant.

Considering this demonstration of the flammability risks of retrofitting residential AC systems as well as the lack of risk mitigation available for existing equipment (e.g., charge limits or design for reduced leakage), EPA is listing R-22a, 22a, and other similar liquefied petroleum gases as unacceptable, as well as refrigerants with a flammability classification of 3 in ASHRAE 34–2013 or that meet the criteria for such classification, including R-22a, 22a, and other similar liquefied petroleum gases, as unacceptable in this end use.

In addition to refrigerants specifically identified in the ASHRAE 34–2013 standard as having a flammability classification of 3, EPA is listing refrigerants meeting the criteria of that standard as unacceptable. In other words, refrigerants are unacceptable if they exhibit flame propagation and either have a heat of combustion of 19,000 kJ/kg (8,174 BTU/lb) or greater or an LFL of 0.10 kg/m³ or lower, when tested in accordance with ASTM E681 using a spark ignition source at 60 °C and 101.3 kPa. Thus, refrigerants identified with a flammability classification of 3 in future editions of ASHRAE 34 would also be unacceptable if they meet those criteria. We are aware of a number of refrigerant products sold over the internet aimed at the market for retrofit usage in refrigeration and AC equipment using HCFC-22 with names

containing “22a,” such as R-22a, Blue Sky 22a refrigerant, Coolant Express 22a, DURACOL-22a, EC-22, Ecofreeez EF-22a, Envirosafe 22a, ES-22a, Frost 22a, HC-22a, Maxi-Fridge, MX-22a, Oz-Chill 22a, and RED TEK 22a. EPA has analyzed one of these refrigerants and determined that it contained propane mixed with a pine-scented odorant. These refrigerants are also identified as flammable in their Safety Data Sheets and are often identified as “liquified petroleum gases.” Although none of these liquified petroleum gas refrigerants have been submitted to SNAP for review, EPA expects that they all are comparable in their flammability to propane and other refrigerants that meet an ASHRAE flammability classification of 3. It is our

understanding these refrigerants are all of the same or similar composition, are produced by a limited number of facilities using the same process, and then are marketed under different names by different distributors.

i. How do these unacceptable refrigerants compare to other refrigerants for these end-uses with respect to SNAP criteria?

EPA has listed a number of alternatives as acceptable for retrofit usage in unitary split AC systems and heat pumps. All of the listed alternatives are HFC blends, with some containing small percentages (approximately five percent or less) of HCs. Specific blends include R-125/134a/600a (28.1/70/1.9), R-125/290/

134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407C, R-407F, R-417A, R-417C, R-421A, R-422B, R-422C, R-422D, R-424A, R-427A, R-434A, R-438A, R-507A, and RS-44 (2003 composition). These blends are all non-ozone-depleting. As shown in Table 3, they have GWPs ranging from approximately 1,770 for R-407C to 3,990 for R-507A. Knowingly venting or releasing these refrigerants is prohibited under section 608(c)(2) of the CAA, codified at 40 CFR 82.154(a)(1). The HFC components of these refrigerant blends are excluded from the definition of VOC under CAA regulations (see 40 CFR 51.100(s)) addressing the development of SIPs to attain and maintain the NAAQS, while the HC components are VOC.

TABLE 3—GWP, ODP, AND VOC STATUS OF REFRIGERANTS LISTED AS FLAMMABILITY CLASS 3 OR MEETING THE CRITERIA FOR FLAMMABILITY CLASS 3 COMPARED TO OTHER REFRIGERANTS LISTED AS ACCEPTABLE FOR RETROFIT IN EXISTING EQUIPMENT FOR RESIDENTIAL AND LIGHT COMMERCIAL AC

[Unitary split AC systems and heat pumps]^{1 2}

Refrigerants	GWP	ODP	VOC	Listing status
All refrigerants identified as flammability Class 3 in ANSI/ASHRAE Standard 34–2013.	2–120	0	Yes ³	Unacceptable.
All refrigerants meeting the criteria for flammability Class 3 in ANSI/ASHRAE Standard 34–2013, including, but not limited to the products named R-22a, 22a, Blue Sky22a refrigerant, Coolant Express 22a, DURACOL-22a, EC-22, Ecofreeez EF-22a, Envirosafe 22a, ES-22a, Frost 22a, HC-22a, Maxi-Fridge, MX-22a, OZ-Chill 22a, Priority Cool, and RED TEK22a.	2–120	0	Yes ³	Unacceptable.
R-404A, R-407A, R-407C, R-407F, R-421A, R-427A, R-507A	1,770–3,990	0	No	Acceptable.
Hot Shot 2, R-125/R-134a/R-600a (28.1/70.0/1.9), R-125/R-290/R-134a/R-600a (55.0/1.0/42.5/1.5), R-417A, R-422B, R-422C, R-422D, R-424A, R-427A, R-434A, R-437A, R-438A, RS-44 (2003 formulation) ..	1,810–3,390	0	Yes ⁴	Acceptable.

¹ The table does not include not-in-kind technologies listed as acceptable for the stated end-use.

² HCFC-22 and several blends containing HCFCs are also listed as acceptable but their use is severely restricted by the phasedown in HCFC production and consumption.

³ The entire refrigerant or most of the constituents are VOC.

⁴ One or more constituents of the refrigerant are VOC.

In the proposed rule (81 FR 22835; April 18, 2016), EPA provided information on the risk to human health and the environment presented by the alternatives that are being found unacceptable as compared with other available alternatives listed as acceptable for this end-use. In addition, a technical support document⁶¹ that provides the **Federal Register** citations concerning data on the SNAP criteria (e.g., ODP, GWP, VOC, toxicity, flammability) for acceptable alternatives in the relevant end-uses may be found in the docket for this rulemaking (EPA–HQ–OAR–2015–0663). In summary, both the currently acceptable refrigerants and those we are listing as

unacceptable in this action are non-ozone depleting. The refrigerants being listed as unacceptable would result in higher VOC emissions than the acceptable refrigerants, with the saturated HCs (e.g., propane, isobutane) having a low impact and unsaturated HCs (e.g., propylene) having a significant impact (see section VI.A.1.b.i on the potential local air quality impacts of propylene and R-443A). The refrigerants being listed as unacceptable have significantly lower GWPs than the refrigerants that would remain acceptable.

As discussed in section VI.A.3.a.ii in the proposed rule (81 FR 22835–36; April 18, 2016), EPA’s SNAP program evaluated the flammability and toxicity risks from the flammable refrigerants in the end-use in this rule. EPA is providing some of that information in this section as well. All refrigerants

currently listed as acceptable in this end-use are nonflammable, resulting in no risk of fire or explosion from flammability of the refrigerant. In comparison, ASHRAE Class 3 refrigerants are highly flammable. As discussed in section VI.A.4.b.i, EPA analyzed the flammability impacts of one ASHRAE Class 3 refrigerant, R-443A, and found that a release of the entire refrigerant charge inside a building from a larger unitary split AC system or heat pump could result in surpassing the LFL.⁶² Because of the large charge sizes required for this type of equipment and the similar LFLs for other ASHRAE Class 3 refrigerants, it is likely the LFL would also be surpassed

⁶¹ EPA, 2016b. Tables of Alternatives for End-Uses Considered in the Rule, Protection of Stratospheric Ozone: Listing Modifications for Certain Substitutes under the Significant New Alternatives Policy Program. September, 2016.

⁶² ICF, 2016f. Significant New Alternatives Policy Program. Refrigeration and Air Conditioning Sector Risk Screen on Substitutes in Residential and Light Commercial Air Conditioning and Heat Pumps. Substitute: R-443A.

for other ASHRAE Class 3 refrigerants in a similar worst-case situation. Fires and harm to people and property have already occurred in multiple cases due to retrofit or drop-in use of R-22a and similar products in existing unitary split AC systems and heat pumps. As discussed above, EPA expects that R-22a, Blue Sky 22a refrigerant, Coolant Express 22a, DURACOL-22a, EC-22, Ecofreeez EF-22a, EnviroSAFE 22a, ES-22a, Frost 22a, HC-22a, Maxi-Fridge, MX-22a, Oz-Chill 22a, and RED TEK 22a are comparable in their flammability to propane and other refrigerants that meet an ASHRAE flammability classification of 3.

Both the acceptable refrigerants and the unacceptable refrigerants are able to be used in this end-use in accordance with their respective 8-hr or 10-hr workplace exposure limits. However, acute exposure may also be of concern during use in unitary split AC systems and heat pumps because of possible exposure to consumers in the event of a sudden release. For instance, as discussed below in section VI.A.4.b.i, EPA analyzed the acute toxicity of the propylene component of one ASHRAE Class 3 refrigerant, R-443A, and found that a release of the entire refrigerant charge inside a building from a larger unitary split AC system or heat pump could result in surpassing the acute exposure limit.⁶³ Because of the large charge sizes required for this type of equipment and somewhat lower acute exposure limits for the HC components of ASHRAE Class 3 refrigerants compared to HFCs and the acceptable refrigerants in this end-use, acute exposure could be a concern for some specific Class 3 refrigerants.

For these end-uses, although use of the highly flammable refrigerants would result in a reduced climate impact, the safety risks of using these refrigerants in existing equipment that was designed for nonflammable refrigerants creates a more significant and imminent risk. In addition to flammability risk, in at least some cases, the likelihood for an exceedance of acute exposure limits of the unacceptable refrigerants also supports a determination that those refrigerants pose significantly greater risk than other available alternatives. The Agency is open to revisiting this listing decision if we receive information on how risks from the refrigerants listed as unacceptable can be sufficiently mitigated. Further information on these analyses and

EPA's risk assessments are available in the docket for this rulemaking (EPA-HQ-OAR-2015-0663).

ii. When will the listings apply?

EPA is establishing a listing date as of January 3, 2017, the same as the effective date of this regulation. To date, none of these substitutes have been submitted to EPA for this end-use for retrofit use. Under 40 CFR 82.174, manufacturers are prohibited from introducing them into interstate commerce for this end-use for retrofit use. Thus, manufacturers and service technicians should not be currently using these substitutes in the manner that would be prohibited by this listing decision.

c. How is EPA responding to comments?

EPA received several comments from individuals and organizations with various interests in residential AC. Comments were in reference to the proposed listing status of ASHRAE Class 3 flammable refrigerants, extending the proposal to other end-uses, and use of unique fittings with flammable refrigerants. Most commenters supported the proposed listing decisions and effective date of 30 days after date of publication of the rule in the **Federal Register**, while one commenter suggested a listing as unacceptable was not needed for some specific refrigerants. Commenters generally agreed that use of flammable refrigerants in equipment that was not designed for them was potentially dangerous.

Commenters included AHRI, the Japan Refrigeration and Air Conditioning Industry Association (JRAIA), and the Alliance, three industry organizations; Whitmyre Equipment Company and Whitmyre Research, consultants for A.S. Trust & Holdings; United Technologies Climate Controls & Security (UTC CCS and hereafter "UTC"); Hudson, a refrigerant reclaimer; Chemours, a chemical producer; and environmental organizations NRDC and IGSD.

We have grouped comments together and responded to the issues raised by the comments in the sections that follow, or in a separate Response to Comments document which is included in the docket for this rule (EPA-HQ-OAR-2015-0663).

i. Substitutes and End-Use Proposed

Comment: The Alliance, Chemours, Hudson, JRAIA, and NRDC, all supported EPA's proposal to list refrigerants classified as A3 (or meeting A3 criteria) under ASHRAE Standard 34 as unacceptable for retrofitting unitary

split AC systems and heat pumps. AHRI, JRAIA, and Chemours supported the proposed listing, stating it would mitigate demonstrated risks of serious injury and property damage. NRDC and IGSD found EPA's proposed unacceptability finding for Class 3 flammable refrigerants in retrofit applications reasonable and necessary to ensure a safe transition to low-GWP alternatives.

Response: EPA agrees with the commenters and is finalizing these listing decisions as proposed.

Comment: AHRI, JRAIA, and the Alliance requested that EPA list all refrigerants classified as A3 under ASHRAE Standard 34 as unacceptable for retrofitting in all types of residential and light commercial AC and heat pumps. JRAIA also requested similar treatment for retrofitting of flammable refrigerants to all types retail food refrigeration equipment. The commenters expressed concern that by issuing an unacceptability listing only for unitary split AC and heat pumps, some may conclude that it is currently acceptable to retrofit other, similar equipment classes with similar risks with these refrigerants.

Response: EPA did not propose and is not finalizing provisions to list Class 3 flammable as unacceptable for retrofitting other types of refrigeration and AC equipment besides unitary split AC systems and heat pumps. This would require an additional opportunity for public comment. We have received reports of the use of highly flammable refrigerants only in unitary split AC systems and heat pumps, so we are less concerned that such refrigerants are likely to be used in other types of residential and light commercial AC and heat pump equipment. Further, in EPA's listings of the Class 3 flammable refrigerants propane, isobutane, and R-441A in a number of end-uses, including stand-alone retail food refrigeration equipment and room AC and heat pump equipment, we have included a use condition specifying that the listing is only for new equipment specifically designed for the refrigerant. Thus, EPA does not agree that the industry is likely to perceive an unacceptable listing only for retrofit of one type of equipment as implying acceptability of retrofit for other types of equipment. Further, as EPA has received no submissions for retrofitting flammable refrigerants in any residential AC or retail food refrigeration use and has not issued a listing for any such use, both introduction into interstate commerce and use in retrofit refrigeration and AC equipment are violations of EPA's SNAP regulations.

⁶³ ICF, 2016f. Significant New Alternatives Policy Program. Refrigeration and Air Conditioning Sector Risk Screen on Substitutes in Residential and Light Commercial Air Conditioning and Heat Pumps. Substitute: R-443A.

Thus, even without an explicit listing of unacceptability, it is not allowed to retrofit with flammable refrigerants in existing equipment.

Comment: JRAIA commented that charging systems with refrigerants for which the equipment was not originally designed can lead to failures and malfunctions, as well as safety risks. The commenter stated that if defects occur in equipment due to improperly retrofitting with flammable refrigerant, even if no injury occurs, in most cases the equipment must be replaced with the equipment owners themselves responsible for the replacement cost.

Response: EPA agrees that charging systems with refrigerants for which the equipment was not originally designed can lead to failures and malfunctions. However, that type of issue is not a consideration in determining whether to list a substitute as acceptable or unacceptable, though it could be considered in establishing use conditions for an acceptable substitute. The basis of EPA's unacceptability decision is that the overall risk to human health and the environment is greater for ASHRAE Class 3 refrigerants because of the flammability risk, and in some cases the toxicity risk, than for other available substitutes for retrofitting in unitary split AC and heat pumps.

ii. Industry Standards and Codes

Comment: UTC, with Carrier, Taylor, and Kidde Fenwal as member companies, stated that EPA should list Class 3 refrigerants as unacceptable for use in unitary split AC and heat pumps but should clarify that future Class 3 refrigerants added to successive editions of ASHRAE 34 will also be unacceptable. The commenter noted that the regulatory text references ANSI/ASHRAE standard 34–2013: Designation and Safety Classification of Refrigerants, November 2013, and thus, EPA's determination of "all refrigerants" meeting the criteria in the 2013 edition of the standard might not extend to refrigerants which meet the criteria in future editions of the standard.

Response: To the extent that future Class 3 refrigerants meet the criteria in ANSI/ASHRAE 34–2013, they will be unacceptable. Specifically, if a refrigerant exhibits flame propagation and either has a heat of combustion of 19,000 kJ/kg (8,174 BTU/lb) or greater or an LFL of 0.10 kg/m³ or lower, it is unacceptable because it is a refrigerant "meeting the criteria for flammability Class 3 in ANSI/ASHRAE Standard 34–2013." However, EPA cannot create a listing that would automatically find refrigerants unacceptable based on the

criteria for Class 3 refrigerants in future versions of ANSI/ASHRAE 34, as those criteria are not available for EPA or the public to consider. If ASHRAE changes the standard to revise those criteria, EPA could consider whether to take rulemaking action considering whether to modify the listing decision to reflect the criteria in the revised standard.

iii. Unique Fittings

Comment: AHRI supported the use of separate servicing fittings for flammable refrigerants beyond labeling and color coded hosing and piping. The commenter stated that equipment originally designed for non-flammable refrigerants will not necessarily be equipped with different fittings increasing the risk of injury during servicing. Whitmyre Equipment Company and Whitmyre Research asserted that there is no need for concern about AC or heat pump systems being retrofitted for use with R-443A or other propylene-containing refrigerants, as this will not be permitted due to use of unique hardware fittings which have already been discussed with, and approved by, EPA.

Response: There currently is no requirement for unique fittings on residential AC and heat pump equipment. EPA has not proposed and is not finalizing the use of separate servicing fittings for flammable refrigerants. We agree that such fittings can be useful to prevent the use of refrigerants that a piece of equipment was not designed to use and could consider whether to modify the existing acceptable listings to include such a requirement. While it is true that certain of the refrigerants EPA is listing as unacceptable in this end-use have developed unique fittings for other end-uses for which there is a unique fitting requirement, it is unclear that would prevent use as a retrofit in the end-uses at issue here since for those end-uses, there is no unique fitting requirement.

4. Unacceptable Listing of Propylene and R-443A for New Residential and Light Commercial AC and Heat Pumps, Cold Storage Warehouses, and Centrifugal and Positive Displacement Chillers

a. Background

The refrigeration and AC end-uses addressed in this action include:

- Centrifugal chillers;
- positive displacement chillers;
- residential and light commercial AC and heat pumps, including both self-contained units (e.g., window air conditioners, PTACs and PTHPs, portable AC units) and split systems;

- cold storage warehouses.

EPA has received a submission for R-443A in new residential and light commercial AC and heat pumps and for new window air conditioners, a subset of that end-use. We have also received a submission for propylene for use in new chillers for commercial comfort AC (centrifugal and positive displacement chillers) and for cold storage warehouses. Because the two refrigerants, R-443A and propylene, have similar properties and risk profiles, we reviewed both refrigerants for all four end-uses.

Propylene, also known as propene or R-1270, is a HC with three carbons, the chemical formula C₃H₆, and the CAS Reg. No. 115–17–1. R-443A is a HC blend⁶⁴ consisting of 55 percent propylene, 40 percent propane, and five percent isobutane by weight.

DOE has indicated its intent to issue a proposed energy conservation standard for portable air conditioners, a subset of the residential and light commercial air conditioning and heat pumps end-use. For further information on the relationship between this action and other federal rules, see section VI.A.3.b.v of the proposed rule (81 FR 22841; April 18, 2016).

b. What is EPA's final decision?

As proposed, EPA is listing the refrigerants propylene (R-1270) and R-443A as unacceptable in new equipment in residential and light commercial AC and heat pumps, cold storage warehouses, and centrifugal and positive displacement chillers for commercial comfort AC. EPA's concerns about propylene and R-443A are primarily due to the effect of these refrigerants on local air quality, although for some equipment with higher charge sizes, flammability and toxicity are also a concern. Other acceptable refrigerants are available in the same end-uses that pose overall lower risk than R-443A and propylene.

i. How do these unacceptable refrigerants compare to other refrigerants for these end-uses with respect to SNAP criteria?

EPA has listed a number of alternatives as acceptable in new equipment in residential and light commercial AC and heat pumps, cold

⁶⁴ EPA notes that under the SNAP program, we review and list refrigerants with specific compositions (59 FR 13,044; March 18, 1994). To the extent possible, we follow ASHRAE's designations for refrigerants. Blends of refrigerants must be reviewed separately. For example, we consider each blend of propane with isobutane to be a different and unique refrigerant, and each would require separate submission, review and listing.

storage warehouses, and centrifugal and positive displacement chillers for commercial comfort AC. In the proposed rule (81 FR 22837–22841; April 18, 2016), EPA provided information on the risk to human health and the environment presented by the alternatives that are being found unacceptable as compared with other available alternatives listed as acceptable in these end-uses. In addition, a technical support document that provides the **Federal Register** citations concerning data on the SNAP criteria (e.g., ODP, GWP, VOC, toxicity, flammability) for acceptable alternatives in the relevant end-uses may be found in the docket for this rulemaking (EPA–HQ–OAR–2015–0663).

Propylene and R-443A have an ODP of zero. Many acceptable substitutes in the refrigeration and AC end-uses addressed in this rule also have an ODP

of zero (e.g., HFCs, HFOs, CO₂, ammonia, HCs, and not-in-kind technologies).⁶⁵ Of the acceptable refrigerants having an ODP, they have ODPs ranging from 0.00024 to 0.047.^{66 67} Thus, propylene and R-443A have ODPs comparable to or less than the ODPs of other alternatives in the end-uses in this rule.

Propylene and the components of R-443A have relatively low GWPs of less than ten. As shown in Table 4, GWPs of acceptable refrigerants in these end-uses range from zero (NIK) to 3,990 (R-507A) in new residential and light commercial AC and heat pumps; zero (ammonia and not-in-kind technologies) to 630 (R-513A) in new chillers, and zero (ammonia) to approximately 1,830 (R-407F) for new cold storage warehouses.⁶⁸ The GWPs of propylene and R-443A are lower than those of a number of HFCs and HFC/HFO blends,

such as R-450A and R-513A in all four end-uses; HFC-134a, R-407C and R-407F in cold storage warehouses and residential and light commercial AC and heat pumps; and R-410A in residential and light commercial AC and heat pumps. The GWPs of propylene and R-443A are comparable to or higher than those of CO₂, propane, isobutane, R-441A, ammonia, HFO-1234ze(E), *trans*-1-chloro-3,3,3-trifluoroprop-1-ene, and not-in-kind technologies such as Stirling cycle, water/lithium bromide absorption, desiccant cooling, or evaporative cooling, each of which is acceptable in new equipment for one or more of the four end-uses. In addition, propylene and R-443A have lower GWPs than those of ODS historically used in these end-uses, CFC-12 (GWP = 10,900); HCFC-22 (GWP = 1,810); and R-502 (GWP = 4,660).⁶⁹

TABLE 4—GWP, ODP, AND VOC STATUS OF PROPYLENE AND R-443A COMPARED TO OTHER REFRIGERANTS IN NEW EQUIPMENT FOR RESIDENTIAL AND LIGHT COMMERCIAL AC AND HEAT PUMPS, COLD STORAGE WAREHOUSES, CENTRIFUGAL CHILLERS AND POSITIVE DISPLACEMENT CHILLERS ^{1 2}

Refrigerants	GWP	ODP	VOC	Listing status
Propylene, R-443A	2–3	0	Yes	Unacceptable.
New Residential and Light Commercial AC and Heat Pumps				
HFC-32 ³ , HFC-134a, R-404A, R-407A, R-407C, R-407F, R-410A, R-410B, R-417A, R-421A, R-507A.	675–3,990	0	No	Acceptable.
R-290 ³ , R-441A ³ , THR-03 ³ , R-125/R-134a/R-600a (28.1/70.0/1.9), R-125/R-290/R-134a/R-600a (55.0/1.0/42.5/1.5), R-422B, R-422C, R-422D, R-424A, R-434A, R-437A, R-438A, RS-44 (2003 formulation).	3–3,390	0	Yes ⁴	Acceptable.
New Cold Storage Warehouses				
HFC-134a, R-407C, R-407F, R-450A, R-513A, R-717, R-744	1–1,810	0	No	Acceptable.
FOR12A, FOR12B, IKON A, IKON B, KDD6, R-437A, RS-24 (2002 composition), RS-44, SP34E, THR-02, THR-03.	30–1,810	0—Not public ⁵	Yes ⁴	Acceptable.
New Centrifugal Chillers				
HFO-1234ze(E), R-1233zd(E), R-450A, R-513A, R-717, R-744	0–630	0–0.00034	No	Acceptable.
HFO-1336mzz(Z), IKON A, IKON B, R-514A, THR-02	7–560	0—Not public ⁵	Yes ⁴	Acceptable.
New Positive Displacement Chillers				
HFO-1234ze(E), R-450A, R-513A, R-717, R-744	0–631	0	No	Acceptable.
HFO-1336mzz(Z), IKON B, R-514A, THR-02	0–560	0—Not public ⁵	Yes ⁴	Acceptable.

¹ The table does not include not-in-kind technologies listed as acceptable for the stated end-use.

² HCFC-22 and several blends containing HCFCs are also listed as acceptable but their use is severely restricted by the phasedown in HCFC production and consumption.

³ Listed only for use in room AC units.

⁴ One or more constituents of the refrigerant are VOC.

⁵ The ODP of one or more alternatives is not published here in order to avoid disclosing information that is claimed as confidential business information.

⁶⁵ We assume that substitutes containing no chlorine, bromine, or iodine have an ODP of zero.

⁶⁶ EPA, 2016b. Tables of Alternatives for End-Uses Considered in the Final Rule, Protection of Stratospheric Ozone: Listing Modifications for Certain Substitutes under the Significant New Alternatives Policy Program. September, 2016.

⁶⁷ Under EPA's phaseout regulations, virgin HCFC-22, HCFC-142b, and blends containing HCFC-22 or HCFC-142b may only be used to service existing appliances. Consequently, virgin HCFC-22,

HCFC-142b, and blends containing HCFC-22 or HCFC-142b may not be used to manufacture new pre-charged appliances or appliance components or to charge new appliances assembled onsite. Substitutes containing these HCFCs have ODPs ranging from 0.01 to 0.065. Class I and II ODS historically used as refrigerants in these end-uses have ODPs that range from 0.01 to 1.0.

⁶⁸ At the time of proposal, the highest GWP of any acceptable alternative in each of these end-uses was 3,990.

⁶⁹ IPCC, 2007. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. This document is accessible at: www.ipcc.ch/publications_and_data/ar4/wg1/en/contents.html.

In addition to ODP and GWP, EPA evaluated potential impacts of propylene and the components of R-443A on local air quality. Propylene and the three components of R-443A, propylene, propane, and isobutane meet the definition of VOC under CAA regulations (see 40 CFR 51.100(s)) and are not excluded from that definition for the purpose of developing SIPs to attain and maintain the NAAQS. However, there is a significant difference in the photochemical reactivity between propylene and the other two HCs. Propylene, because it has an unsaturated double bond between two carbons, is significantly more reactive in the atmosphere than propane, the saturated HC with the same number of carbon atoms, and isobutane. For example, the Maximum Incremental Reactivity (MIR) of propylene, in gram ozone per gram of the substance, is 11.57 while the MIR of propane is 0.56 g O₃/g and the MIR of isobutane is 1.34 g O₃/g.⁷⁰ Thus, propylene is roughly 21 times more reactive than propane and roughly nine times more reactive than isobutane for the same mass. Propylene is also more than 100 times more reactive than HFC-134a (MIR < 0.1) and a number of other HFCs acceptable for these end-uses and is significantly more reactive than unsaturated halogenated substitutes in these end-uses, such as HFO-1234yf (MIR = 0.28), HFO-1234ze(E) (MIR = 0.098), or *trans*-1-chloro-3,3,3-trifluoroprop-1-ene (Solstice™ 1233zd(E)) (MIR = 0.040).

EPA analyzed a number of scenarios to consider the potential impacts on local air quality if HC refrigerants were used widely. We used EPA's Vintaging Model to estimate the HC emissions from these scenarios and EPA's Community Multiscale Air Quality (CMAQ) model to assess their potential incremental contributions to ground-level ozone concentrations.⁷¹ The first analysis assumed that all refrigerant used was emitted to the atmosphere, as it could be if refrigerants were exempted from the venting prohibition of CAA section 608. In that highly conservative scenario, the model predicted that the maximum increase in the 8-hour average ground-level ozone concentration would be 0.72 ppb in Los Angeles if the most reactive saturated HC, isobutane, were the only refrigerant and it was all emitted to the atmosphere. If the unsaturated HC propylene was assumed to be the only

refrigerant used in equipment and it was all emitted (if it were to be exempted from the venting prohibition under CAA section 608), the model predicted that the maximum increase in the 8-hour average ground-level ozone concentration would be 6.61 ppb in Los Angeles, which is the area with the highest level of ozone pollution in the United States. For purposes of comparison, the ground-level ozone limit under the NAAQS has been 75 ppb since 2008.⁷² We have concerns that widespread emissions of propylene from use as a refrigerant could interfere with the ability of some nonattainment areas to reach attainment, both with the 2008 NAAQS and the new, more stringent standard.

EPA also performed less conservative analyses that considered the end-uses where these refrigerants would more likely be used, based upon submissions received and upon end-uses where there are industry standards addressing the use of flammable refrigerants. Propylene was previously listed as an acceptable substitute in industrial process refrigeration. EPA has received submissions for use of R-443A in residential and light commercial AC and heat pumps and window air conditioners. We have received a SNAP submission for use of propylene in cold storage warehouses and in commercial comfort AC in chillers, and have received inquiries about using propylene in retail food refrigeration. In addition, EPA is aware that UL has developed standards addressing use of flammable refrigerants in stand-alone retail food refrigeration equipment and coolers; vending machines; water coolers; commercial ice machines; household refrigerators and freezers; and room air conditioners; and is currently developing revisions to UL 1995 for residential AC equipment. Thus, we considered scenarios where propylene would be used and emitted (1) in all stationary AC and refrigeration end-uses, but excluding MVAC, (2) in all refrigeration end-uses and all AC end-uses except for MVAC and chillers for commercial comfort AC. For further details on the scenarios and end-uses in the analysis, see the docket for this rulemaking.⁷³

Based on this still conservative assessment of refrigerant use, we found that if all the refrigerant in appliances in the end-uses analyzed were to be

emitted, there would be a worst-case impact of 4.47 ppb ozone in the Los Angeles area. In the other cities examined in the analysis, Houston and Atlanta, which have also had historically high levels of ambient ozone, impacts were smaller (as much as 0.67 and 0.39 ppb, respectively).⁷⁴ Approximately 72–73 percent of the emissions were estimated to come from the residential and light commercial AC and heat pumps end-use in those less conservative analyses, indicating that emissions from this end-use could have a particularly large impact. Both the most conservative as well as the less conservative but more probable assessments indicated there could be significant air quality impacts of these refrigerants if they are released to the atmosphere.

An analysis we performed to support the proposed rule specifically examining use of R-443A and propylene in residential and light commercial AC and heat pumps, cold storage warehouses, and commercial comfort AC (centrifugal and positive displacement chillers) found noticeable impacts from these end-uses. If propylene were the only refrigerant in these end-uses and it was emitted from residential and light commercial AC and heat pumps and cold storage warehouses,⁷⁵ the analysis indicated there would be a worst-case impact of 4.45 ppb ozone in the Los Angeles area, 1.21 ppb in Houston, and 0.65 in Atlanta, respectively.^{76 77} Assuming that propylene were used in all cold storage warehouses and centrifugal and positive displacement chillers; room air conditioners could use either R-443A or the currently listed VOC refrigerants propane or R-441A; other residential and light commercial AC and heat pumps all used R-443A; and these refrigerants were all emitted from cold storage warehouses and residential and light commercial AC and heat pumps, there would be a worst-case impact of 2.57 ppm ozone in the Los Angeles area, 0.77 ppb in Houston, and 0.44 ppb in Atlanta, respectively.^{78 79}

⁷⁴ Ibid.

⁷⁵ The analysis assumed that local and state safety regulations required recovery of refrigerant from commercial comfort air conditioning equipment.

⁷⁶ ICF, 2016f. Significant New Alternatives Policy Program. Refrigeration and Air Conditioning Sector Risk Screen on Substitutes in Residential and Light Commercial Air Conditioning and Heat Pumps. Substitute: R-443A.

⁷⁷ ICF, 2016g. Significant New Alternatives Policy Program. Refrigeration and Air Conditioning Sector Risk Screen on Substitutes in Chillers and Cold Storage Warehouses. Substitute: Propylene (R-1270).

⁷⁸ ICF, 2016f. Significant New Alternatives Policy Program. Refrigeration and Air Conditioning Sector

⁷⁰ ICF, 2014a. Assessment of the Potential Impact of Hydrocarbon Refrigerants on Ground Level Ozone Concentrations. February, 2014.

⁷¹ ICF, 2014a. Assessment of the Potential Impact of Hydrocarbon Refrigerants on Ground Level Ozone Concentrations. February, 2014.

⁷² The standard has recently been lowered to 70 ppb (80 FR 65292; October 26, 2015).

⁷³ ICF, 2016g. Significant New Alternatives Policy Program. Refrigeration and Air Conditioning Sector Risk Screen on Substitutes in Chillers and Cold Storage Warehouses. Substitute: Propylene (R-1270).

Based on these analyses, EPA estimates that potential emissions of saturated HCs, if used as refrigerant substitutes in all end-uses in the refrigeration and AC sector would have little impact on local air quality. However, emissions of propylene, an unsaturated HC, whether used as propylene or as part of the blend R-443A, could have a significant negative impact, whether for all refrigeration and AC uses or for the uses in which we are listing these refrigerants as unacceptable.⁸⁰

In response to public comments, EPA reevaluated these substitutes, assuming a prohibition on venting propylene and R-443A. However, even that additional analysis showed that there was still a potential for significant negative impacts on air quality. Assuming that propylene were used in all cold storage warehouses and centrifugal and positive displacement chillers; room air conditioners could use either R-443A or the currently listed VOC refrigerants propane or R-441A; other residential and light commercial AC and heat pumps all used R-443A; and these refrigerants were subject to the venting prohibition, there would be a worst-case impact of 2.09 ppb ozone in the Los Angeles area, 0.54 ppb in Houston, and 0.28 ppb in Atlanta, respectively.⁸¹ For further details on the scenarios and end-uses in the analyses, see the docket for this rulemaking.

Ecosystem effects, primarily effects on aquatic life, of the substitutes we are listing as unacceptable are expected to be small as are the effects of other acceptable substitutes. Propylene, propane and isobutane are all highly volatile and would evaporate or partition to air, rather than contaminate surface waters. Neither propylene nor R-443A pose a greater risk of aquatic or ecosystem effects than those of other substitutes for these uses.

As discussed in section VI.A.3.b.iii in the proposed rule (81 FR 22839–41; April 18, 2016), EPA's SNAP program evaluated the flammability and toxicity risks from propane in the end-uses in

this rule. Risk screens containing these evaluations are provided in the docket, but EPA is providing some of that information in this section as well. Propylene and R-443A are both designated as A3 refrigerants according to ASHRAE 34–2013 and subsequent addenda. Thus, their flammability is comparable to that of ethane, propane, isobutane, and R-441A, other refrigerants that EPA has listed as acceptable, subject to use conditions, in a number of end-uses (76 FR 78832, December 20, 2011; 80 FR 19454, April 10, 2015). Due to their flammable nature, propylene and R-443A could pose a significant safety concern for workers and consumers if they are not properly handled. In the presence of an ignition source (e.g., static electricity spark resulting from closing a door, using a torch during service, or a short circuit in wiring that controls the motor of a compressor), an explosion or a fire could occur when the concentration of refrigerant exceeds its LFL. The LFLs of the substitutes are 2.03 percent for R-443A⁸² and 2 percent for propylene.⁸³ To determine whether flammability would be a concern for manufacturing and service personnel or for consumers, EPA analyzed a plausible worst-case scenario to model a catastrophic release of the refrigerants. Those analyses found that a release of the entire charge from equipment with smaller charge sizes, such as room air conditioners or small chillers, would not exceed the LFL. Release of larger charge sizes such as from a large residential unitary split AC system or heat pump or a large chiller could exceed the LFL under some circumstances.⁸⁴ Further information on these analyses and EPA's risk assessments are available in section VI.A.3.b.iii of the proposed rule (81 FR 22837; April 18, 2016) and in the docket for this rulemaking (EPA-HQ-OAR–2015–0663).

In evaluating potential toxicity impacts of propylene and R-443A on human health, EPA considered occupational risk for all end-uses, and also considered consumer risk for the residential and light commercial AC and heat pump end-use. EPA investigated

the risk of asphyxiation and of exposure to toxic levels of refrigerant for a plausible worst-case scenario and a typical use scenario for each refrigerant in each end-use.

To evaluate toxicity of both refrigerants, EPA estimated the maximum TWA exposure both for a short-term exposure scenario, with a 30-minute TWA exposure, and for an 8-hour TWA that would be more typical of occupational exposure for a technician servicing the equipment. We compared these short-term and long-term exposure values to relevant industry and government workplace exposure limits for propylene and the components of R-443A (including potential impurities). The modeling results indicate that both the short-term (30-minute) and long-term (8-hour) worker exposure concentrations would be below the relevant workplace exposure limits in cold storage warehouses, centrifugal and positive displacement chillers, and residential and light commercial AC and heat pumps.⁸⁶ The acceptable refrigerants in these end-uses and those we are listing as unacceptable in this action can be used in these end-uses in accordance with their respective workplace exposure limits.

For equipment with which consumers might come into contact, such as residential AC and heat pumps, EPA also performed a consumer exposure analysis. EPA considered toxicity limits for consumer exposure that reflect a short-term or acute exposure such as might occur at home or in a store or other public setting where a member of the general public could be exposed and could then escape. In EPA's initial risk screen used to support the proposal, the estimated 30-minute consumer exposures to the refrigerants exceeded the toxicity limits for the propylene component of R-443A in all cases but the least conservative, for a room air conditioner. In response to public comments on the proposal, EPA reconsidered the toxicity profile and the toxicity limit for consumer exposure for propylene and determined that its acute toxicity was not significantly different from that of propane. We reanalyzed the modeled exposures against the same exposure threshold we used for analyzing acute toxicity of propane (e.g., 6,900 ppm over 30 minutes by analogy to the 30-minute Acute Emergency Guideline Limits (AEGL)-1 for propane). Using this less conservative analysis, the propylene fraction of R-443A could meet the exposure limit in smaller room

Risk Screen on Substitutes in Residential and Light Commercial Air Conditioning and Heat Pumps. Substitute: R-443A.

⁷⁹ ICF, 2016g. Significant New Alternatives Policy Program. Refrigeration and Air Conditioning Sector Risk Screen on Substitutes in Chillers and Cold Storage Warehouses. Substitute: Propylene (R-1270).

⁸⁰ ICF, 2014a and attachment, Follow-on Assessment of the Potential Impact of Hydrocarbon Refrigerants on Ground Level Ozone Concentrations. March, 2016.

⁸¹ ICF, 2016l. Additional Follow-on Assessment of the Potential Impact of Hydrocarbon Refrigerants on Ground Level Ozone Concentrations. September, 2016.

⁸² A.S. Trust & Holdings, 2014. Response to Incompleteness Letter from A.S. Trust & Holdings to EPA—Sent March 7, 2014.

⁸³ Airgas, 2015. Safety Data Sheet for Propylene.

⁸⁴ ICF, 2016f. Significant New Alternatives Policy Program. Refrigeration and Air Conditioning Sector Risk Screen on Substitutes in Residential and Light Commercial Air Conditioning and Heat Pumps. Substitute: R-443A.

⁸⁵ ICF, 2016g. Significant New Alternatives Policy Program. Refrigeration and Air Conditioning Sector Risk Screen on Substitutes in Chillers and Cold Storage Warehouses. Substitute: Propylene (R-1270).

⁸⁶ Ibid.

air conditioners, but not in split AC systems with higher charges.

The currently acceptable refrigerants such as HFCs, HFC blends, or HFOs, are able to achieve their acute exposure limits, which are generally higher than that for propylene. Because of the relatively low acute exposure limit for propylene and the potential for exceedances of that limit, acute exposure may be a greater concern than for many other acceptable refrigerants in residential and light commercial AC systems and heat pumps with larger charge sizes. Further information on these analyses, EPA's risk assessments, as well as information from the submitters of the substitutes are in the docket for this rulemaking (EPA-HQ-OAR-2015-0663).

ii. When will the listings apply?

EPA is establishing a listing date as of January 3, 2017, the same as the effective date of this regulation. To our knowledge, manufacturers and service technicians are not currently using these substitutes in the end-uses in this rule. We note that EPA has only recently found submissions complete for these substitutes, and under the SNAP program regulations, a substitute may not be introduced into interstate commerce prior to 90 days after EPA receives a complete submission.

c. How is EPA responding to comments?

EPA received several comments from individuals and organizations with various interests in R-443A and propylene. Comments were in reference to the proposed listing status of R-443A and propylene and the environmental, flammability, and toxicity impacts of R-443A and propylene. Some commenters supported the proposed listing decisions and effective date of 30 days after date of publication of the rule in the **Federal Register**, while others opposed them and suggested that R-443A and/or propylene should be listed as acceptable or acceptable, subject to use conditions in one or more of the four end-uses being considered. Some commenters thought that these refrigerants could be used safely and with minimal environmental impacts with appropriate controls, while others expressed concern about the flammability and environmental impacts of these refrigerants.

Commenters included Whitmyre Research and Whitmyre Equipment Corporation, consultants for A.S. Trust & Holdings; UTC; Chemours, a chemical producer; Refrigerants, Naturally!, an industry organization supporting the use of HC refrigerants; NRDC, IGSD, and

EIA; and a number of anonymous commenters.

We have grouped comments together and responded to the issues raised by the comments in the sections that follow, or in a separate Response to Comments document which is included in the docket for this rule (EPA-HQ-OAR-2015-0663).

Comment: NRDC and IGSD stated that EPA's extensive tests on exposure and toxicity, as well as the effects on local air quality, show significant concern with propylene. The commenters stated that propylene and majority-propylene blends are neither ideal nor necessary for achieving EPA's climate goals, and threaten a safe, environmentally-sound transition to lower-GWP refrigerants. Chemours also supported EPA's proposal.

Response: EPA agrees that there are significant concerns with the use of propylene—in particular, the potential air quality impacts. Other alternatives are available for the same uses that pose lower overall risk to human health and the environment.

Comment: EIA commented that both academic studies and end users cite propylene as a very high performing refrigerant, offering both energy efficiency and increased volumetric cooling capacity in comparison to other alternatives, and provided links to some of this information. EIA stated that propylene's low GWP and high performance in terms of efficiency and capacity carries significant environmental benefits, its flammability risks can be mitigated, and its benefits significantly outweigh potential limited environmental impacts of a small relative contribution of propylene as a refrigerant to formation of ground level ozone.

Refrigerants, Naturally! commented that propylene has particular advantages over propane such as the same or better efficiency, a larger cooling capacity giving more compact systems, higher LFL and also a distinctive smell. The commenter claimed that combined, these lead to more compact and safer systems (in terms of lower charge sizes per kW of cooling, smaller flammable volumes in event of a leak and pre-warning to technicians working on systems). Both commenters noted that propylene is already safely used in Europe and the United States, particularly in stand-alone retail food refrigeration equipment, as well as in positive displacement chillers and remote condensing units. Refrigerants, Naturally! recommended that EPA reconsider its proposed decision and stated that it would be significantly preferable to impose a ban on venting

propylene than to introduce a ban on its use.

Response: EPA appreciates the additional information provided by the commenters concerning the performance of propylene as a refrigerant but does not find this information a sufficient reason for changing our proposal, given the primary basis for EPA's decision is effects on local air quality. Concerning comments that propylene is already used in Europe and the United States, we note that propylene is only listed as acceptable in industrial process refrigeration and not in the other types of equipment mentioned by the commenters. EPA disagrees with the commenters on other points concerning the SNAP criteria. Refrigerant performance, refrigerant capacity, energy efficiency, and use of odorants are not among the SNAP program's review criteria. Concerning flammability, the LFL of propylene is not significantly different from that of propane (2 percent versus 2.1 percent). We note that additional work is underway on industry standards to address flammability risks for most of the end-uses in this final rule. EPA disagrees that propylene can be assumed to have a small relative contribution to the formation of ground-level ozone, considering both the results of EPA's analyses, discussed in this section under the heading "Environmental Impacts," and the lack of a way for EPA to limit sales and use to a specific amount. Emissions from industrial process refrigeration equipment are already part of existing VOC emissions, and use in additional end-uses would result in additional, incremental VOC emissions that could result in significant impacts, depending on the amount used. As discussed in the section "Environmental Impacts," prohibiting venting of propylene (and R-443A) is not sufficient to ensure minimal impacts on local air quality or to mitigate the environmental risks of these refrigerants. Also see the previous response concerning how propane and other available low-GWP refrigerants compare to propylene in EPA's evaluation.

i. Environmental Impacts

Comment: Refrigerants, Naturally! and Whitmyre Research stated that there is no need for concern about R-443A being released into the air because R-443A is not exempt from the venting prohibition. The commenters stated that R-443A refrigerant will be recovered and recaptured during servicing by trained and certified technicians. Refrigerants, Naturally! and EIA

recommended that EPA perform another assessment to re-evaluate the assumptions made and to consider controls to mitigate the release and venting of propylene and R-443A.

Response: EPA disagrees that the CAA section 608 prohibition on venting sufficiently addresses potential risks due to impacts on air quality. There are refrigerant emissions from causes other than venting that could result in sufficient emissions of propylene to have significant impacts on local air quality. As discussed in the preamble to the proposed rule, “Other emissions could occur that are not subject to the venting prohibition and no equipment is free of refrigerant emissions. Because of the reactivity of these refrigerants, those emissions could interfere with the ability of some nonattainment areas to reach attainment, both with the 2008 NAAQS and the new, more stringent standard” (81 FR 22839). Examples of refrigerant releases that are not subject to the venting prohibition are releases during good-faith efforts to service equipment, releases at installation, leaks during the lifetime of the equipment, and any refrigerant that is not withdrawn from the equipment at its end of life.

EPA repeated its local air quality analysis assuming use of propylene in chillers for commercial air conditioning and in cold storage warehouses and use of R-443A in residential air conditioning and heat pumps.⁸⁷ This analysis also assumed use of propane and R-441A in room air conditioners, where they have already been listed as acceptable, as well as R-443A. In this follow-on analysis, EPA assumed that the venting prohibition remains in place for propylene and R-443A. Although emissions were reduced relative to the scenarios where all HC refrigerants were exempted from the venting prohibitions, the analysis still showed that there could still be significant impacts. For example, in the revised analysis, the incremental increase in the maximum 8-hour average ozone value estimated for Los Angeles was 2.1 ppb.

Comment: Whitmyre Research said all of EPA’s analyses, and particularly Scenarios 1, 2, and 3 (in which propylene is the sole refrigerant used in all refrigeration and AC; in all refrigeration and AC uses except MVAC; and in all refrigeration and AC uses except MVAC and chillers, respectively), cross the line from being overly-conservative to having no real-

world applicability because they unrealistically assume a rapid takeover of the market with propylene-based refrigerants, thereby ignoring the realities of the refrigerant market. This commenter suggested that EPA should focus upon Scenario 4, the most realistic of the scenarios analyzed, which in the commenter’s view does not justify restrictions on the use of R-443A in split system air conditioning and heat pumps, window ACs or portable room ACs. In contrast, NRDC and IGSD noted that Scenario 1 shows widespread use and venting of propylene in refrigeration and AC contributing almost seven ppb to ground-level ozone concentrations in Los Angeles, demonstrating the value of EPA’s proposed unacceptability finding.

Response: Concerning the three most conservative scenarios, Scenarios 1, 2, and 3 were not intended to be realistic projections of the refrigerant market, but rather, to provide screening estimates to see if there would be some level of refrigerant emissions that could result in unacceptably high increases in ground-level ozone. See our response to the same comment at 80 FR 19474 (April 10, 2015).

The scenario suggested by the first commenter, Scenario 4, would not consider impacts from use of propylene and R-443A in all of the end-uses for which they have been submitted—R-443A in residential split system AC and heat pumps and propylene in cold storage warehouses and centrifugal and positive displacement chillers for commercial comfort AC. Under the scenarios where EPA also considered the four end-uses for which R-443A and propylene were submitted result in most of the emissions, and thus, the scenario suggested by the commenter would likely underestimate the impact of emissions of these two substitutes on air quality. EPA analyzed additional Scenarios 5, 6, 7, and 8 to evaluate potential impacts of propylene and R-443A in the end-uses addressed in this action.⁸⁸ The analysis of Scenario 6, a scenario assuming use of R-443A for residential split system AC and heat pumps, along with some use of propane and R-441A for room air conditioners, and for propylene in cold storage warehouses and centrifugal and positive displacement chillers for commercial comfort AC, found there would be a worst-case impact of 2.57 ppm ozone in the Los Angeles area, 0.77 ppb in Houston, and 0.44 ppb in Atlanta,

respectively (see NPRM at 81 FR 22839). In response to comments that EPA should not assume that all propylene or R-443A is vented, EPA created Scenario 8, where it was assumed that intentional venting of propylene and R-443A during service, maintenance, repair, and disposal, were prohibited in those same end-uses. Under this scenario, the worst-case impacts would be 2.1 ppb ozone in the Los Angeles area, 0.54 ppb in Houston, and 0.28 ppb in Atlanta, respectively. We considered these less conservative assumptions to show that, even if the venting prohibition were observed, emissions of R-443A from residential split system AC and heat pumps and emissions of propylene from cold storage warehouses and centrifugal and positive displacement chillers could result in air quality impacts that are not significantly different from those in the analyses we relied upon in our proposal.

Comment: Whitmyre Research stated that EPA was inconsistent in leak profiles used in its ground-level ozone modeling and the modeling for occupational exposure impacts. The commenter stated that if EPA had used those more realistic assumptions in its ground-level ozone analysis, this would have reduced by nearly 89 percent the “disposal” emissions in the analysis.

Response: EPA disagrees with the commenter’s suggestion that the disposal emissions should be the same as those used in EPA’s occupational exposure analysis. The release estimates used in the occupational exposure estimates at disposal are for release in the vicinity of workers involved in disposing of the equipment and do not include releases to the environment when equipment leaks at the end of its useful life. In an additional analysis, rather than assuming the release of 100 percent of remaining charge at disposal, EPA reassessed emissions at disposal using the assumptions in EPA’s Vintaging Model—the same assumptions we use when analyzing emissions of HFC refrigerants from the same kinds of equipment. These emission rates reflect input from industry reviewers and historic information. They also reflect emissions due to leaks from equipment over the lifetime of the equipment as well as emissions at disposal. The remaining emissions were still significant, resulting in worst-case incremental ground-level ozone of 2.1 ppb.

Comment: Richard Maruya of A.S. Trust & Holdings commented that the proposed unacceptable listing for propylene is an abuse of EPA’s authority, since propylene is not listed

⁸⁷ ICF, 2016l. Additional Follow-on Assessment of the Potential Impact of Hydrocarbon Refrigerants on Ground Level Ozone Concentrations. September, 2016.

⁸⁸ ICF, 2016l. Additional Follow-on Assessment of the Potential Impact of Hydrocarbon Refrigerants on Ground Level Ozone Concentrations. September, 2016.

by EPA as a hazardous air pollutant under the CAA.

Response: It is not necessary for a substitute to be listed as a hazardous air pollutant in order for EPA to list it as unacceptable under the SNAP program established by section 612 of the CAA. Rather, EPA must determine that there are other alternatives available or potentially available for the same use that pose lower overall risk to human health and the environment.

ii. Assumptions in EPA's Analyses

Comment: Whitmyre Research stated that the release of any refrigerant from air-conditioning or heat pump units must be viewed probabilistically—that is, only a very small fraction of AC or heat pump units would experience leaks at any given point in time, and only a small fraction of these leaks would be sudden releases. The commenter stated that there is no basis for assuming that every possible leak in an R443A-based system would be sudden and complete, as opposed to slow and diluted. Values of 0.1 to one percent are much more realistic than 100 percent full release.

Response: With respect to EPA's assumptions for estimating total emissions for its air quality analysis, EPA assumed 100 percent release of refrigerant at disposal in most of the scenarios, to simulate a situation where venting would not be prohibited. As discussed previously, EPA considered scenarios where venting would be prohibited and also considered emissions from leaks. However, based upon the historical information EPA used in establishing the Vintaging Model and on reviewer input of those data, we consider the commenter's estimated probability of leaks to be low, particularly for residential split AC and heat pump equipment and for older equipment, which would be more likely to leak through extended lines. The study that was the basis for the commenter's estimates was based upon monitoring of commercial AC equipment in supermarkets of a type and age that was not described. If the equipment in the study was chiller equipment, this leak rate would be reasonable and close to the annual average leak rate EPA used in its emissions analysis for chillers, but the leak rate would be low for residential or light commercial AC and heat pump equipment, particularly for split systems.

With respect to EPA's leak assumptions in our risk screens for purposes of assessing flammability and toxicity impacts, we first conducted a worst-case analysis that assumed a release of 95 percent of the refrigerant

charge within one minute. This was an initial screen to determine whether the refrigerant would ever potentially exceed the LFL or relevant exposure limits. Since there were some potential exceedances with the most conservative assumptions, EPA then considered additional, less conservative assumptions concerning ventilation rates, charge sizes, and stratification or complete mixing of release refrigerant, and did not evaluate smaller leaks. EPA agrees with the commenter that slow, small leaks are likely to be far more common than large leaks. However, EPA must consider the possibility of a complete release because that is a possible, if less frequent, situation.

Comment: Whitmyre Research stated that EPA analyses incorrectly assumed air-exchange rates far lower than those allowed by ASHRAE standards incorporated in building codes (at least 0.35 ACH in typical residential structures). Based on data from Pandian et al. (1998),⁸⁹ the median residential air exchange rate in the United States (across all regions, all seasons) is 0.5 ACH. Therefore, the presumed exposures are unlikely and unrealistic for both the toxicity and flammability scenarios presented in this rule.

Response: We disagree that the air exchange rates used in the scenarios are not representative and do not represent likely scenarios. First, we note that the air-exchange value from ASHRAE is from a 2016 standard and applies only to newly constructed buildings; thus, it does not apply to existing housing stock, which is the vast majority of what is available. Second, both the value from ASHRAE and the median value from Pandian et al. fall within the range of air exchange rates that EPA analyzed of 0.11 to 0.67 ACH.

Comment: Whitmyre Research and Whitmyre Equipment Corporation claimed there is no need for concern about leakage because a safety valve design option already exists (per the request of EPA) that will greatly limit refrigerant loss during leak events.

Response: A safety valve, such as the check valve suggested by the commenter for R-443A, may reduce the size of leaks and thereby reduce risk of using the refrigerant. However, the submitter did not provide information on applying the check valve to equipment in this end-use. It is not clear, based on the information provided for the check valve in another end-use, that it would mitigate risk sufficiently to say R-443A

poses lower overall risk to human health and the environment. For instance, if the check valve works as described, it could reduce the amount of refrigerant leaked and potentially avoid exceedances of the LFL or the acute exposure limit. However, it is not clear that this check valve would be able to avoid slower leaks that over time contribute substantially to VOC emissions and to adverse air quality impacts, even if it works as designed. Further, EPA has not seen sufficient information to be confident of the performance of the safety valve.

iii. Flammability

Comment: Whitmyre Research and Refrigerants, Naturally! stated that EPA's discussion of flammability risk does not account for probability and therefore greatly overstates any concern for use of R-443A in both normal operation and maintenance/repair/disposal situations. Whitmyre Research stated that in order for there to be a flammability risk, there must be a co-occurrence of a *leak event* and a *spark generation* event. Subsequently, the probabilities of fire for normal operation of these devices, when charged with the specified amount of R-443A, and during maintenance, repair, and disposal, are quite low as calculated by the commenter in a fault tree analysis (FTA) included in the submission for R-443A. Refrigerants, Naturally! commented that there should be no differentiation between R-443A and other HCs in regards to flammability.

Response: EPA agrees that flammability risk for R-443A and propylene would not be significantly different from the risks for other HC refrigerants for the same uses. EPA's risk screen is intended to look first at reasonable worst-case scenarios and then at more typical scenarios, while remaining protective, and is not intended to discuss probability. EPA did evaluate the probability of events presented by the submitter in the FTA. As discussed in this section VI.A.4.c.i under "Assumptions in EPA's Analyses," the study that was the basis for the commenter's estimates was based upon monitoring of commercial AC equipment in supermarkets of a type and age that was not described. If the equipment in the study was chiller equipment, this leak rate would be reasonable and close to the annual average leak rate EPA used in its emissions analysis for chillers, but the leak rate would be low for residential or light commercial AC and heat pump equipment, particularly for split systems. Thus, the probabilities estimated by the commenter likely

⁸⁹ Pandian et al., 1998. "Correcting Errors in the Nationwide Data Base of Residential Air Exchange Rates." *Journal of Exposure Analysis and Environmental Epidemiology*, Vol. 8, No. 4, 577–585.

underestimate risks for residential and light commercial AC and heat pumps. In addition to worst-case scenarios, more typical scenarios, and FTAs, EPA also considered where there are industry standards or controls in place that can mitigate flammability risks.

Comment: UTC supported EPA's proposal to list both R-443A and propylene as unacceptable in residential and light commercial AC and heat pumps, cold storage warehouses, and centrifugal and positive displacement chillers for commercial comfort AC. However, the commenter believed that they also should be found unacceptable based on flammability concerns. In particular, the commenter asserted that since both propylene and R-443A are Class 3 flammable refrigerants, they should be considered unacceptable.

Response: EPA disagrees that flammability concerns should also provide a basis for listing R-443A and propylene as unacceptable in all the proposed end-uses. EPA previously listed two ASHRAE Class 3 refrigerants as acceptable, subject to use conditions, for use only in new room air conditioners (*i.e.*, propane and R-441A). For those refrigerants, EPA established use conditions that limited charge size and that would mitigate flammability risks. We note that the flammability risks for R-443A and propylene are similar to those for other Class A3 refrigerants.

For equipment with larger charge sizes, such as some unitary split AC systems and heat pumps or most centrifugal and positive displacement chillers, the flammability risk is a greater concern than for equipment with smaller sizes, such as self-contained room air conditioners. However, by stating the flammability risk is greater for equipment with larger charge sizes, EPA is not implying that such risks could never be mitigated. ASHRAE, AHRI, and DOE are investing \$5.2 million in research with the goal of using the results to update industry standards, subject to the ANSI consensus process, to address flammability risks. Such updates to standards would address risks in a broader range of equipment than the current UL standards.

iv. Toxicity and Exposure

Comment: Whitmyre Research stated that the Agency had "misconstrued the toxicity of propylene." The commenter stated that propylene is widely recognized as having very low toxicity by inhalation (*e.g.*, narcosis occurs at 35–46 percent by volume). Whitmyre Research stated that the Agency's concern for the toxicity of propylene is

misplaced, because (1) the Agency's modeled exposures are based on flawed methods and incorrect assumptions; (2) R-443A is only partially made of propylene; (3) propylene is simply not toxic at the modeled levels; and (4) the Agency used inappropriate toxicity benchmarks. Specific assumptions in some of EPA's scenarios that the commenter disagreed with included the length of time for the entire refrigerant charge to release, the ventilation rates, and the assumption of stratification of refrigerant (*i.e.*, pooling near the floor). The commenter also stated that the Agency must match the time-frame of exposure to catastrophic releases of R-443A (minutes) in establishing a toxicity benchmark.

Response: Based on this comment, EPA reconsidered the available toxicology data for propylene and agrees that it indicates lower concern for acute exposure than indicated in our risk assessment for the proposed rule. Concerning the commenter's complaint about the methods and assumptions for modeled exposures, EPA's analysis looked at a variety of scenarios. These scenarios considered ventilation rates both above and below those suggested by the commenter and both stratification of refrigerant and complete mixing of refrigerant within the space. We note that with a higher ventilation rate than that suggested by the commenter and with an assumption of no refrigerant stratification, concentrations reached 9,680 ppm over 30 minutes from release of a larger charge for a split system, exceeding both the excursion limit of 1,500 ppm and an acute exposure limit of 6,900 ppm over 30 minutes, analogous to the AEGL-1 for propane. EPA separately evaluated the propylene fraction when comparing modeled concentrations against the guideline for propylene, and thus, considered that it is only part of R-443A's composition.

We agree that the modeled exposure levels are below the level at which toxicity has actually been observed. However, it is standard practice to use more conservative values in evaluating toxicity risk than the no observed adverse effect level (NOAEL) seen in studies to account for uncertainty, such as variability within the general population or differences between species. Concerning the toxicity benchmark used by EPA—an excursion limit of three times the ACGIH TLV—EPA agrees that there could be other, less conservative benchmarks that could be used. We reviewed the available toxicity data for propylene and also considered how the toxicity profile of propylene differs from that of propane

to determine what might be an appropriate, less conservative benchmark. We concluded that there were not major differences between the two HCs that warranted using a much lower acute exposure limit for propylene than for propane.⁹⁰ Therefore, we reevaluated consumer exposure to propylene using an acute exposure limit of 6,900 ppm over 30 minutes for propylene, analogous to the AEGL-1 of 6,900 ppm for propane. In that revised evaluation, releases of the propylene fraction of R-443A from smaller room air conditioners could meet this acute exposure limit, but releases from split AC systems and heat pumps with higher charges could exceed the acute exposure limit. Thus, we still consider toxicity of propylene in R-443A to potentially be of concern for residential and light commercial AC and heat pump equipment with large charge sizes such as split AC systems, but it is not a concern for room air conditioners with limited charge sizes.

Comment: Whitmyre Research stated that there is no asphyxiation risk at the Immediately Dangerous to Life and Health (IDLH) limit; it is not an indicator of asphyxiation risk.

Response: EPA agrees that the IDHL is not an indicator of asphyxiation risk; however, EPA used a minimum oxygen concentration of 12 percent in assessing asphyxiation risk and did not use the IDLH.

Comment: Whitmyre Research stated that the TLV of 500 ppm for propylene that was established by ACGIH is a chronic exposure limit to be applied only to repeated exposures at least 40 hours per week over an occupational lifetime. ACGIH based the TLV of 500 ppm for propylene on nasal irritation effects occurring in treated animals exposed 6 hours per day, five days per week, for 103 weeks (2 years). No such nasal effects were observed in rats or mice exposed acutely (*i.e.*, single inhalation dose) or when exposed to up to 10,000 ppm propylene for 6 hours per day, 5 days per week for 14 days (ACGIH 2006).

Response: EPA agrees that the ACGIH's TLV for propylene, like other TLVs, is intended to be a chronic exposure limit and is based on longer term exposure. However, the ACGIH also recommends that short term excursions over a TLV should be no more than three times the TLV, on a regular basis, and in no case should exceed five times the TLV. The commenter has not suggested a specific

⁹⁰ Abt Associates, 2016. Review of propylene acute toxicity for R-443A risk screen. Prepared for EPA. July 6, 2016.

value that they propose EPA should use instead to assess risks of short-term exposure.

5. Change of Listing Status for Certain HFC Refrigerants for New Centrifugal Chillers and for New Positive Displacement Chillers

a. Background

i. What are the affected end-uses?

In the proposed rule, EPA described two chiller end-uses, specifically centrifugal chillers and positive displacement chillers. We draw attention to the fact that, as discussed there, in some cases the same refrigerant is used in both end-uses. Of note is the fact that HFC-134a is used for some centrifugal chillers, namely “high-pressure” centrifugal chillers, as well as in some positive displacement chillers, such as screw chillers. In addition, as discussed below, at least two alternatives—HFO-1234ze(E) and R-513A—have been used in both types of chillers. EPA received many comments concerning chillers that did not specifically say whether the comment was referencing centrifugal chillers, positive displacement chillers, or both. Therefore, in today’s rule, we are addressing both end-uses in this section.

Centrifugal chillers are equipment that utilize a centrifugal compressor in a vapor-compression refrigeration cycle. They are typically used for commercial comfort AC although other uses do exist. Centrifugal chillers tend to be used in larger buildings, such as office buildings, hotels, arenas, convention halls, airport terminals, and other buildings.

For commercial comfort and some other applications, centrifugal chillers typically cool water that is then pumped to fan coil units or other air handlers to cool the air that is supplied to the occupied spaces transferring the heat to the water. The heat absorbed by the water can then be used for heating purposes, and/or can be transferred directly to the air (“air-cooled”), to a cooling tower or body of water (“water-cooled”) or through evaporative coolers (“evaporative-cooled”). See section VI.A.4.a.i of the proposed rule for additional information on the centrifugal chiller end-use (81 FR 22841–42; April 18, 2016).

Positive displacement chillers are vapor compression cycle chillers that utilize positive displacement compressors, such as reciprocating, screw, scroll or rotary types. Positive displacement chillers are applied in similar situations as centrifugal chillers, primarily for commercial comfort AC, except that positive displacement

chillers tend to be used for smaller capacity needs such as in mid- and low-rise buildings. See section VI.A.4.b.i of the proposed rule for additional information on the positive displacement chiller end-use (81 FR 22841–42; April 18, 2016).

ii. What other types of equipment are used for similar applications but are not covered by this section of the rule?

Other equipment including packaged rooftop units and split system air conditioners, both of which fall under the SNAP end-use “residential and light commercial air conditioning,” can also be used for commercial comfort AC, typically for even smaller capacity needs than positive displacement chillers. These equipment types are not centrifugal or positive displacement chillers and hence are not covered under this section of the rule. EPA responds to comments regarding the scope of chillers—both centrifugal and positive displacement—end-uses in section VI.A.5.c.i.

iii. What refrigerants are used in centrifugal and positive displacement chillers?

EPA discussed historical and recent use of refrigerants in centrifugal chillers in section VI.A.4.a.i.(c) of the proposed rule (81 FR 22842; April 18, 2016). Since then, EPA has become aware of numerous additional demonstrations, availability, and announcements regarding alternative refrigerants for use in centrifugal chillers. For example, Honeywell stated in their comments that “[s]everal manufacturers currently offer high-efficiency chillers, air-cooled (outdoor) and water-cooled (indoor), using HFO-1234ze(E) in sizes ranging from tens of tons to hundreds of tons” and listed some examples, including some centrifugal chillers. Multiple companies have introduced chillers using HFO-1234ze(E), including Star Refrigeration,⁹¹ Klima-Therm,⁹² Airedale,⁹³ Geoclima,⁹⁴ Mitsubishi

Heavy Industries,⁹⁵ Smardt Chiller Group,⁹⁶ RC Group,⁹⁷ Engie Refrigeration,⁹⁸ and Climaveneta.⁹⁹

Centrifugal chillers using the alternative R-1233zd(E) have also been offered, from at least three manufacturers: Trane (a brand of Ingersoll Rand),¹⁰⁰ Carrier (a brand of UTC)¹⁰¹ and Mitsubishi Heavy Industries.¹⁰² Ingersoll Rand confirmed in their comment that they have R-1233zd(E) centrifugal chillers available now and further stated that they will have centrifugal chillers under their Trane brand using R-514A available in 2017.

A fourth alternative that is already available for some centrifugal chillers is R-513A. For instance, Johnson Controls announced this year that the centrifugal (and screw) chillers they offer, originally designed for HFC-134a, are compatible with R-513A.¹⁰³

EPA discussed historical and recent use of refrigerants in positive

⁹⁵ Mitsubishi, 2012. “Deployment to New Series of ‘eco Turbo chiller ETI series.’” This document is accessible at <http://www.mhi.co.jp/technology/review/pdf/491/491058.pdf>.

⁹⁶ SMARDT, 2016. “Revolutionary Energy Savings for the Built Environment”, “Trendsetting Technologies for Centrifugal Chillers.” These documents are available at <http://climatecontrolme.com/2013/12/trendsetting-technologies-for-centrifugal-chillers/> and <http://www.smaridt.com/docs/SMART%20BROCHURE%20ENGLISH%20JAN%202016.pdf>.

⁹⁷ RC Group, 2016. “Unico Turbo Air Cooled Liquid Chiller.” This document is accessible at <http://www.rcgroup.it/EN/Prodotti/?idP=1563>.

⁹⁸ Engie Refrigeration, 2016. “Quantum: Series and features of the energy-efficient chiller series.” This document is accessible at https://www.engie-refrigeration.de/export/sites/cofelyrefrigeration/content/documents/ENG/Produkte/Quantum/ENG_Quantum_Folder.pdf.

⁹⁹ Climaveneta, 2015. “Against Global Warming with the NEW TECs2 HFO Chillers.” January 12, 2015. This document is accessible at <http://www.climaveneta.com/EN/Media/Press-Releases/112.html>.

¹⁰⁰ Trane, 2016. “Trane Announces Significant Centrifugal Chiller Line Expansion and Services for the United States and Canada.” June 15, 2016. This document is accessible at <http://www.trane.com/commercial/north-america/us/en/about-us/newsroom/press-releases/centrifugal-chiller-line-expansion.html>.

¹⁰¹ Carrier, 2016. “Carrier China Showcases latest Innovations at China Refrigeration Expo.” April 7, 2016. This document is accessible at http://www.carrier.com/carrier/en/us/news/news-article/carrier_china_showcases_latest_innovations_at_china_refrigeration_expo.aspx.

¹⁰² MHI, 2015. “MHI Develops ‘ETI-Z Series’ of Next-generation Centrifugal Chiller—Adopt New Non-ozone-depleting Refrigeration to Minimize Greenhouse Gas Emissions.” June 10, 2015. This document is accessible at www.mhi-global.com/news/story/1506101900.html.

¹⁰³ Johnson Controls, 2016. “Johnson Controls Advances Environmental Sustainability with Chiller Platforms Compatible with Low GWP Refrigerants.” January 20, 2016. <http://www.johnsoncontrols.com/media-center/news/press-releases/2016/01/20/advanced-environmental-sustainability-with-chiller-platforms-compatible-with-low-gwp-refrigerants>.

⁹¹ Star Refrigeration, 2012. “Star’s Three-Way Development Test for R-1234ze(E).” July 2012. This document is accessible at <http://www.star-ref.co.uk/star/images/stories/pdf/Case%20Study%20No%2082%20-%20Refrigerant%20R-1234ze.pdf>.

⁹² RAC, 2012. “Klima-Therm discusses world’s first HFO chiller for Waitrose.” January 10, 2012. This document is accessible online at <http://www.racplus.com/features/klima-therm-discusses-worlds-first-hfo-chiller-for-waitrose/8624689.article>.

⁹³ The NEWS, 2014. “Airedale Chiller with Low-GWP HFO Refrigerant to Cool New John Lewis Store.” June 9, 2014. This document is accessible at <http://www.achnews.com/articles/126828-airedale-chiller-with-low-gwp-hfo-refrigerant-to-cool-new-john-lewis-store>.

⁹⁴ Geoclima, 2014. Geoclima Brochure. This document is accessible at http://www.benndorf-hildebrand.eu/sites/default/files/fabrikate/pdf/geoclima_broschure.pdf.

displacement chillers in section VI.A.4.b.i.(c) of the proposed rule (81 FR 22846; April 18, 2016), noting for instance that Trane introduced a series of positive displacement chillers offered with R-513A and that UTC had installed a screw chiller using HFO-1234ze(E).

Since then, EPA has become aware of additional demonstrations, availability and announcements regarding alternative refrigerants for use in positive displacement chillers. For example, in their comments, Ingersoll Rand noted their commitment to transition its entire chiller portfolio, including positive displacement screw and scroll chillers, before the end of 2018. They separately announced their

intention to use R-452B in “small chillers” as well as other products.¹⁰⁴ Johnson Controls also announced that they were offering multiple positive displacement chillers, covering their entire line of screw chillers, with the choice of R-513A refrigerant.¹⁰⁵ It was reported that UTC chose HFO-1234ze(E) for their global line of screw chillers.¹⁰⁶ Blue Box has designed its Kappa Rev range of screw chillers specifically for HFO-1234ze(E).¹⁰⁷ This refrigerant is also available in positive displacement chillers from Geoclima.¹⁰⁸

b. What is EPA’s final decision?

For new centrifugal chillers, EPA proposed to change the status as of January 1, 2024, of the following

refrigerants from acceptable to unacceptable: FOR12A, FOR12B, HFC-134a, HFC-227ea, HFC-236fa, HFC-245fa, R-125/134a/600a (28.1/70/1.9), R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407C, R-410A, R-410B, R-417A, R-421A, R-422B, R-422C, R-422D, R-423A, R-424A, R-434A, R-438A, R-507A, RS-44 (2003 composition), and THR-03. We also proposed narrowed use limits for HFC-134a and R-404A for certain centrifugal chillers. In this action, we are finalizing the status changes and narrowed use limits that we proposed with no changes. The change of status determinations for new centrifugal chillers are summarized in Table 5.

TABLE 5—CHANGE OF STATUS DECISIONS FOR NEW CENTRIFUGAL CHILLERS

End-use	Substitutes	Listing status
Centrifugal Chillers (new only).	FOR12A, FOR12B, HFC-134a, HFC-227ea, HFC-236fa, HFC-245fa, R-125/134a/600a (28.1/70/1.9), R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407C, R-410A, R-410B, R-417A, R-421A, R-422B, R-422C, R-422D, R-423A, R-424A, R-434A, R-438A, R-507A, RS-44 (2003 composition), and THR-03.	Unacceptable as of January 1, 2024, except where allowed under a narrowed use limit.
Centrifugal Chillers (new only).	HFC-134a	Acceptable, subject to narrowed use limits, for military marine vessels, as of January 1, 2024.
Centrifugal Chillers (new only).	HFC-134a and R-404A	Acceptable, subject to narrowed use limits, for human-rated spacecraft and related support equipment, as of January 1, 2024.

For new positive displacement chillers, EPA proposed to change as of January 1, 2024 the status of the following refrigerants from acceptable to unacceptable: FOR12A, FOR12B, HFC-134a, HFC-227ea, KDD6, R-125/134a/600a (28.1/70/1.9), R-125/290/134a/

600a (55.0/1.0/42.5/1.5), R-404A, R-407C, R-410A, R-410B, R-417A, R-421A, R-422B, R-422C, R-422D, R-424A, R-434A, R-437A, R-438A, R-507A, RS-44 (2003 composition), SP34E, and THR-03. We also proposed narrowed use limits for HFC-134a and R-404A for

certain positive displacement chillers. In this action, we are finalizing the status changes and narrowed use limits that we proposed with no changes. The change of status determinations for new positive displacement chillers are summarized in Table 6.

TABLE 6—CHANGE OF STATUS DECISIONS FOR NEW POSITIVE DISPLACEMENT CHILLERS

End-use	Substitutes	Listing status
Positive Displacement Chillers (new only).	FOR12A, FOR12B, HFC-134a, HFC-227ea, KDD6, R-125/134a/600a (28.1/70/1.9), R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407C, R-410A, R-410B, R-417A, R-421A, R-422B, R-422C, R-422D, R-424A, R-434A, R-437A, R-438A, R-507A, RS-44 (2003 composition), SP34E, and THR-03.	Unacceptable as of January 1, 2024, except where allowed under a narrowed use limit.
Positive Displacement Chillers (new only).	HFC-134a	Acceptable, subject to narrowed use limits, for military marine vessels, as of January 1, 2024.
Positive Displacement Chillers (new only).	HFC-134a and R-404A	Acceptable, subject to narrowed use limits, for human-rated spacecraft and related support equipment, as of January 1, 2024.

¹⁰⁴ Ingersoll Rand, undated. “Ingersoll Rand Innovates HVAC Portfolio Using

Next Generation, Low Global Warming Refrigerant, R-452B.” This document is accessible at <http://company.ingersollrand.com/content/dam/ir-corp/documents/pdf/2016-DR55-Update-Release-FINAL.pdf>.

¹⁰⁵ Johnson Controls, 2016. “Johnson Controls Advances Environmental Sustainability with Chiller Platforms Compatible with Low GWP

Refrigerants.” January 20, 2016. This document is accessible at <http://www.johnsoncontrols.com/media-center/news/press-releases/2016/01/20/advanced-environmental-sustainability-with-chiller-platforms-compatible-with-low-gwp-refrigerants>.

¹⁰⁶ RAC, 2016. “Carrier opts for HFO 1234ze refrigerants for global chiller range.” February 26, 2016. This document is accessible at <http://www.racplus.com/news/carrier-opts-for-hfo-1234ze>.

[refrigerants-for-global-chiller-range/10003440.article?blocktitle=News&contentID=15773](http://www.benndorf-hilbrand.eu/sites/default/files/fabrikate/pdf/refrigerants-for-global-chiller-range/10003440.article?blocktitle=News&contentID=15773).

¹⁰⁷ Cooling Post, 2015. “Blue Box offers R1234ze chiller option.” April 29, 2015. This document is accessible at <http://www.coolingpost.com/world-news/blue-box-offers-r1234ze-chiller-option/>.

¹⁰⁸ Geoclima, 2014. Geoclima Brochure. This document is accessible at http://www.benndorf-hilbrand.eu/sites/default/files/fabrikate/pdf/geoclima_broschure.pdf.

i. How do these unacceptable refrigerants compare to other refrigerants for these end-uses with respect to SNAP criteria?

Other refrigerants for new centrifugal chillers not subject to this action are HFO-1234ze(E), HFO-1336mzz(Z), IKON A, IKON B, R-450A, R-513A, R-514A,¹⁰⁹ R-717 (ammonia), R-744 (carbon dioxide), THR-02, and *trans*-1-chloro-3,3,3-trifluoroprop-1-ene.¹¹⁰ In the proposed rule and SNAP Acceptability Determination 31, EPA provided information on the environmental and health risks presented by the alternatives that are being found unacceptable compared with alternatives listed as acceptable (81 FR 22842, April 18, 2016; and 81 FR 32242–45, May 23, 2016). In addition, a technical support document¹¹¹ that provides the **Federal Register** citations

concerning data on the SNAP criteria (e.g., ODP, GWP, VOC, toxicity, flammability) for acceptable alternatives as well as those we are finding unacceptable for new centrifugal chillers may be found in the docket for this rulemaking (EPA–HQ–OAR–2015–0663).

For new centrifugal chillers, the refrigerants we are listing as unacceptable have an insignificant ODP. Acceptable refrigerants HFO-1234ze(E), HFO-1336mzz(Z), IKON A, IKON B, R-1233zd(E), R-450A, R-513A, R-514A, R-717 (ammonia), R-744 (carbon dioxide), and THR-02 also have an insignificant ODP. The alternative refrigerant R-1233zd(E) has an ODP of 0.00024 to 0.00034.^{112 113} Estimates of this compound's potential to deplete the ozone layer indicate that even with worst-case estimates of emissions, which assume that this compound

would substitute for all compounds it could replace, the impact on global atmospheric ozone abundance would be statistically insignificant.¹¹⁴ R-514A has an ODP of approximately 0.00006, lower than that of R-1233zd(E) and comparable to HFC-134a's calculated ODP of less than 0.000015,¹¹⁵ which has generally been described as zero by EPA and in common practice. Thus, the acceptable alternatives have ODPs lower than or of the same practical effect to the ODPs of the alternatives which EPA is listing as unacceptable, and lower than the ODPs of ODS historically used in this end-use.

The refrigerants we are listing as unacceptable through this action have GWPs ranging from about 920 to 9,810. As shown in Table 7, alternatives acceptable for this end-use not subject to this action have GWPs ranging from zero to 630.

TABLE 7—GWP, ODP, AND VOC STATUS OF REFRIGERANTS IN NEW CENTRIFUGAL CHILLERS^{1 2}

Refrigerants	GWP	ODP	VOC	Listing status
HFO-1234ze(E), R-1233zd(E), R-450A, R-513A, R-717, R-744	0–630	0–0.00034	No	Acceptable.
HFO-1336mzz(Z), IKON A, IKON B, R-514A, THR-02	7–560	0—Not public ³	Yes ⁴	Acceptable.
HFC-134a, HFC-245fa	1,030–1,430	0	No	Unacceptable.
FOR12A, FOR12B, THR-03	920–1,220	Not public ³	Yes ⁴	Unacceptable.
R-407C, R-410A, R-410B, R-421A, R-423A, HFC-227ea	1,770–3,220	0	No	Unacceptable.
R-125/134a/600a (28.1/70/1.9), R-125/290/134a/600a (55/1/42.5/1.5), R-417A, R-422B, R-422C, R-422D, R-424A, R-434A, R-438A, RS-44 (2003 composition).	1,985–3,250	0	Yes ⁴	Unacceptable.
HFC-236fa, R-404A, R-507A	3,920–9,810	0	No	Unacceptable.

¹ The table does not include not-in-kind technologies listed as acceptable for the stated end-use.

² HCFC-22, HCFC-123, HCFC-124, and several blends containing HCFCs are also listed as acceptable but their use is severely restricted by the phasedown in HCFC production and consumption.

³ The ODP of one or more alternatives is not published here in order to avoid disclosing information that is claimed as confidential business information.

⁴ One or more constituents of the refrigerant are VOC.

One of the refrigerant blends not subject to this action (THR-02), as well as several of the substitutes for which we are changing the listing from acceptable to unacceptable, include small amounts of R-290 (propane), R-600 (n-butane), or other substances that are VOCs. These amounts are small and for this end-use are not expected to contribute significantly to ground level ozone formation.¹¹⁶ HFO-1336mzz(Z) and *trans*-1,2-dichloroethylene (constituents of R-514A) are considered

VOCs; the producer has petitioned EPA to exempt HFO-1336mzz(Z) from the definition of VOC. In the actions where EPA listed these refrigerants as acceptable, EPA concluded none of these refrigerants in this end-use pose significantly greater risk to ground-level ozone formation than other alternative refrigerants that do not meet the definition of VOC under CAA regulations (see 40 CFR 51.100(s)) or that are specifically excluded from that

definition for the purpose of developing SIPs to attain and maintain the NAAQS.

The refrigerants listed as acceptable and not subject to this action are highly volatile and typically evaporate or partition to air, rather than contaminating surface waters. Their effects on aquatic life are expected to be small and pose no greater risk of aquatic or ecosystem effects than those of the refrigerants for which we are changing the listing from acceptable to unacceptable for this end-use.

¹⁰⁹ In SNAP Determination 31 (81 FR 32241; May 23, 2016), EPA found acceptable a blend of 74.7 percent by weight HFO-1336mzz(Z) and 25.3 percent by weight *trans*-1,2-dichloroethylene. The Standing Standard Project Committee updating ASHRAE Standard 34–2013 has proposed assigning this blend a designation of R-514A, which is how we refer to it throughout section VI.A.5 of this rule.

¹¹⁰ ASHRAE Standard 34–2013 designates this chemical as R-1233zd(E), which is how we refer to it throughout section VI.A.5 of this rule.

¹¹¹ EPA, 2016b. Tables of Alternatives for End-Uses Considered in the Final Rule, Protection of Stratospheric Ozone: Listing Modifications for

Certain Substitutes under the Significant New Alternatives Policy Program. September, 2016.

¹¹² Wang D., Olsen S., Wuebbles D. 2011. "Preliminary Report: Analyses of tCFP's Potential Impact on Atmospheric Ozone." Department of Atmospheric Sciences. University of Illinois, Urbana, IL. September 26, 2011.

¹¹³ Patten and Wuebbles, 2010. "Atmospheric Lifetimes and Ozone Depletion Potentials of *trans*-1-chloro-3,3,3-trichloropropylene and *trans*-1,2-dichloroethylene in a three-dimensional model." Atmos. Chem. Phys., 10, 10867–10874, 2010.

¹¹⁴ Wang D., Olsen S., Wuebbles D. 2011. "Preliminary Report: Analyses of tCFP's Potential

Impact on Atmospheric Ozone." Department of Atmospheric Sciences. University of Illinois, Urbana, IL. September 26, 2011.

¹¹⁵ The ODP of HFC-134a was estimated to be less than 1.5×10^{-5} using a theoretical 2-dimensional model. Ravishankara, A. R., A. A. Turnipseed, N. R. Jensen, S. Barone, M. Mills, C. J. Howard, and S. Solomon. 1994. Do hydrofluorocarbons destroy stratospheric ozone? *Science* 263: 71–75. Available online at <http://www.ciesin.org/docs/011-552/011-552.html>.

¹¹⁶ ICF, 2014a. Assessment of the Potential Impact of Hydrocarbon Refrigerants on Ground Level Ozone Concentrations. February, 2014.

With the exceptions of HFO-1234ze(E) and R-717, all other refrigerants listed as acceptable and those we are listing as unacceptable, are not flammable. HFO-1234ze(E) is nonflammable at standard temperature and pressure using the standard test method ASTM E681; however, at higher temperatures it is mildly flammable. It is classified as a Class 2L (mild flammability, low burning velocity) refrigerant under the standard ASHRAE 34 (2013). Our assessment and listing decision (77 FR 47768; August 10, 2012) found that the overall risk, including the risk due to this mild flammability at elevated temperature, is not significantly greater than for other refrigerants or for the refrigerants we are listing as unacceptable.

The toxicity of the refrigerants we are listing as unacceptable is comparable to that of other alternatives that are acceptable in this end-use, with the exception of R-717 and R-514A. R-717 is of a higher toxicity than the other acceptable refrigerants and is classified as a B refrigerant under ASHRAE 34 (2013). See section VI.A.4.a.iii.(b) of the proposed rule (81 FR 22843; April 18, 2016) for a discussion on the long history of use of R-717 and our original decision finding it acceptable in new centrifugal chillers. The use of R-717, also known as ammonia, and the risks it might present are controlled through industry standards, code requirements and other regulations. In the original SNAP rule, EPA noted “[a]mmonia [R-717] has been used as a medium to low temperature refrigerant in vapor compression cycles for more than 100 years. Ammonia [R-717] has excellent refrigerant properties, a characteristic pungent odor, no long-term atmospheric risks, and low cost. It is, however, mildly flammable and toxic, although it is not a cumulative poison. OSHA standards specify a 15 minute short-term exposure limit of 35 ppm for ammonia [R-717].” (53 FR 13072; March 18, 1994). In that rule, we found R-717 acceptable for use in centrifugal chillers, concluding that its overall risk to

human health and the environment was not significantly greater than the other alternatives found acceptable. This conclusion was based on the assumption that the regulated community adheres to OSHA regulations on such use as well as standard refrigeration practices, such as the adherence to ASHRAE Standard 15 and the International Institute of Ammonia Refrigeration (IIAR) Standard 2,¹¹⁷ which are utilized by local authorities when setting their own building and safety requirements.

R-514A is designed for use in low-pressure centrifugal chillers and has the same toxicity rating as HCFC-123, which has and continues to be used safely in such chillers. Because these refrigerants operate in low-pressure chillers only, any leaks are more likely to cause air to enter the chiller, rather than refrigerant to escape. Exposure is further reduced by requirements set forth in ASHRAE Standard 15, which is often cited in building codes. Specifically, Occupant Exposure Limits and Refrigerant Concentration Limits for B1 refrigerants—specified in ASHRAE Standard 34—2013 and mandated by ASHRAE Standard 15 and building codes—are lower than for A1 refrigerants, and these limits must be observed in chiller operations. EPA’s risk screen¹¹⁸ found that for a typical-size chiller using R-514A, even under conservative assumptions, the estimated 15-minute time-weighted average exposure would be well below (less than 12 percent of) the corresponding limit. The other acceptable alternatives listed previously that are included in ASHRAE 34 (2013) are classified as A (lower toxicity) refrigerants. For further information, including EPA’s risk screens and risk assessments as well as information from the submitters of the substitutes, see docket EPA-HQ-OAR-2015-0663.

In summary, for new centrifugal chillers, because the risks other than GWP are not significantly different for the other available alternatives than for those we proposed to list as

unacceptable, and because the GWPs for the refrigerants we proposed to list as unacceptable are significantly higher and thus pose significantly greater risk, we are listing the following refrigerants as unacceptable: FOR12A, FOR12B, HFC-134a, HFC-227ea, KDD6, R-125/134a/600a (28.1/70/1.9), R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407C, R-410A, R-410B, R-417A, R-421A, R-422B, R-422C, R-422D, R-424A, R-434A, R-437A, R-438A, R-507A, RS-44 (2003 composition), SP34E, and THR-03.

For new positive displacement chillers, other alternatives that are listed as acceptable and not subject to this action pose lower overall risk to human health and the environment than the refrigerants we are listing as unacceptable. Acceptable refrigerants for new positive displacement chillers include: HFO-1234ze(E), HFO-1336mzz(Z), IKON B, R-450A, R-513A, R-514A, R-717, R-744, and THR-02. In the proposed rule and SNAP Acceptability Determination 31, EPA provided information on the environmental and health risks presented by the alternatives that are being found unacceptable compared with other available alternatives listed as acceptable (81 FR 22846; April 18, 2016 and 81 FR 32242–32245; May 23, 2016). In addition, a technical support document¹¹⁹ that provides the **Federal Register** citations of actions in which we provide information on the SNAP criteria (e.g., ODP, GWP, VOC, toxicity, flammability) for acceptable alternatives for new positive displacement chillers, as well as those we are finding unacceptable, may be found in the docket for this rulemaking (EPA-HQ-OAR-2015-0663).

For new positive displacement chillers, the refrigerants that we are listing as unacceptable have insignificant ODPs and have GWPs ranging from about 920 to 3,990. As shown in Table 8, other alternatives that we are not listing as unacceptable in this end-use have GWPs ranging from zero to 630.

TABLE 8—GWP, ODP, AND VOC STATUS OF REFRIGERANTS IN NEW POSITIVE DISPLACEMENT CHILLERS^{1 2}

Refrigerants	GWP	ODP	VOC	Listing status
HFO-1234ze(E), R-450A, R-513A, R-717, R-744	0–630	0	No	Acceptable.
HFO-1336mzz(Z), IKON B, R-514A, THR-02	7–560	0—Not public ³	Yes ⁴	Acceptable.
HFC-134a	1,430	0	No	Unacceptable.
FOR12A, FOR12B, SP34E, THR-03	920–1,410	0—Not public ³	Yes ⁴	Unacceptable.
HFC-227ea, R-407C, R-410A, R-410B, R-421A	1,770–3,220	0	No	Unacceptable.

¹¹⁷ ANSI/International Institute of Ammonia Refrigeration (IIAR) Standard 2–2008 (Addendum B)—American National Standard for Equipment, Design, & Installation of Closed Circuit Ammonia Mechanical Refrigerating Systems.

¹¹⁸ ICF, 2016m. Risk Screen on Substitutes in Chillers Substitute: HFO-1336mzz(Z)/trans-1,2-dichloroethylene blend (74.7/25.3) (Opteon™ XP30).

¹¹⁹ EPA, 2016b. Tables of Alternatives for End-Uses Considered in the Final Rule, Protection of Stratospheric Ozone: Listing Modifications for Certain Substitutes under the Significant New Alternatives Policy Program. September, 2016.

TABLE 8—GWP, ODP, AND VOC STATUS OF REFRIGERANTS IN NEW POSITIVE DISPLACEMENT CHILLERS^{1 2}—Continued

Refrigerants	GWP	ODP	VOC	Listing status
KDD6, R-125/134a/600a (28.1/70/1.9), R-125/290/134a/600a (55/1/42.5/1.5), R-417A, R-422B, R-422C, R-422D, R-424A, R-434A, R-437A, R-438A, RS-44 (2003 composition).	1,810–3,250	0	Yes ⁴	Unacceptable.
R-404A, R-507A	3,920–3,990	0	No	Unacceptable.

¹ The table does not include not-in-kind technologies listed as acceptable for the stated end-uses.

² HCFC-22 and several blends containing HCFCs are also listed as acceptable but their use is severely restricted by the phasedown in HCFC production and consumption.

³ The ODP of one or more alternatives is not published here in order to avoid disclosing information that is claimed as confidential business information.

⁴ One or more constituents of the refrigerant are VOC.

One of the refrigerant blends not subject to this action (THR-02), as well as several of the substitutes for which we are changing the listing from acceptable to unacceptable, include small amounts of R-290 (propane), R-600 (butane), or other substances that are VOCs. These amounts are small and for this end-use are not expected to contribute significantly to ground level ozone formation.¹²⁰ HFO-1336mzz(Z) and *trans*-1,2-dichloroethylene (constituents of R-514A) are considered VOCs; the producer has petitioned EPA to exclude HFO-1336mzz(Z) from the definition of VOC. In the actions where EPA listed these refrigerants as acceptable, EPA concluded that none of the refrigerants in this end-use pose significantly greater risk to ground-level ozone formation than other alternative refrigerants that are not VOCs or that are specifically excluded from the definition of VOC under CAA regulations (see 40 CFR 51.100(s)) addressing the development of SIPs to attain and maintain the NAAQS.

The refrigerants not subject to this action are highly volatile and typically evaporate or partition to air, rather than contaminating surface waters. Their effects on aquatic life are expected to be small and pose no greater risk of aquatic or ecosystem effects than those of the refrigerants that are subject to the status change for this end-use.

With the exception of HFO-1234ze(E) and R-717, all other refrigerants that have been listed as acceptable, including those for which we are now changing the status to unacceptable, are not flammable. HFO-1234ze(E) is nonflammable at standard temperature and pressure using the standard test method ASTM E681; however, at higher temperatures it is mildly flammable. It is classified as a Class 2L (mild flammability, low burning velocity) refrigerant under the standard ASHRAE 34 (2013). Our assessment and listing

decision (77 FR 47768; August 10, 2012) found that the overall risk, including the risk due to this mild flammability at elevated temperature, is not significantly greater than for other refrigerants or for the refrigerants we are listing as unacceptable.

R-717 (ammonia) is mildly flammable with a low flame speed; it is classified as a 2L refrigerant under ASHRAE 34 (2013). R-717 has a long history of use as a refrigerant in positive displacement chillers, especially in water-cooled screw chillers, and other applications. In our evaluation finding R-717 acceptable in this end-use, EPA noted “[a]mmonia [R-717] has been used as a medium to low temperature refrigerant in vapor compression cycles for more than 100 years. Ammonia [R-717] has excellent refrigerant properties, a characteristic pungent odor, no long-term atmospheric risks, and low cost. It is, however, mildly flammable and toxic, although it is not a cumulative poison. Ammonia [R-717] may be used safely if existing OSHA and ASHRAE standards are followed” (61 FR 47015).

With the exception of R-717, the toxicity of the refrigerants we are listing as unacceptable is comparable to that of other alternatives that are acceptable in this end-use. R-717, a refrigerant we are not listing as unacceptable, is of a higher toxicity than some other refrigerants and is classified as a B refrigerant under ASHRAE 34 (2013). See section VI.A.4.b.iii.(b) of the proposed rule (81 FR 22847; April 18, 2016) for a discussion on the long history of use of R-717 and our original decision finding it acceptable in new positive displacement chillers. However, as we provided in listing it as acceptable, if used consistent with OSHA regulations, as well as standard refrigeration practices, such as the adherence to ASHRAE Standard 15 and the International Institute of Ammonia Refrigeration (IIAR) Standard 2, which are utilized by local authorities when setting their own building and safety requirements, it does not pose significantly greater risk than other

available refrigerants in this end-use. For further information, including EPA’s risk screens and risk assessments as well as information from the submitters of the substitutes, see docket EPA-HQ-OAR-2015-0663.

In summary, for positive displacement chillers, because the risks other than GWP are not significantly different for the other available alternatives than for those we proposed to list as unacceptable, and because the GWPs for the refrigerants we proposed to list as unacceptable are significantly higher and thus pose significantly greater risk, we are listing the following refrigerants as unacceptable: FOR12A, FOR12B, HFC-134a, HFC-227ea, KDD6, R-125/134a/600a (28.1/70/1.9), R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407C, R-410A, R-410B, R-417A, R-421A, R-422B, R-422C, R-422D, R-424A, R-434A, R-437A, R-438A, R-507A, RS-44 (2003 composition), SP34E, and THR-03.

ii. Narrowed Use Limits for Military Marine Vessels and Human-Rated Spacecraft and Related Support Equipment

EPA is establishing a narrowed use limit that would allow continued use of HFC-134a in centrifugal and positive displacement chillers for military marine vessels as of January 1, 2024. EPA is also establishing a narrowed use limit that would allow continued use of HFC-134a and R-404A in centrifugal and positive displacement chillers for human-rated spacecraft and related support equipment applications as of January 1, 2024. See section VI.A.4.a.iv and VI.A.4.b.iv of the proposed rule (81 FR 22844; April 18, 2016) for a discussion of the reasons for these narrowed use limits. EPA responds to comments regarding the narrowed use limits in section VI.A.5.c.v.

Under these narrowed use limits, the end users will need to ascertain that other alternatives are not technically feasible due to performance or safety requirements, and they would also need to document the results of their

¹²⁰ ICF, 2014a. Assessment of the Potential Impact of Hydrocarbon Refrigerants on Ground Level Ozone Concentrations. February, 2014.

analysis. See 40 CFR 82.180(b)(3). Users are expected to undertake a thorough technical investigation of alternatives to the otherwise restricted substitute. Although users are not required to report the results of their investigations to EPA, users must document these results and retain them in their files for the purpose of demonstrating compliance. This information includes descriptions of:

- Process or product in which the substitute is needed;
- Substitutes examined and rejected;
- Reason for rejection of other alternatives, *e.g.*, performance, technical or safety standards; and/or
- Anticipated date other substitutes will be available and projected time for switching.

iii. When will the status change?

EPA proposed and is finalizing a status change date of January 1, 2024, for new centrifugal chillers and new positive displacement chillers, except as otherwise allowed under a narrowed use limit. The status change date is based on comments and our understanding of the needs for industry standards, model codes, and adoption of those items to allow for a range of alternatives, including flammable alternatives, in both types of chillers addressed. As pointed out by AHRI and NRDC in their joint comment on the proposed rule, for chillers with alternatives not subject to a status change to be used “effectively and safely, the appropriate mitigation must be developed, proven, and finally adopted by safety standards. Only then can states and municipalities adopt building codes reflecting the updated safety standards.” The Agency understands that relevant industry standards and model building codes are likely to change in the 2017 to 2021 timeframe, and that such changes will be a necessary step for the acceptable alternatives feasibly to be used in the chiller market. These standards and codes include ASHRAE 15, UL 1995, UL 60335–2–40, and the International Building Code (IBC). EPA also recognizes that even once standards and model building codes are changed, time will be required for locations to adopt such codes allowing for the use of chillers using the alternative refrigerants, many of which may not currently be allowed to be used based on existing codes. While some non-flammable, code-acceptable refrigerants are available for some of the chiller market, the use of other acceptable alternatives would require code changes or exceptions made by code officials. Comments indicated that there is a

progression from the release of a model code until adoption by State authorities, and that the majority of States are currently using either the most recent (2015) model code or are only one cycle behind (2012). While EPA does not believe the status change date must occur after all such authorities have adopted a new model code, we are allowing a reasonable time to provide that opportunity where such code adoption would facilitate the introduction of chillers with alternative refrigerants. Comments also indicate that, if the appropriate codes are not adopted, there are alternative means and measures that may be taken to allow the use of alternatives otherwise not allowed. A change of status date of January 1, 2024, is necessary to provide an expeditious yet reasonable time for this process to occur. The status change date is also necessary to allow continued development of designs of new centrifugal and positive displacement chillers using an acceptable alternative, covering the wide range of capacity and design types (low/medium pressure, indoor/outdoor, etc.) that exist in the market, and allow those chillers to be tested and certified. EPA is aware that some equipment has been introduced with acceptable alternatives, as discussed above in section VI.A.5.a.ii, and that additional research and development is underway with these and other possible alternatives. EPA responds to comments regarding the status change date in section VI.A.5.c.ii.

Some commenters suggested an earlier date for all or parts of the centrifugal and positive displacement chiller market, suggesting status change dates as early as 2019. While EPA noted that multiple chillers with alternative refrigerants are already available on the market now, and we expect more to become so by that date, we did not find evidence that a significant portion of the chiller market could transition at an earlier date than the date we are finalizing. Further, EPA did not receive enough technical detail to support dividing the centrifugal chiller end-use or the positive displacement chiller end-use so that different change of status dates could apply to different portions of the end-uses.

Commenters who suggested a later status change date had concerns regarding their ability to maintain current energy efficiency levels with alternative refrigerants. The data provided by commenters, however, showed only minor theoretical losses of efficiency for some alternatives, up to about four percent. These commenters suggested more time is needed to

recover these losses by redesigning and recertifying centrifugal chillers. These losses are considered small and only pertain to “drop-in” conditions; it is expected that any losses can be recovered by designing new chillers to utilize those refrigerants, as commenters indicate they expect to do. Furthermore, several alternatives were found to exceed current efficiency levels even in these theoretical conditions. While some commenters provided a general description of the steps that must be taken in this redesign process, none provided a detailed timeline of how long each step would take and how multiple models can be redesigned in parallel during the proposed timeframe. Therefore, we disagree that efficiency concerns would support a later change of status date.

Commenters who suggested a later status change date were also concerned about the need to update industry standards and building codes, and adoption of those codes, specifically for flammable alternatives. For centrifugal chillers, they stated such changes must take place for HFO-1234ze(E), a mildly flammable A2L refrigerant, to be used. They also identified that refrigerant and several other A2L refrigerants for positive displacement chillers, and likewise indicated that standards and codes actions hindered the availability of chillers with those alternatives. EPA found several examples where acceptable alternatives have been used in both centrifugal and positive displacement chillers, and received information that indicates that industry standards are expected to be updated as early as 2017 and that model building codes would be updated possibly in the 2018 cycle or most likely the 2021 cycle. By establishing a 2024 status change, we allow time for adoption of those model codes by States and other jurisdictional authorities. In addition, commenters noted that there are other alternative means and measures by which the use of a flammable refrigerant, if so chosen by the manufacturer, in a centrifugal or positive displacement chiller may be permitted, even if that refrigerant were not otherwise allowed under a particular State or locality’s existing code requirements.

c. How is EPA responding to comments?

EPA received several comments from individuals and organizations with various interests in the refrigerants industry. Comments addressed EPA’s proposed status change date of January 1, 2024, for new centrifugal chillers and new positive displacement chillers. Some commenters, including Chemours, EIA, Honeywell, and Ingersoll Rand

supported EPA's proposed status change date. These commenters identified a range of potential alternatives but generally agreed that new centrifugal chillers using these alternatives needed some time to be brought to the market. Other commenters opposed the proposed status changes or suggested different change of status dates from the one EPA proposed, such as 2021 and 2025. Other comments we received related to energy efficiency, industry standards and codes, and the narrowed use limits for military and spacecraft uses.

Commenters included Boeing, Eastman Chemical Company, Honeywell, Chemours, Johnson Controls, Ingersoll Rand, UTC, PSEG Services Corporation, Arkema, the Alliance, National Association of Manufacturers (NAM), AHRI, EIA, NRDC, IGSD, NASA, and DoD.

As stated above, EPA received many comments discussing "chillers" or "HFC-134a alternatives" that did not specify whether the comments applied specifically to centrifugal chillers, positive displacement chillers, or both. We have grouped comments together and responded to the issues raised by the comments in the sections that follow, or in a separate Response to Comments document which is included in the docket for this rule (EPA-HQ-OAR-2015-0663). Our responses should be considered as equally applicable to both end-uses unless otherwise specified.

i. Substitutes and End-Use Proposed

Comment: Eastman requested that EPA clarify whether the status changes under the chiller end-uses apply to the IPR end-use. Eastman pointed out that since the inception of the SNAP program, EPA has separated these into different end-uses.

Response: EPA confirms that this action will change the status of refrigerants for new positive displacement chillers and new centrifugal chillers and does not affect refrigerants listed under the separate IPR end-use.

Comment: Eastman raised concerns about retrofits to existing equipment, specifically for "any of these systems with remaining useful life [that] are scheduled for retrofits due to previous phase-outs of refrigerants such as R-22," and pointed out issues related to using certain refrigerants listed as acceptable for the chiller end-uses "to replace the one the [IPR] system was originally designed to use." PSEG submitted similar comments, requesting that EPA "clarify its intent that the prohibition of HFC-134a in chillers applies to new

chillers installed on or after January 1, 2024," and did not require "units that are newly installed with HFC-134a after the final rule becomes effective, but prior to January 1, 2024, to retrofit those 'existing' units by January 1, 2024." PSEG stated that "there are few viable zero or low GWP refrigerants available for use in HFC-134a large tonnage equipment" and that highly flammable refrigerants and both R-717 and R-744 are not viable for nuclear applications, noting that "the equipment must be designed specifically for the gas."

Response: The status changes to the centrifugal and positive displacement chiller end-uses in this rule apply to "new" equipment installed on or after the status change date of January 1, 2024. EPA has historically issued separate decisions under the SNAP program for new equipment in a given end-use and retrofit (*i.e.*, the replacement of the refrigerant with an alternate refrigerant) in the same end-use. This action changes the status of refrigerants for new chillers created on or after the status change date; it does not change the status of refrigerants currently acceptable for retrofitting chillers. Thus, concerns about retrofitting "HFC-134a" equipment are not pertinent for this action.

Comment: EIA supported EPA's proposal to change the status of high-GWP refrigerants to unacceptable for centrifugal and positive displacement chillers, mentioning specifically refrigerants HFC-134a, R-404A, R-407C, R-410A and R-507A. Chemours also supported EPA's proposed status changes for both chiller end-uses, and identified several alternatives and what they would replace, including R-513A (HFC-134a replacement), R-452B (R-410A replacement), R-449A (R-404A replacement) and HFO-1234yf (HFC-134a replacement).

Response: EPA thanks the commenters for their support of the proposed rule. Regarding the alternatives identified by Chemours, EPA agrees that R-513A is an acceptable alternative for centrifugal and positive displacement chillers. EPA has received submissions for R-449A and R-452B for both centrifugal and positive displacement chillers and the Agency is reviewing them for these and other end-uses. We have not received a submission specifically for HFO-1234yf in chillers.

Comment: UTC provided information regarding various refrigerants that are listed as acceptable or that may be under research for use in centrifugal chillers, specifically HFO-1234ze(E), R-290, R-450A, R-513A, R-452B, R-718, R-744, R-1233zd(E) and R-515A. They

likewise provided information on the first six of these refrigerants in positive displacement chillers. Additional information regarding the compressor displacement to utilize these alternatives was also provided. UTC noted the flammability of R-290 and felt that R-718 and R-744 "do not provide a long-term solution or require additional work to make such refrigerants feasible in chillers." UTC provided information regarding the application and efficiency of the other refrigerants and said some of these that could be used "are short-term, but less efficient" options. They also indicated others are "longer-term," and identified HFO-1234ze(E) as a specific example but also noted its flammability. They stated that R-452B was not a viable option to replace HFC-134a but did indicate it was under consideration as one of several R-410A alternatives, all of which are flammable.

Response: EPA interprets this comment to apply to both centrifugal and positive displacement chillers. EPA thanks the commenter for this information. This information shows that much is known about these refrigerants and how they could be employed in chillers. UTC indicates a desire to transition to what it considered "longer-term" solutions, but did not provide adequate information to indicate why their recommended status change date of January 1, 2025, would provide such time but the proposed status change date of January 1, 2024, would not. As discussed in section VI.A.5.b.iii above, EPA has established a change of status date that considers the need for standards and model codes to change to incorporate requirements for flammable refrigerants as well as additional time for States and localities to adopt such codes as part of their requirements.

Comment: UTC indicated that HFO-1234ze(E) is flammable and therefore mitigation is required and "appropriate safety standards and approved building codes must be in place before it can be used." Comments submitted as CBI indicate that a chiller using HFO-1234ze(E) has been introduced in Europe and that the potential flammability of the refrigerant was addressed through added mitigation requirements sufficient for A2 (and hence A2L) refrigerants. As noted in section VI.A.5.a.iii above, Honeywell stated that "[s]everal manufacturers currently offer high-efficiency chillers, air-cooled (outdoor) and water-cooled (indoor), using HFO-1234ze(E) in sizes ranging from tens of tons to hundreds of tons" and listed some examples, including some centrifugal chillers and some positive displacement chillers.

Response: EPA interprets these comments as applying to both centrifugal and positive displacement chillers. This information indicates that manufacturers and installers have been successful in introducing chillers with alternative flammable refrigerants in some instances, and that building codes allow for such installations under certain circumstances. However, as discussed in section VI.A.5.b.iii above, EPA agrees that for flammable refrigerants to become more widely used across the multiple applications and configurations where centrifugal and positive displacement chillers are deployed, standards and model codes need to be revised and the States and localities must adopt such codes. Our status change date of January 1, 2024, provides the time necessary for this to occur. As discussed above in section VI.A.5.a.iii, multiple companies have introduced chillers using HFO-1234ze(E). Comments indicate that this refrigerant is already being employed in chillers and that steps to address the flammability of the refrigerant in some applications are known. Thus, this refrigerant is one of the many options that can be utilized by manufacturers to develop chillers using acceptable refrigerants by the January 1, 2024, status change date. In addition to HFO-1234ze(E), other flammable refrigerants have been used, especially in positive displacement chillers. For instance, in the proposed rule (81 FR 22847; April 18, 2016), EPA noted that “R-717 has a long history of use as a refrigerant in positive displacement chillers, especially in water-cooled screw chillers, and other applications.”

Comment: Honeywell stated that “HFO-1233zd(E), has a GWP of one, is non-flammable and more energy efficient than HFC-134a, and chillers utilizing HFO-1233zd(E) are available from at least three manufacturers,” identifying Trane (a brand of Ingersoll Rand), Carrier (a brand of UTC), and Mitsubishi Heavy Industries.

Response: EPA thanks the commenter for this information regarding R-1233zd(E). The proposed rule (81 FR 22842; April 18, 2016) noted that one manufacturer had introduced a chiller using this refrigerant.¹²¹ That same company now offers all of their large tonnage low-pressure centrifugal chillers using this refrigerant.¹²² As

Honeywell notes, and as we cite in section VI.A.5.a.iii above, other manufacturers have also produced centrifugal chillers using R-1233zd(E). These will serve part of the chiller market but do not satisfy the full market, for instance where a smaller tonnage, positive displacement chiller is required.

Comment: Ingersoll Rand stated that they will have small tonnage low-pressure centrifugal chillers under their Trane brand using R-514A available in 2017.

Response: EPA thanks the commenter for this comment indicating the development of small tonnage low-pressure centrifugal chillers using R-514A, which we cite in section VI.A.5.a.iii.

Comment: EIA suggested that EPA “signal the likelihood” of finding alternatives with GWPs above 600 unacceptable, including R-450A and R-513A.

Response: EPA cannot, at this time, project what actions it may take in the future. Moreover, any proposal to change the status of R-450A and R-513A in the chiller end-uses would need to occur through a separate notice and comment rulemaking in which EPA performs a full comparative assessment using the SNAP criteria.

ii. Change of Status Date

Comment: Honeywell supported a January 1, 2024, status change date for chillers but felt that certain types could transition sooner. They noted that the discussion regarding the need for building codes to change to accept 2L flammable refrigerants was most applicable to water-cooled indoor chiller installations and that “for the most part this issue does not impact the installation of air-cooled chillers that are installed outdoors.” Based on that, Honeywell believed that EPA could adopt an earlier transition date for air-cooled (outdoor) chillers. EIA suggested a staged transition with a change of status date of January 1, 2019, for air-cooled chillers and January 1, 2021, for water-cooled chillers. The California Air Resources Board (CARB) recommended that all chillers be subject to a January 1, 2021, status change date. Arkema suggested a 2021 transition date for R-407A, R-407B, R-407C, R-407D, R-407E, and R-407F.

Response: EPA interprets these comments as applying to both centrifugal and positive displacement chillers. The commenters supporting

one or more earlier change of status dates for all or portions of the chiller end use did not provide enough technical detail to conclude that such dates are achievable for the chillers that would be subject to such dates. Further, EPA did not receive enough information regarding how extensive code changes would (or would not) be specifically for air-cooled outdoor chillers and thus we do not believe that an earlier status change date for that portion of the chiller market as suggested by Honeywell and EIA is supported. EPA notes that nonflammable (A1) and flammable (A2L and B2L) alternatives are acceptable for both centrifugal and positive displacement chillers.

We also recognize that it is important under the SNAP program to not limit end users to a single choice. EPA has identified several alternatives that are acceptable for centrifugal chillers and likewise positive displacement chillers. By establishing the same change of status date for all chillers, manufacturers will be able to choose from the full list of acceptable alternatives the refrigerant(s) and chiller type(s) that best meet their specific needs, and customers will be able to apply the particular type(s) of chillers using the particular acceptable alternative that best meet their needs. Individual manufacturers may determine for themselves which alternative(s) to use in their particular equipment and given the variety of alternatives available there may not be a single “widely-accepted” replacement, even for a specific type of chiller; there may be several refrigerants and chiller types competing in the market. For additional comments regarding building codes and standards, please see section VI.A.c.iv.

Comment: UTC argued for a status change date no earlier than January 1, 2025. One factor that they cited was that HFO-1234ze(E) “is a new HFO.” Regarding this chemical, UTC stated that it has “approximately equal performance” to HFC-134a and indicated that changes to equipment designs are required to use it. UTC also stated that “typical development projects require 2–3 years to complete,” but indicated that HFO-1234ze(E) “require[s] major redesign work.” Commenting on positive displacement chillers, EIA stated that “[t]he first HFO-1234ze chillers were installed back in 2011 and production uptake of HFO-1234ze chillers has been increasing rapidly” noting two major manufacturers—Carrier (a brand of UTC) and Trane (a brand of Ingersoll Rand)—using that refrigerant in chillers.

¹²¹ Cooling Post, 2014. “Trane first with 1233zd chiller.” June 30, 2014. This document is accessible at <http://www.coolingpost.com/world-news/trane-first-with-1233zd-chiller/>.

¹²² Trane, 2016. “Trane Announces Significant Centrifugal Chiller Line Expansion and Services for the United States and Canada.” June 15, 2016. This document is accessible at <http://www.trane.com/>

commercial/north-america/us/en/about-us/newsroom/press-releases/centrifugal-chiller-line-expansion.html.

Response: EPA interprets UTC's comment as applying to both centrifugal and positive displacement chillers while EIA's comment was specific to positive displacement chillers. HFO-1234ze(E) is not a "new" refrigerant—it was added to ASHRAE Standard 34–2010 via addendum i, which was approved by the ASHRAE Standards Committee on June 25, 2011, by the ASHRAE Board of Directors on June 29, 2011, and by the ANSI on June 30, 2011. EPA listed it acceptable for centrifugal and positive displacement chillers on August 10, 2012. As discussed previously in section VI.A.5.b.iii and as EIA noted, multiple companies have utilized HFO-1234ze(E) in chillers to date. Finally, we note that Carrier Corporation, a brand of UTC, has at least six HFO-1234ze(E) chiller installations in Switzerland.¹²³

Comment: UTC, Johnson Controls and AHRI stated that any status change date earlier than January 1, 2025, would not provide the time necessary to transition to alternatives that remain acceptable. UTC stated that "EPA must take into account certain properties, including flammability, for refrigerants for which EPA does *not* propose to change status" (emphasis in the original), such as HFO-1234ze(E), R-1233zd(E), R-450A and R-513A. UTC commented that the substitutes that remain acceptable for centrifugal chillers and for positive displacement chillers currently utilizing HFC-134a are not "drop-in" refrigerants and will require substantial equipment redesign to account for displacement changes and changes in cycle efficiency and heat transfer. For positive displacement chillers currently utilizing R-410A, UTC and Johnson Controls said system changes must be made for A2L refrigerants, and concluded that all the alternatives being investigated for such use are or would be classified as A2L. UTC provided further information on the steps required during redesign. These included steps for "each chiller type" as well as additional steps for 2L flammable refrigerants. To redesign equipment, UTC said one necessary step was the development of oils and new materials to be used in the new equipment. They also indicated that new components and overall systems would need to be requalified by test laboratories. More generally, UTC indicated that "different equipment redesign, requalification and equipment

sensor and alarms will be required along with state and local adoption of building and fire code changes" to transition positive displacement chillers.

UTC said that typical development projects would require two to three years to complete but also indicated that this time frame could be delayed due to the availability of manufacturer and test labs for certification, Johnson Controls indicated a project duration of two to nine years for low-pressure and medium-pressure chillers. AHRI also estimated it would take two to nine years to commercialize including time to reengineer and re-optimize chillers to use alternative refrigerants. Ingersoll Rand noted their commitment to transition its entire chiller portfolio, including positive displacement screw and scroll chillers, before the end of 2018.

Response: EPA interprets these comments as applying (regarding the development process) to both centrifugal and positive displacement chillers. Although EPA prefers not to use the term "drop-in," it is sometimes used by various parties to refer to the circumstance where one refrigerant can be used in place of another without any modification to the relevant piece of refrigeration equipment. EPA recognizes that in many cases designs will need to be modified to use different refrigerants. This is expected and was evidenced when centrifugal chillers transitioned from CFC-11 and CFC-12 to HCFC-123 and HFC-134a and when positive displacement chillers transitioned from CFC-12 and HCFC-22 to HFC-134a, R-407C and R-410A. Past experiences show that such redesigns offer the opportunity for manufacturers to integrate other changes to improve performance of their products and could offer them competitive advantages in the market. EPA realizes that the degree of design changes may vary by the refrigerant chosen and more so from decisions by the manufacturers in adopting designs for those refrigerants and including other design changes during the process.

The information from these commenters did not provide sufficient detail to determine the time it would take to transition all chillers to acceptable alternatives to serve its current market. For instance, UTC did not indicate whether the two to three year product development timeframe applied to just one or multiple products, and if the latter, whether those development projects could overlap and occur simultaneously. Johnson Controls and AHRI did not address these situations either. However, the January

1, 2024, change of status date for both centrifugal and positive displacement chillers that EPA is establishing in the final rule should provide sufficient time for the activities described by the commenters to occur in order to meet that date.

Comment: In addition to the argument for a change of status date no earlier than January 1, 2025, UTC suggested that HFC-134a in chillers should remain acceptable until states and localities adopted the "relevant building, fire and mechanical codes that may be necessary." The commenter suggested a narrowed use limit could apply. UTC also provided a table indicating the number of states adopting various editions of the IBC, the International Fire Code, and the International Mechanical Code. UTC indicated a desire for "regulatory certainty" and an avoidance of "balkanization of the market."

Response: UTC did not indicate specifically which codes, and specifically which provisions in any codes, would need to be modified. Although EPA recognizes that in general standards and model codes need to be developed to allow for the use of A2L refrigerants, and that States and localities need to adopt those model codes or similar requirements, it is not reasonable to condition the entire market by such actions. As stated above in section VI.A.5.b.iii, a status change date of January 1, 2024, provides a reasonable amount of time for these actions to take place for most if not all States and localities. Where such actions have not fully occurred, manufacturers have the option to offer nonflammable refrigerants for some chiller types, and alternative means and methods exist to allow for the use of A2L refrigerants if needed.

Further, as the table of approvals provided showed, various states are adopting different cycles of codes, some dating back to 2003 and others adopting the latest 2015 codes. In section VI.A.5.c.iv below, EPA points to the concerted effort by DOE, AHRI, and ASHRAE to fund vital research that will establish a more robust fact base about the properties and uses of flammable refrigerants. The results from this work will help provide the technical knowledge needed to facilitate and accelerate the safe use of flammable refrigerants. EPA finds that conditioning a status change on code adoption would not only be unnecessary, but would create the "balkanization" or patchwork of regulations that UTC said it wanted to avoid.

Comment: AHRI and NRDC jointly stated that "[t]he forthcoming redesign

¹²³ RAC, 2016. "Carrier opts for HFO 1234ze refrigerants for global chiller range." February 26, 2016. This document is accessible at <http://www.racplus.com/news/carrier-opts-for-hfo-1234ze-refrigerants-for-global-chiller-range/> 10003440.article?blocktitle=News&contentID=15773.

will require modification not only to the equipment itself, but also to the manufacturing environment, servicing practices and shipping logistics, and most importantly, to the equipment rooms and buildings in which these equipment may be installed.” AHRI and NRDC recommended a January 1, 2025, change of status date to allow time for these modifications to occur.

Response: EPA interprets these comments as applying to both centrifugal and positive displacement chillers. As discussed in the previous response, EPA recognizes that equipment modification and redesigns will be required to use alternatives. The commenters did not indicate specifically why the other modifications were required, did not provide any detail regarding the time needed for the identified modifications, whether the various steps could be addressed in parallel or only one after the other in series and why these steps cannot take place in time to meet a January 1, 2024, change of status date. Thus, these comments do not support a claim that the change of status date should be January 1, 2025, instead of January 1, 2024, for either centrifugal or positive displacement chillers.

Comment: Arguing for a January 1, 2025, status change date, Johnson Controls stated that the alternatives not subject to status change are not “drop-ins” for HCFC-123 in low-pressure centrifugal chillers and likewise that to transition HFC-134a chillers to low-pressure alternatives would require redesign of heat exchangers and compressors and take two to nine years or longer.

Response: As noted above, although EPA prefers not to use the term “drop-in,” it is sometimes used by various parties to refer to the circumstance where one refrigerant can be used in place of another without any modification to the relevant piece of refrigeration equipment. We recognize that manufacturers typically redesign products to varying extents when transitioning refrigerants in most cases to address the unique properties of the new refrigerant that will be used. As an initial matter, EPA’s change of status rule does not limit manufacturers currently using HFC-134a to convert to low-pressure alternatives. Higher-pressure alternatives that are not subject to status change may also be considered, including HFO-1234ze(E), R-450A and R-513A. In addition, manufacturers may develop and submit to SNAP other alternatives for evaluation. Regardless, the commenter has suggested a wide timeframe for the time in which it would take manufacturers to convert

equipment, but has provided no detail as to the actual expected timeframe. We note that a January 1, 2024, change of status date will provide the manufacturer slightly more than seven years in which to achieve a conversion, which is on the later side of the time they suggest might be needed. In addition, we note that the commenter has already announced that the centrifugal and screw chillers they offer, originally designed for HFC-134a, are compatible with R-513A, which is not subject to the status change in this action.¹²⁴

Comment: AHRI stated that the flammability of new refrigerants will require safety upgrades for manufacturing and reclamation facilities. AHRI also indicated that transition to flammable refrigerants involves capital investments that need to be planned well in advance.

Response: AHRI did not provide any specific information on the time required to prepare these facilities for flammable refrigerants and how that might affect the proposed change of status date. We note that neither of the two certified reclaimers that commented on the proposed rule indicated that safety upgrades were needed and that a later change of status date should be established to allow for such upgrades.

Comment: Johnson Controls stated that the AHRI/NRDC proposal called for a tremendously aggressive transition away from HFCs in just over eight years and compared that time period to what they indicated was over 20 years to transition chillers from CFCs and HCFCs. They stated that after more than 25 years from the signing of the Montreal Protocol, there are manufacturers still using HCFCs in chillers. AHRI also stated that the last refrigerant transition from ODS has taken 20 years and is still in process.

Response: EPA disagrees that a 2024 status change date is overly aggressive or that the transition away from CFCs and HCFCs provides support that an over seven-year period for moving away from the use of many HFCs and HFC blends is insufficient. It is important to note that the transition away from CFCs and HCFCs in the earlier years was due to a phasedown, not a phaseout, of CFCs. While based on later regulations CFCs were phased out of production in 1995, a phaseout in production of

HCFCs has only more recently started. Thus, during the first 15 years of the SNAP program, there was no obligation and no incentive for manufacturers to transition from HCFCs. Therefore, the pace of transition away from HCFCs does not reflect the time needed to transition away from the substitutes subject to the change of status. As provided in more detail in section VI.A.5.b.iii, we evaluated the steps it would take for manufacturers to transition chillers away from the substitutes that we are changing the listing status to unacceptability, examining the technical challenges for that transition and considering the use of flammable alternatives and the related need for changes to industry standards and model building codes and the adoption of those codes. For the reasons provided there, we have determined that January 1, 2024, is a reasonable, but expeditious date for such a transition.

Comment: The Alliance asked EPA to explain in more detail what technical analysis or timelines would be needed to justify a change of status later than our lead proposal of January 1, 2024.

Response: EPA interprets this comment as applying to both centrifugal and positive displacement chillers. EPA has not established a specific list of items that are needed to justify a later change of status date. In establishing a change of status date, EPA examined the technical challenges in order to determine a reasonable, but expeditious change of status date. Thus, to support a later change of status date, EPA would need additional information indicating that the information it relied on to support a January 1, 2024, change of status date was flawed and that additional time was needed to meet the technical challenges of a transition.

Comment: Arkema provided a list of steps needed for “product line development” including “researching options, risk assessment, analyzing existing manufacturing capabilities, working with component suppliers, building test units, testing beta units, updating manufacturing processes (including employee training), building pre-production units, field testing, completing the customer approval process, phasing in production, disposing of trapped inventory, and training installation and maintenance personnel” and ensuring “products conform to local building codes.” For new chillers specifically, Arkema suggested a change of status date of 2025 for HFC-134a and R-410A, stating as their “[r]ationale” that “HFC-134a is used in screw and centrifugal chillers;

¹²⁴ Johnson Controls, 2016. “Johnson Controls Advances Environmental Sustainability with Chiller Platforms Compatible with Low GWP Refrigerants.” January 20, 2016. <http://www.johnsoncontrols.com/media-center/news/press-releases/2016/01/20/advanced-environmental-sustainability-with-chiller-platforms-compatible-with-low-gwp-refrigerants>.

[R-410A is used in smaller chillers, especially scroll chillers.”

Response: EPA interprets this comment as applying to both centrifugal and positive displacement chillers. EPA agrees with the commenter’s indication of which types of chillers HFC-134a and R-410A are currently used, but this does not provide any rationale for their proposed change of status date for these refrigerants. Further, the commenter did not provide any indication of how the product line development tasks apply specifically to chillers and how they relate to the change of status date proposed. The commenter did not provide any justification to support a 2025 status change date instead of a change of status date of January 1, 2024.

iii. Energy Efficiency

Comment: Information submitted and claimed as CBI compared the full load efficiency and the integrated part-load value (IPLV), another measure of efficiency, of several alternatives relative to HFC-134a. Similar information was included for eight alternatives relative to R-410A. Given the number of alternatives shown, this information appears to be based on theoretical calculations (e.g. “cycle calculations”) or tests of non-optimized equipment rather than a sample of equipment in operation. The estimates showed that R-450A, R-513A, and R-515A had lower full load efficiencies than HFC-134a (up to 3.3 percent below) and that R-1233zd(E) and HFO-1234ze(E) had higher full load efficiencies and IPLVs than HFC-134a (up to 3.1 percent above). The information provided and claimed as CBI also indicated that some refrigerants have better IPLVs (up to 2.3 percent higher) and some have worse IPLVs (up to 2.5 percent lower) than HFC-134a in chillers. Of the eight alternatives compared to R-410A, including for example HFC-32 and R-452B, seven had higher IPLVs (up to 0.7 percent) and all eight had higher full load efficiencies (up to 3.2 percent).

UTC stated that “the primary environmental impact (~95 percent) of HVAC systems stems from the electric power needed to operate them, not from refrigerant leaks (which constitute about five percent of the overall impact).” Johnson Controls and AHRI both stated that 98 percent of the CO₂-equivalent emissions from chillers are the result of the power. Johnson Controls claimed that medium-pressure options to replace HFC-134a in chillers are two to four percent less efficient in “drop-in” conditions while AHRI stated that some acceptable alternatives “may be two to three percent less efficient.” Johnson

Controls stated that “the minimum efficiency of chillers is mandated” and indicated that it is unacceptable to offer lower-efficiency equipment to their customers. They suggested that any loss in efficiency might be possibly regained by increasing the surface area of the heat exchangers and from modifying the aerodynamics of compressors.

Response: EPA interprets these comments as applying to both centrifugal and positive displacement chillers. As discussed in section VII.D.3 below, energy efficiency is not a specific criterion under SNAP; however, manufacturers indicated the desire to maintain or improve efficiency with alternative refrigerants, and EPA is supportive of that as well. The information provided shows that some options offer better energy efficiency than refrigerants such as HFC-134a and R-410A currently used in many chillers.

While we agree with the commenters who suggest that certain refrigerants may have a lower energy efficiency if used as “drop-ins,” (i.e., without equipment modification), energy efficiency could be addressed, as some commenters recognize, by adjusting design. The change of status date allows time for such redesign to occur.

It is unclear what the commenter is referencing when it states that “minimum efficiency of chillers is mandated.” EPA does not mandate energy efficiency and, as we noted in the proposal (81 FR 22845; April 18, 2016), there are no specific DOE requirements for minimum energy efficiency for chillers apart from those used in federal government-owned buildings.¹²⁵ It is reasonable to assume that Johnson Controls’ line of “over 40 chiller product families” already comes with varying degrees of energy efficiency and that as they move forward to develop systems that comply with the status change there will still be a range of energy efficient products available.

EPA also addresses energy efficiency in section VII.D.3 in this action and in sections V.B.6.a, V.C.7, V.D.3.c, and VII.C.3 of the preamble to the July 2015 rule (80 FR 42870; July 20, 2015).

Comment: UTC indicated generally that while it would not face any code barriers, “an A1 [i.e., nonflammable] refrigerant may result in reduced energy

efficiency that may limit customer demand and drive decisions to repair, and not replace, existing equipment.”

Response: EPA interprets these comments as applying to both centrifugal and positive displacement chillers. EPA recognizes that the energy efficiency is a significant factor when choosing equipment. We also recognize that the energy efficiency of any given piece of equipment is in part affected by the choice of refrigerant and the particular thermodynamic and thermophysical properties that refrigerant possesses. We also do not believe that the evidence supports that the change of status will result in end users needing to choose lower efficiency equipment. As detailed in the previous comment and response, the substitutes that will remain available provide both higher and lower energy efficiencies than HFC-134a. Also, as noted by the commenter in the previous comment and response, there are strategies that manufacturers may pursue to mitigate against any losses in energy efficiency.

With respect to UTC’s comment that reduced energy efficiency may drive decisions to repair rather than replace existing equipment, EPA does not dictate through the SNAP program when a chiller must be replaced rather than repaired. Instead, EPA allows the user to determine when to repair and when to replace their system.

iv. Industry Standards and Codes

Comment: UTC stated that flammability is “a new risk for comfort cooling” and that “[s]afety cannot be compromised by setting requirements ahead of the [ASHRAE] and [UL] standards.” UTC, AHRI, and Johnson Controls indicated that these standards would need to change to allow for the safe use of alternatives, and that such changes would only be a first step in that process. After that, model building codes would need to incorporate the revised standards and then State and local jurisdictions would adopt those codes, thereby making the use of new alternatives viable in those locations. Commenters noted that HFO-1234ze(E) is flammable and UTC listed eight options under consideration to replace R-410A in positive displacement chillers and stated that “[a]ll of these refrigerants are A2L and will require and [sic] update of state and local codes.” AHRI and NRDC jointly said “[m]any promising alternative refrigerants are mildly flammable (especially for R-410A) and currently restricted under product safety standards and building codes.” The Alliance indicated “[t]here has been notable progress this year on the

¹²⁵ EPA stated in section VI.A.4.a.vi of the proposed rule (81 FR 22845; April 18, 2016) that DOE has established efficiency requirements, based on ANSI/ASHRAE/IES Standard 90.1–2010, for chillers used in federal buildings and provided our understanding of that standard. Since that time, EPA has become aware that such chiller efficiency requirements are now based on the 2013 version of that standard (80 FR 68749; November 6, 2015).

challenge of incorporating the use of mildly flammable and flammable low-GWP alternatives into the relevant codes and standards.” Ingersoll Rand stated that “ASHRAE 15 and UL 60335–2–40 are being updated to accommodate A2L refrigerants in chillers and are on track to be complete by the end of 2017” while EIA said “ASHRAE Standards and International Code Council (ICC) code changes required for adopting A2L refrigerants . . . are already proposed and are expected to be completed by 2018.” AHRI pointed to an “unprecedented effort”—a \$5.2 million program jointly funded by AHRI, ASHRAE and DOE—to undertake independent research to allow flammable refrigerants to be used safely in air conditioning and refrigeration equipment.

Response: EPA interprets these comments as applying to both centrifugal chillers and positive displacement chillers. These comments indicate that the process of updating standards for flammable refrigerants is underway and expected to be completed shortly. The results of this research announced by DOE, ASHRAE, and AHRI will immediately be transmitted to the committees responsible for ANSI/ASHRAE Standard 15–2013, “Safety Standard for Refrigeration Systems,” and ANSI/ASHRAE Standard 34–2013, “Designation and Safety Classification of Refrigerants,” with a goal of using the results to update the standards as soon as possible, subject to full compliance with the ANSI consensus process. EPA is encouraged by this \$5.2 million program as part of the ongoing global effort to identify appropriate climate-friendly alternatives and the announcement that another \$500,000 has been pledged for this work.¹²⁶ While EPA acknowledges that additional time may be needed to adopt such standards in codes, or provide other means for approval of the use of chillers with flammable refrigerants by authorities having jurisdiction, such time is provided through our January 1, 2024, status change date. Furthermore, EPA has noted that nonflammable alternatives are available for both centrifugal and positive displacement chillers, especially for designs currently using HCFC-123 or HFC-134a. While commenters stated that the alternatives for positive displacement chillers currently using R-410A—such as those listed by UTC—are flammable, this does not preclude the possibility of designing

a chiller using a nonflammable alternative nor as mentioned the revision of standards to allow the use of flammable refrigerants, the incorporation of those standards into model building codes, and the adoption of these building codes.

Comment: AHRI and NRDC maintained that “appropriate mitigation must be developed, proven, and finally adopted by safety standards” before they can be used. They said that “product and safety standards will not be updated until 2018 at the earliest” and that model building codes reflecting those updates were expected in 2021. NAM and UTC likewise indicated that state and local adoption of building and fire codes was necessary for chillers to use 2L refrigerants, including HFO-1234ze(E) and alternatives for R-410A positive displacement chillers. UTC provided an undated table that showed the number of states that had adopted various editions (from 2003 to 2015) of three different codes. UTC said the process for adoption typically takes 8–10 years. They stated that they “do not expect model codes to be completely updated until 2021.” Johnson Controls and AHRI also provided information on code adoption by states. AHRI claimed that historically it has taken on average up to 10 years to adopt updated building codes and listed the four states using the 2006 or older IBC. AHRI stated that a January 1, 2025, transition date is reasonable “based on the assumption that the HVAC industry would work together with the Federal government to accelerate the adoption of the standards and codes necessary to allow for commercialization of the products.” A private citizen pointed out that codes produced by the ICC, including the IBC, “allows the jurisdiction to accept new methods and materials, so long as that acceptance doesn’t reduce the level of safety provided by a code compliant material or method.” This would indicate that a manufacturer or other interested party could develop chillers using those refrigerants and provide additional risk mitigation techniques that could then be deemed as acceptable under the codes, even if the codes did not specifically address the requirements to use 2L refrigerants in such equipment. The citizen indicated that a subsidiary company to the ICC can provide manufacturers with reports of its assessment of such new products or methods, and that manufacturers in turn can share that report with jurisdictions to demonstrate the product meets the intent of the code. This would then allow the use of that chiller, and possibly others, using 2L refrigerants in

that particular jurisdiction. Finally, the citizen noted two examples where code changes are being undertaken that would “more appropriately address” the use of A2L refrigerants. NRDC and IGSD pointed to “several mechanisms” by which individual building codes may be modified by 2018 to allow for A2L refrigerants to be used. They further pointed out that even without such measures building codes are expected to allow the use of A2L refrigerants if a “very high level of ventilation and explosion-proof electronics are used.” They concluded that “states with old codes will not truly be off limits to manufacturers using mildly flammable refrigerants in their chillers.”

Response: EPA interprets these comments as applying to both centrifugal chillers and positive displacement chillers. The comments provided indicated that some changes could be incorporated into the model codes 2018 cycle. Nonetheless, EPA agrees with other commenters that the integration of appropriate changes to the model codes may not occur until the 2021 cycle, and as explained in section VI.A.5.b.iii above, finds that a January 1, 2024, change of status date, which allows three years for State and local adoption of the 2021 model code, is appropriate under such circumstances. AHRI is one of three entities that announced a new research program between the HVAC industry and the Federal government that “will provide the technical knowledge needed to facilitate and accelerate the safe use of these refrigerants.”¹²⁷ As the table provided by UTC shows, some states were already using the most recent (2015) codes and the majority were just one cycle (*i.e.*, 2012) behind as of early 2016. This would imply that many states will be able to adopt the 2021 codes by the 2024 status change date. UTC, Johnson Controls, AHRI, and NRDC did not address whether amendments could be made, either to the codes themselves or to state and local adoptions of the codes, without full adoption of a specific cycle of building codes, providing the necessary changes, if any, to allow chillers with acceptable alternatives to be used after the status change date, but other comment provide evidence of such possibility. UTC, Johnson Controls, and AHRI also did not address whether alternative means and measures, such as those discussed by the private citizen

¹²⁶ EPA, 2016c. A “Cool” Way to Combat Climate Change under the Montreal Protocol. July 20, 2016. Available online at <https://blog.epa.gov/blog/2016/07/a-cool-way-to-combat-climate-change/>.

¹²⁷ AHRI, 2016. “AHRI, ASHRAE, DOE Partner to Fund Flammable Refrigerant Research.” June 2, 2016. This document is accessible at <http://www.ahrinet.org/News-Events/News-and-Shipping-Releases.aspx?A=1170>.

and NRDC jointly with IGSD, could be taken to obtain approval from the authority having jurisdiction to approve the use of such chillers where a state or locality had not otherwise adopted the building codes suggested as needed. Finally, considering UTC, Johnson Controls, and AHRI are aware that some state adoptions lag the most recent codes by up to 12 years, it is logical to assume there would be plans to address such adoptions if they were to persist past their proposed status change date of 2025, which is only four years after the code cycle that their comments presume will allow for implementation of A2L options. UTC, Johnson Controls, and AHRI, did not provide any details on such plans, or why they could not equally be implemented by the 2024 status change date, apart from AHRI's assumption of Federal government assistance and further announcements of such. EPA is not aware that any part of the Federal government was represented or consulted when the AHRI Chiller Section and NRDC agreed to recommend a January 1, 2025, transition date; however, we do note subsequent to the AHRI Chiller Section and NRDC letter announcing this agreement, DOE along with AHRI and ASHRAE, announced the \$5.2 million effort "that will establish a more robust fact base about the properties and the use of flammable refrigerants" with an intent to update standards.¹²⁸

Comment: UTC maintained that where codes did not allow the use of A2L refrigerants after the status change date, businesses' only option would be to repair a less efficient system. Elsewhere UTC stated that another possibility would be for customers to use a packaged product or variable refrigerant flow system.

Response: EPA interprets these comments as applying to both centrifugal chillers and positive displacement chillers. As previously noted, EPA believes that the change of status date of January 1, 2024, allows sufficient time for adoption of industry standards and changes to relevant codes. In determining a change of status date, EPA does not simply pick the latest date by which the Agency can be certain that all codes will be updated. To the extent there may be codes that have not been modified by the change of status date, users will have several options in addition to the option of repair of an existing system or use of a non-chiller system. As noted in the

preamble and in information in the docket to this rule, multiple chillers using nonflammable refrigerants are available today and others have been announced for release by 2017. Both Ingersoll Rand and Johnson Controls have indicated a full line of centrifugal chillers using nonflammable options. These two companies also have nonflammable options for positive displacement chillers. Although commenters indicated the only options currently being investigated for positive displacement chillers currently using R-410A are flammable refrigerants, there is sufficient time to develop, certify and release such chillers prior to the change of status date.

v. Narrowed Use Limits for Military Marine Vessels, Human-Rated Spacecraft, and Related Support Equipment

Comment: Boeing, Chemours, and the Department of Defense (DoD) supported EPA's proposal to find HFC-134a acceptable, subject to narrowed use limits for centrifugal and positive displacement chillers on military marine vessels. In addition to the reasons discussed in the proposed rule (81 FR 22844; April 18, 2016), comments submitted by the Department of the Navy on behalf of DoD addressed several alternatives that are acceptable for chillers and not subject to status change that have been found to not meet the stringent requirements for military marine vessels. For instance, DoD pointed out that certain alternatives that are flammable, such as HFO-1234ze(E) and R-717, would not meet the DoD's requirements. While in stationary applications the flammability may be handled, for instance, by increased ventilation, this is not a practical solution for submarines or surface-going ships under warfare conditions. DoD also discussed R-1233zd(E), noting that it would be used in low-pressure chillers that are not acceptable for narrow military uses due to reliability and maintenance issues. Boeing also reiterated that "testing of alternate refrigerants or blowing agents for these niche markets may require more time than for mass-market commercial items, due to customer and regulatory agency approval requirements."

Response: EPA interprets these comments as applying to both centrifugal and positive displacement chillers. EPA agrees with the assessment made by DoD of specific technical issues in transitioning for military marine vessels and is finalizing the narrowed use limit. Because EPA is finalizing a status change date of January 1, 2024 for this refrigerant in

other chillers, the narrowed use limit would likewise start on January 1, 2024.

Comment: Boeing, Chemours, and NASA supported EPA's proposal to find HFC-134a and R-404A acceptable subject to narrowed use limits for centrifugal and positive displacement chillers for human-rated spacecraft and related support equipment. Although NASA anticipates using this narrowed use limit for only a small number of chillers, they indicated that critical properties of the chiller system were required for such applications that include ground-based assembly, integration and test operations, and launch of the spacecraft.

Response: EPA interprets these comments as applying to both centrifugal and positive displacement chillers. EPA agrees with the assessment made by NASA and is finalizing the narrowed use limit. Because EPA is finalizing a status change date of January 1, 2024 for these refrigerants in other chillers, the narrowed use limit would likewise start on January 1, 2024.

6. Change of Status Listing for Certain HFC Refrigerants for New Cold Storage Warehouses

a. Background

i. What is the affected end-use?

Cold storage warehouses are temperature-controlled facilities used to store meat, produce, dairy and other products that are delivered to other locations for sale to the ultimate consumer. This end-use within the SNAP program describes an application of refrigeration equipment for an intended purpose, and hence the listings of acceptable and unacceptable refrigerants for this end-use apply regardless of the type of refrigeration system used.

As explained in the proposed rule (81 FR 22849; April 18, 2016), cold storage warehouses are usually deemed "private" or "public," and some may be both, describing the relationship between the owner or operator of the cold storage warehouse and the owner of the products stored within.

Cold storage warehouses are also often divided into two general uses: "coolers" that store products at temperatures above 32 °F (0 °C) and "freezers" that store products below this temperature. Some subdivisions of these types were also provided in the proposed rule (81 FR 22849; April 18, 2016).

We explained that several other end-uses under the SNAP program cover other parts of the food (and product) cold chain and are distinct from the cold storage warehouse end-use. We

¹²⁸ ASHRAE, 2016. "ASHRAE, AHRI, DOE Partner to Fund Flammable Refrigerant Research." June 2, 2016. This document is accessible at <https://www.ashrae.org/news/2016/ashrae-ahri-doe-partner-to-fund-flammable-refrigerant-research>.

drew distinctions between the “cold storage warehouse” end-use which is subject to this action and the IPR end-use while noting that many facilities may have operations and refrigeration equipment for both end-uses. We also discussed “refrigerated food processing and dispensing equipment,” which is a category of the “retail food refrigeration” end-use and is subject to separate decisions in this action (see section VI.A.7). Finally, we discussed “cold rooms” and “walk-in” coolers and freezers, noting that many used for storage of food and beverages at a retail food location (e.g., a supermarket or restaurant) are considered to fall within other retail food refrigeration end-use categories that were covered by a previous rule (80 FR 42870; July 20, 2015). See section VI.A.4.c.i of the proposed rule for background on the cold storage warehouse end-use (81 FR 22849–51; April 18, 2016).

EPA understands that existing cold storage warehouses may undergo expansion to handle needs such as increased production, consolidation of distribution points, or increased population or other reasons for increased demands of the products stored. Such expansions could include a physical expansion of the storage space or using racking techniques to increase the amount of product within a given facility. The owner of cold storage warehouses undergoing such expansions (or the owner's designer) may determine that a new system needs to be added. That new system could be a complete newly manufactured system separate from the existing system, or it could be equipment and refrigerant added to the existing system increasing the capacity of the existing system. In both cases, EPA considers these actions as the manufacturing of a new system and hence that equipment is affected by the changes of status in this final rule.

A commenter stated that cold storage warehouses are “typically designed with planned expansions” and that the change of status should not apply to any future expansion of such warehouses. EPA addressed the definition of a “new” system as used in the SNAP program in a previous rule (80 FR 42902–03; July 20, 2015). As explained there, consistent with the definition in 40 CFR part 82, subparts A and I, EPA considers a system to be new for purposes of these SNAP determinations as of the date upon which the refrigerant circuit is complete, the system can function, the system holds a full refrigerant charge, and the system is ready for use for its intended purposes. Therefore, as used in the SNAP program, “new” refers to the

manufacture and often installation of a refrigeration system for an intended purpose, which may occur on a newly manufactured or an existing cold storage warehouse. The status changes in this action would apply to the expansion of the refrigeration system in an existing cold storage warehouse if the capacity of that existing refrigeration system is increased to handle the expansion. Because the existing system capacity was inadequate to provide the necessary cooling for the expanded load, the existing system did not meet the intended purpose of the expanded capacity, and therefore if it were expanded to handle that load it would be considered “new” with respect to SNAP. On the other hand, if an existing refrigeration system is extended (for instance, by adding additional refrigerant lines and evaporators to a newly manufactured or newly commissioned building, to a portion of the existing facility previously not used for cold storage, or to an extension of the previous building), without requiring an increase in capacity and while only needing the same full refrigerant charge as before, the system is not considered “new” and hence may continue its operations with the existing refrigerant. Likewise, a facility may increase the amount of products it handles while at the same time providing better sealing around infiltration points and/or increasing the insulation on walls and roofs, and thereby avoid the need to increase the refrigeration capacity of the equipment serving the cold storage warehouse.

Commenters suggested divisions in the cold storage warehouse market by which EPA should finalize separate decisions. One suggestion was to distinguish between indirect and direct systems. In today's action, EPA is not subdividing the cold storage warehouse end-use based on whether a direct or indirect system is used. As addressed below, the commenter suggesting this subdivision, and different change of status decisions for the two subdivisions, did not provide evidence how any of the SNAP criteria varied between the two subdivisions, instead only addressing energy efficiency and economic burden.

Another comment suggested a distinction between those cold storage warehouses with a footprint of 3,000 square feet (279 square meters) or less, noting they are covered by DOE energy conservation standards for walk-in coolers and freezers, a point brought out in the proposed rule (81 FR 22853; April 18, 2016). A commenter stated that EPA should consider all such cold storage warehouses to be part of the retail food

refrigeration end-use because manufacturers make equipment that could be used for retail food refrigeration or could be used in a manner that would be classified as a cold storage warehouse within SNAP. In today's action, EPA is not changing the definition of the cold storage warehouse end-use such that some types are considered a different end-use by virtue of their size. As addressed below, comments suggesting this subdivision did not provide evidence how any of the SNAP criteria varied between these two subdivisions. Although comments as well as the proposed rule noted that such types of cold storage warehouses are subject to DOE energy conservation regulations, the comments did not indicate how this fact would change the availability of acceptable alternatives by the change of status date proposed.

An equipment manufacturer commented that many industrial processors have multiple cold storage warehouses on the same campus and that these may be cooled from a system that also provides cooling to other applications, such as an industrial process refrigeration system. The manufacturer stated that EPA should “treat campuses with multiple building and processing areas as one complete industrial process.” EPA notes, however, that SNAP decisions are on an end-use basis, and therefore any cold storage warehouse may only use a refrigerant listed as acceptable for that end-use. While through today's action EPA is not changing the status of refrigerants in the industrial process refrigeration end-use, we are doing so for new cold storage warehouses, and as such some refrigerants in this end-use will be listed as unacceptable as of the change of status date.

EPA is not aware of other federal rules applying to efficiency of cold storage warehouses (i.e., the buildings), but we find that some federal rules apply to equipment that could be used in this specified end-use. Specifically, EPA noted in the proposed rule (81 FR 22853; April 18, 2016) that air-cooled commercial unitary air conditioners and heat pumps (“CUACs” and “CUHPs”) might be applied at cold storage warehouses, and such equipment is subject to DOE energy conservation standards. Comment from NRDC and IGSD confirmed that cold storage warehouses, among other types of designs, could be outfitted with rooftop units that must comply with the DOE rule, and that “[m]anufacturers are expecting to begin using HFC-32, R-452B, and other A2L-class refrigerants in rooftop units in 2023 at the latest.” For further information on the

relationship between this action and other federal rules, see section VI.A.4.c.v of the proposed rule (81 FR 22853; April 18, 2016).

ii. What other types of equipment are used for similar application but are not covered by this section of the rule?

EPA has found several not-in-kind systems (*i.e.*, systems that operate using thermodynamic cycles other than vapor-compression) acceptable for this end-use, including ammonia absorption, evaporative cooling, desiccant cooling, and Stirling cycle systems, which are not subject to this action.

iii. What refrigerants are used in cold storage warehouses?

In section VI.A.4.c.i of the proposed rule, EPA indicated that R-717 is believed to be the most common refrigerant used in cold storage warehouses and provided information on equipment types and system designs that facilitate the use of that refrigerant (81 FR 22850–22851; April 18, 2016).

We noted that limitations on the use of R-717 do exist. For example, it is reported that charge sizes exceeding 10,000 pounds of R-717 “may require

government-mandated process safety management (PSM) and [a] risk management plan (RMP).”¹²⁹ Various state and local building codes could also apply, and adherence to such codes might hinder or even eliminate the use of R-717 in some cold storage warehouses. Likewise, regulations may require employing operators with special levels of expertise, reporting of use or accidental releases, and other actions not typically required for other alternatives, increasing the operating cost compared to facilities using other refrigerants. These increased costs however are often offset by the high energy efficiencies typically achieved with R-717 systems. We also pointed to equipment designs, such as low charge packaged R-717 systems, R-717/R-744 cascade systems, and indirect secondary-loop systems using R-717 as the primary refrigerant in a machine room separated from the cooled interior, that can overcome some limitations on the use of R-717. These systems are described in market characterizations found in the docket to this rule (EPA–HQ–OAR–2015–0663).¹³⁰ While R-717 is the most common refrigerant used in cold storage warehouses, others have

used CFC-12, R-502 and HCFC-22 and more recently R-404A, R-407C, R-407F, R-410A, or R-507A.

One commenter, AHRI, indicated manufacturers are developing R-407A condensing units that could be used in cold storage warehouses, particularly those less than 3,000 square feet which, as noted in section VI.A.4.c.v of the proposed rule (81 FR 22853; April 18, 2016), are subject to DOE energy conservation standards for walk-in coolers and freezers.

b. What is EPA’s final decision?

For new cold storage warehouses, EPA proposed to change as of January 1, 2023, the status of the following refrigerants from acceptable to unacceptable: HFC-227ea, R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407A, R-407B, R-410A, R-410B, R-417A, R-421A, R-421B, R-422A, R-422B, R-422C, R-422D, R-423A, R-424A, R-428A, R-434A, R-438A, R-507A, and RS-44 (2003 composition). In this action, we are finalizing the status changes that we proposed with no changes. The change of status determinations for new cold storage warehouses are summarized in Table 9.

TABLE 9—CHANGE OF STATUS DECISIONS FOR NEW COLD STORAGE WAREHOUSES

End-use	Substitutes	Listing Status
Cold Storage Warehouses (new).	HFC-227ea, R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407A, R-407B, R-410A, R-410B, R-417A, R-421A, R-421B, R-422A, R-422B, R-422C, R-422D, R-423A, R-424A, R-428A, R-434A, R-438A, R-507A, and RS-44 (2003 composition).	Unacceptable as of January 1, 2023.

i. How do these unacceptable refrigerants compare to other refrigerants for this end-use with respect to SNAP criteria?

Other refrigerants for new cold storage warehouse not subject to this action are FOR12A, FOR12B, HFC-134a, IKON A, IKON B, KDD6, R-407C, R-407F, R-437A, R-450A, R-513A, R-717, R-744, RS-24 (2002 composition), SP34E, THR-02, and THR-03. In the proposed rule, EPA provided information on the environmental and health risks presented by the alternatives that are being found unacceptable compared with other available alternatives that are listed as acceptable (81 FR 22851–52; April 18, 2016). In addition, a technical support document¹³¹ that provides the

Federal Register citations concerning data on the SNAP criteria (*e.g.*, ODP, GWP, VOC, toxicity, flammability) for acceptable alternatives, as well as those we are finding unacceptable, for new cold storage warehouses may be found in the docket for this rulemaking (EPA–HQ–OAR–2015–0663).

One commenter requested that EPA clarify which refrigerants in the R-407 series were subject to a change in status, while others specifically requested that we not change the status of R-407A and R-407B in cold storage warehouses. We are finalizing a change of status for the refrigerants we proposed. With respect to the R-407 series refrigerants in this end-use, EPA only proposed a change of status for R-407A and R-407B based on

our analysis that these two blends posed a higher overall risk to human health and the environment than other available refrigerants for this end use. EPA did not propose and is not taking action in this rule to change the status of R-407C and R-407F in cold storage warehouses; those refrigerants remain acceptable in this end-use. EPA has not listed others in the R-407 series, including R-407D, R-407E and R-407G, and R-407H, acceptable in this end-use.

For cold storage warehouses, the refrigerants we are listing as unacceptable have insignificant ODPs, but they have GWPs ranging from 2,090 to 3,990. As shown in Table 10, acceptable alternatives have GWPs ranging from zero to 1,820.

¹²⁹ ASHRAE, 2014. 2014 Handbook—Refrigeration. The American Society of Heating, Refrigerating, and Air-conditioning Engineers, Inc. Atlanta, Georgia, USA. ISBN 978–1–936504–71–8; ISSN 1930–7195.

¹³⁰ ICF, 2016h. Market Characterization for Fire Suppression, Comfort Cooling, Cold Storage, and Household Refrigeration Industries in the United States. Prepared for the U.S. Environmental Protection Agency. October 2015.

¹³¹ EPA, 2016b. Tables of Alternatives for End-Uses Considered in the Final Rule, Protection of Stratospheric Ozone: Listing Modifications for Certain Substitutes under the Significant New Alternatives Policy Program. September, 2016.

TABLE 10—GWP, ODP, AND VOC STATUS OF REFRIGERANTS IN NEW COLD STORAGE WAREHOUSES ^{1 2}

Refrigerants	GWP	ODP	VOC	Listing status
R-450A, R-513A, R-717, R-744	0–630	0	No	Acceptable.
IKON A, IKON B, THR-02	30–560	0—Not public ³ ..	Yes ⁴	Acceptable.
HFC-134a, R-407C, R-407F	1,430–1,820	0	No	Acceptable.
FOR12A, FOR12B, KDD6, R-437A, RS-24 (2002 composition), SP34E, THR-03.	920–1,810	0—Not public ³ ..	Yes ⁴	Acceptable.
R-407A, R-407B, R-410A, R-410B, R-421A, R-423A	2,090–2,800	0	No	Unacceptable.
R-125/290/134a/600a (55/1/42.5/1.5), R-417A, R-422B, R-422D, R- 424A, R-438A, RS-44 (2003 composition).	2,260–2,730	0	Yes ⁴	Unacceptable.
HFC-227ea, R-421B, R-404A, R-507A	3,190–3,990	0	No	Unacceptable.
R-422A, R-422C, R-428A, R-434A	3,080–3,610	0	Yes ⁴	Unacceptable.

¹ The table does not include not-in-kind technologies listed as acceptable for the stated end-uses.

² HCFC-22 and several blends containing HCFCs are also listed as acceptable but their use is severely restricted by the phasedown in HCFC production and consumption.

³ The ODP of one or more alternatives is not published here in order to avoid disclosing information that is claimed as confidential business information.

⁴ One or more constituents of the refrigerant are VOC.

Some of the refrigerant blends not subject to this action, as well as several of the substitutes for which we are changing the listing from acceptable to unacceptable, include small amounts of R-290, R-600, or other substances that are VOCs. These amounts are small and for this end-use, are not expected to contribute significantly to ground-level ozone formation.¹³² In the actions where EPA listed these refrigerants as acceptable or acceptable subject to use conditions, EPA concluded none of these refrigerants in this end-use pose significantly greater risk to ground-level ozone formation than other alternative refrigerants that do not meet the definition of VOC under CAA regulations (see 40 CFR 51.100(s)) or that are specifically excluded from that definition for the purpose of developing SIPs to attain and maintain the NAAQS.

The refrigerants listed as acceptable and not subject to this action are highly volatile and typically evaporate or partition to air, rather than contaminating surface waters. Their effects on aquatic life are expected to be small and pose no greater risk of aquatic or ecosystem effects than those of the refrigerants that are subject to the status change for this end-use.

With the exception of R-717, all other acceptable refrigerants, as well as those that we are listing as unacceptable, are not flammable and are of low toxicity (e.g., those listed under ASHRAE Standard 34–2013 are Class A toxicity and Class 1 nonflammable). R-717 is mildly flammable with a low flame speed; it is classified as a B2L refrigerant under ASHRAE 34 (2013). R-717 has a long history of use as a refrigerant in cold storage warehouses and other applications. In the original

SNAP rule, EPA noted “[R-717] has been used as a medium to low temperature refrigerant in vapor compression cycles for more than 100 years. Ammonia [R-717] has excellent refrigerant properties, a characteristic pungent odor, no long-term atmospheric risks, and low cost. It is, however, mildly flammable and toxic, although it is not a cumulative poison. OSHA standards specify a 15 minute short-term exposure limit of 35 ppm for ammonia [R-717].” (53 FR 13072; March 18, 1994). We further noted its use in various food and beverage processing and storage applications as well as other industrial applications. In that rule, we found R-717 acceptable for use in new cold storage warehouses, concluding that its overall risk to human health and the environment was not significantly greater than the other alternatives found acceptable. This conclusion was based on the assumption that the regulated community adheres to OSHA regulations on such use as well as standard refrigeration practices, such as ASHRAE Standard 15 and the IAR Standard 2,¹³³ which are often utilized by local authorities when setting their own building and safety requirements. See section VI.A.4.c.iii.(b) of the proposed rule (81 FR 22852; April 18, 2016) for a discussion on the long history of use of R-717 and our original decision finding it acceptable in new cold storage warehouses.

In summary, because the risks other than GWP are not significantly different for the other available alternatives than for those we proposed to list as unacceptable, and because the GWPs for the refrigerants we proposed to list as unacceptable are significantly higher

and thus pose significantly greater risk, we are listing the following refrigerants as unacceptable: HFC-227ea, R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407A, R-407B, R-410A, R-410B, R-417A, R-421A, R-421B, R-422A, R-422B, R-422C, R-422D, R-423A, R-424A, R-428A, R-434A, R-438A, R-507A, and RS-44 (2003 composition).

ii. When will the status change?

EPA is establishing a change of status date for the above-listed refrigerants new cold storage warehouses of January 1, 2023, which the Agency finds is a reasonable yet expeditious date by which the technical challenges can be met for a safe and smooth transition to alternatives. This amount of time is needed particularly considering the various equipment types that could be employed to provide the cooling necessary for new cold storage warehouses and the requirement for many of these equipment types to meet energy conservation standards while undergoing such a transition. Although acceptable alternatives, particularly R-717, are widely used, EPA recognizes based on comment that R-717 is not an option due to technical or compliance constraints at some facilities. For these facilities, the user would need the time to investigate the use of other alternatives and to design, and possibly certify to DOE energy conservation standards, equipment using the chosen alternative. As discussed in the proposed rule (81 FR 22850; April 18, 2016), in some cases, R-717 may not have been chosen based on building code and regulatory restrictions that might have eliminated its use. As also discussed there, and as supported by comment, technologies are under development that can overcome some such limitations; for example, newly-developed low-charge R-717 systems

¹³² ICF, 2014a. Assessment of the Potential Impact of Hydrocarbon Refrigerants on Ground Level Ozone Concentrations. February, 2014.

¹³³ ANSI/IAR Standard 2–2008 (Addendum B)—American National Standard for Equipment, Design, & Installation of Closed Circuit Ammonia Mechanical Refrigerating Systems.

can overcome building code and regulatory challenges that arise when large charge sizes would otherwise be required, although we recognize that such equipment may not be allowed in certain jurisdictions or may not be practical in certain situations. EPA is establishing a January 1, 2023, status change date in part to allow these technologies to more fully mature and become more fully available in the market. In addition to these technologies, because a wide variety of other equipment types can be applied at a cold storage warehouse, and some such equipment is subject to DOE energy conservation requirements, EPA expects that this period of time will allow acceptable alternatives to become more fully available for cold storage warehouses. For locations and applications that would otherwise use HFC blends subject to status change, primarily R-404A, R-410A and R-507A, time is needed to develop equipment with other alternative refrigerants or address the technical challenges of using R-717 or other alternatives that are not subject to the proposed change in status. As explained in section VI.A.4.c.v of the proposed rule (81 FR 22853; April 18, 2016), certain types of equipment potentially applied in cold storage warehouses are subject to energy conservation standards, and hence time will be required to design, test and certify equipment for those standards, while at the same time using acceptable alternatives.

c. How is EPA responding to comments?

EPA received comments on various topics including, the proposed status change date of January 1, 2023, the refrigerants proposed for status change, the acceptability of other refrigerants, and requests for subdividing the category and limiting the status changes based on those subdivisions.

Commenters included AHRI, an industry organization; CARB, a state agency; Daikin and Zero Zone, equipment manufacturers; Chemours, Honeywell, and National Refrigerants, three chemical producers; and NRDC, IGSD, and EIA, three environmental organizations.

We have grouped comments together and responded to the issues raised by the comments in the sections that follow, or in a separate Response to Comments document which is included in the docket for this rule (EPA-HQ-OAR-2015-0663).

i. Substitutes and End-Use Proposed

Comment: Daikin suggested that EPA subdivide the cold storage warehouse end-use into “Indirect Expansion

Refrigeration System[s]” and “Direct Expansion Refrigeration System[s].” They did not suggest any different decisions for the former. For the latter, they recommended that R-410A remain acceptable, noting that it (along with R-407C and R-407F) is also used in direct systems. Daikin commented that both direct and indirect systems may be used, even at the same facility. Daikin said that customer requirements will typically determine the refrigeration system and that these requirements depend on “the use conditions, structure of the building and climatic considerations among other factors.”

Response: EPA is not subdividing the end-use as suggested. For direct systems, two of the three refrigerants they mentioned as being typically used—R-407C and R-407F—remain acceptable as proposed. Daikin did not provide any indication of why in direct systems R-410A would be required as opposed to these refrigerants not subject to status change. The commenter did not indicate specifically what use conditions, building structures, climates or other technical barriers warranted subdividing the end-use as suggested, nor did the commenter offer reasons for not changing the status of one particular refrigerant in one of those subdivisions.

Comment: Zero Zone agreed with EPA’s explanation of the distinction between cold storage warehouses and IPR.

Response: EPA thanks the commenter for this comment.

Comment: Zero Zone claimed that EPA should consider small cold storage warehouses—those with a footprint of 3,000 square feet (279 square meters) or less—as fitting in the retail food refrigeration end-use. They noted that DOE and California regulations cover such items, whether they are cold storage warehouses or they are used for retail food refrigeration, as walk-in coolers or freezers. They felt that equipment manufacturers supplying equipment that meets such definitions of walk-in coolers or freezers “need to be able to supply the same equipment” regardless of whether they would be classified as a cold storage warehouse or retail food refrigeration under SNAP. They said that equipment manufacturers should not have to “ascertain what product will be in the building.” Zero Zone stated that both R-407A and R-407B should remain acceptable, especially if EPA did not treat small cold storage warehouses as part of the retail food refrigeration end use. AHRI also stated that R-407A and R-407B should be acceptable in cold storage warehouses because the same unit cooler equipment, whether used in a

cold storage warehouse or in retail food refrigeration, would need to comply with DOE energy efficiency standards for walk-in coolers and freezers. They stated manufacturers are preparing systems that use R-407A for small cold storage warehouses. Daikin, NRDC, and IGSD indicated that R-407C and R-407F are also used in cold storage warehouses. National Refrigerants asked EPA to list all R-407 series refrigerants acceptable for cold storage warehouses to provide additional options and to “eliminate confusion in the industry” and “ease compliance for technicians and equipment owners by giving them the flexibility to utilize their R-407 preferred refrigerant.”

Response: EPA disagrees that certain cold storage warehouses should be included as part of the retail food refrigeration end-use. EPA established status changes for three retail food refrigeration end-use categories in a previous rule and stated that equipment in these categories of the SNAP end-use could also be subject to DOE’s energy conservation standards for Walk-In Coolers and Freezers (80 FR 82902; July 20, 2015). Likewise, we noted in our proposed rule (81 FR 22853; April 18, 2016) that small cold storage warehouses could also be covered by these DOE standards. We disagree that R-407A and R-407B should remain acceptable despite the indication that some products are being designed using the former or for a manufacturer’s preference to use the same refrigerant in different end-uses. We are particularly confused by the inclusion of R-407B in the comments from Zero Zone and AHRI requesting we find it acceptable, as we changed the status of that refrigerant for all categories of new retail food refrigeration addressed in a previous rule (80 FR 42870; July 20, 2015). If we were to treat small cold storage warehouses as retail food refrigeration, as these commenters also suggest, R-407B would be subject to status change. Several alternatives that remain acceptable for cold storage warehouses are also acceptable for various retail food refrigeration end-use categories. For instance, R-407C and R-407F, which as noted are being used in some cold storage warehouses, are also acceptable for the retail food refrigeration remote condensing unit end-use category. Manufacturers who wish to use only one refrigerant may do so and to the extent they are already using a refrigerant that is subject to status change in the cold storage warehouse end-use, EPA finds no evidence that these or other acceptable alternatives cannot be adopted by the

2023 status change date while continuing to meet DOE energy conservation standards.

Further, we disagree that to eliminate confusion, ease compliance, or provide flexibility we should list all R-407 series refrigerants as acceptable. EPA reviews refrigerants individually and is aware that manufacturers, users, and owners make it their business to know the exact refrigerant they are using, since they currently are aware that not all R-407 series refrigerants are acceptable in this or any other end-use. Just because two or more refrigerants are made up of the same components¹³⁴ does not mean they present the same overall risk to human health and the environment. Indeed, R-407 and other series refrigerants are made up of components having different flammability, toxicity, GWP, and other characteristics considered by SNAP, making a knowledge of specific composition critical to evaluating associated risk.

Comment: EIA, NRDC, IGSD, Chemours, and CARB supported EPA changing the status to unacceptable of those refrigerants we proposed for such change in new cold storage warehouses.

Response: EPA thanks the commenters for these comments.

Comment: Chemours felt that R-407C and R-407F should also be listed as unacceptable stating there are multiple alternatives. Daikin compared R-410A to R-448A and R-449A, arguing that because R-410A can reduce the amount of refrigerant needed by 30 percent, the total GWP-weighted emissions would be similar to that of R-448A and R-449A. CARB stated that R-717, especially in low-charge units, and R-744 could be used. EIA suggested that EPA continue to evaluate additional refrigerants and consider those for status change, mentioning HFC-134a, R-407C, R-407F, R-450A, and R-513A.

Response: EPA's proposal was limited to determinations for the specific refrigerants proposed which pose significantly greater risk than other available refrigerants. We cannot take final action changing the status of additional refrigerants without first performing the necessary analysis of the SNAP criteria and providing notice and an opportunity for comment.

In response to the suggestion that we list additional specific refrigerants as unacceptable, we note that at least two—R-407C and R-407F—are currently used in cold storage warehouses. In addition to considering the SNAP criteria in determining whether to propose action to change the status of an

acceptable substitute, we also need to consider whether there are other alternatives available. Although we recognize that alternatives such as R-717 and R-744 are available for certain types of equipment in certain applications in the cold storage warehouses end-use, the information available at this time does not indicate that there are available alternatives for all types of equipment in all types of applications.

Comment: AHRI, Zero Zone, and Honeywell all supported an EPA action to list R-448A and R-449A as acceptable for cold storage warehouses. Honeywell noted that they are already being implemented in similar equipment for the supermarket systems end-use category. On the other hand, NRDC and IGSD urged EPA to find these two refrigerants unacceptable, while EIA asked EPA to “[r]equest advance comments on changing the listing status” of these two HFC/HFO blends as well as R-450A and R-513A for new cold storage warehouses.

Response: These comments suggesting that EPA take action to list additional substitutes as acceptable or to change the listing status of already-listed substitutes go beyond the scope of this rulemaking. As noted previously, EPA may in the future issue a new proposal to change the status of additional refrigerants in this end use after considering what other alternatives are available and performing an analysis using the SNAP criteria. Regarding the request that EPA substitutes not already on one of the lists as acceptable or unacceptable, EPA notes that R-448A and R-449A have been submitted to the SNAP Program for review, but EPA has not yet issued a proposed decision for these refrigerants or issued a Notice of Acceptability.

ii. Change of Status Date

Comment: EIA, NRDC, IGSD, and Chemours supported EPA's proposed 2023 status change date for new cold storage warehouses.

Response: EPA thanks the commenters for these comments.

Comment: Honeywell suggested a status change date of January 1, 2019, based on the fact that several options, including R-407F, R-717, and R-744, are acceptable for new cold storage warehouses. They also indicated R-448A and R-449A are potential options that could be implemented by January 1, 2019.

Response: EPA agrees that many of the acceptable refrigerants not subject to status change have been and can continue to be used in many types of equipment for many of the applications for new cold storage warehouses. EPA

established a status change date of 2023 based on the time required to address the number of different equipment types and system designs used for cold storage warehouse and to redesign, and if required recertify as compliant with DOE energy conservation standards. EPA has determined that a change of status date of January 1, 2023, is reasonable and expeditious in light of the various DOE energy conservation standards that must be met (and for which equipment needs to be designed and manufactured), the need to further assess currently acceptable nonflammable and low toxicity alternatives in specific applications, and the need to develop safe practices and institute State and local code changes if required for flammable and higher toxicity alternatives for certain equipment where the application and/or the location limits the use of flammable or higher toxicity refrigerants at this time. The commenter did not provide a discussion of these equipment design and application issues or an indication of how those can be addressed by 2019.

Comment: CARB suggested a status change date of 2020, noting that low-charge R-717 systems address issues with that refrigerant's use in cold storage warehouses and where it cannot be used, R-744 or other non-toxic, low-GWP refrigerants could be used.

Response: The commenter did not provide technical support that a change of status date of January 1, 2020, was feasible. The commenter does not provide any detail on the use of R-744 in those applications where R-717 is not an option, and we are not aware that its use has been demonstrated for all of those applications. We are aware that R-744 is being used for new cold storage warehouses in cascade and secondary loop systems with R-717. However, we did not see similar evidence it can be used in a direct system (*i.e.*, not in a cascade or secondary loop system with R-717) in the various equipment types and designs used for this end-use.

Comment: Zero Zone stated that the change of status for R-404A and R-507A should be January 1, 2025, because those refrigerants offer the low-glide properties desired for flooded or liquid overfeed systems. They compared these to R-450A and R-513A—both of which are acceptable in new cold storage warehouses and are not subject to the change in status—which they described as also having low glide but low volumetric efficiency. They felt the time was necessary “to allow technology and chemical companies to come up with a solution to this design issue.”

Response: The commenter did not provide any information that it was not

¹³⁴ All R-407 series refrigerants are composed of HFC-32, HFC-125 and HFC-134a.

technically feasible to transition away from R-404A and R-507A until January 1, 2025. No explanatory timeline or past experience was provided that indicated how long it might take to resolve the issues they described. Other commenters have noted that R-407C and R-407F, which are also high-glide blends, are used in cold storage warehouses. Although they did not mention whether those were specifically used in the flooded evaporator systems described, we are not aware and Zero Zone has not provided any information on why they could not be used. Zero Zone also did not discuss why single-component (no glide) refrigerants including R-717 and R-744 could not be used in the types of systems with which they are concerned. Finally, the commenter noted that there are some low-glide blends available, but did not provide the detail on the steps needed to redesign equipment to account for the low volumetric efficiency they indicated for those available alternatives and why those steps could not be completed before January 1, 2025.

iii. SNAP Review Criteria

Comment: Daikin believed that “it is important to note the equipment’s potential total environmental impact (i.e. refrigerant quantity multiplied with GWP), not only the refrigerant’s GWP value.” As such, they stated that R-410A could reduce the total charge size up to 30 percent compared to R-404A.

Response: EPA interprets this comment to be based on the SNAP review criteria of “atmospheric effects,” which is discussed above in section II.E.1. In a previous proposed rule and in the response to comments document for the associated final rule, we discussed the possibility of allowing refrigerants with a higher GWP in low-charge systems. In particular, we stated “given the high GWP of these refrigerants compared to other refrigerants that are available in [supermarket systems], we do not believe that use with a small charge size adequately addresses the greater risk they pose.” (79 FR 46148; August 6, 2014). The same consideration is applicable here for R-410A, even if systems were designed to reduce the total charge size as Daikin says is possible. Use in a lower-charge system does not guarantee lower overall emissions. If catastrophic losses occurred in a system employing R-410A or other high-GWP refrigerants, the

emissions in CO₂-equivalent terms could be more than if a lower-GWP refrigerant were used in the same or a similarly low-charge design. For instance, an acceptable alternative could be used in a secondary loop design, reducing the amount of that refrigerant used for the given application.

7. Change of Status for Certain HFC Refrigerants for New Retail Food Refrigeration (Refrigerated Food Processing and Dispensing Equipment)

a. Background

i. What is the affected end-use?

In the SNAP July 2015 rule (80 FR 42902), EPA clarified that “equipment designed to make or process cold food and beverages that are dispensed via a nozzle, including soft-serve ice cream machines, ‘slushy’ iced beverage dispensers, and soft-drink dispensers” was not included as part of the retail food refrigeration end-use categories specifically identified in that final rule. EPA clarified that this equipment is part of a separate end-use category within the retail food refrigeration end-use. This end-use category, “refrigerated food processing and dispensing equipment,” is covered in this section of the final rule. For an overview of this end-use category, please refer to section VI.A.4.d.i of the proposed rule (81 FR 22854–55; April 18, 2016).

One commenter, UTC, pointed out that certain soft-serve and other frozen dairy treats may not fall within the technical definition of ice-cream due to milk fat content, but that such products “are handled like ice-cream and shake products from an operational point of view.” UTC also stated that a creamer dispenser (refrigerated unit dispensing creamer in a dosed amount) and bulk milk dispensers (refrigerated unit holding a container of milk that dispenses through a small nozzle when the handle is lifted) would fit in this category as well. EPA’s use of “including” in its description of the type of equipment that falls under this end use indicates that the list was not intended to be exclusive. EPA considers the types of equipment identified by UTC, which dispense products through a nozzle, to fit within the end-use.

ii. What other types of equipment are used for similar applications but are not covered by this section of the rule?

As noted in section VI.A.4.d.i of the proposed rule (81 FR 22854; April 18,

2016) certain types of equipment, including water coolers and stand-alone retail food refrigeration units, do not fall within this end-use category.

iii. What Refrigerants Are Used in Retail Food Refrigeration (Refrigerated Food Processing and Dispensing Equipment)

EPA discussed which refrigerants were acceptable in the refrigerated food processing and dispensing equipment end-use category in section VI.A.4.d.i of the proposed rule (81 FR 22855; April 18, 2016). While numerous refrigerants are acceptable in this end use, as noted by the comments from UTC, R-404A is typically used for freezing applications and HFC-134a for refrigerated applications.

In comments submitted on the proposal, AHRI and UTC discussed the potential use of R-448A and R-449A in this end-use category, and AHRI urged EPA to find these blends acceptable. Other information claimed as CBI indicated the potential to transition R-404A applications within this end-use category to those refrigerants. Tecumseh also urged EPA to list these two refrigerants acceptable as well as R-452A. EPA has received submissions for these three refrigerants. Concurrent with this rule, EPA is listing R-448A, R-449A, and R-449B as acceptable without use conditions for new refrigerated food processing and dispensing equipment. We are currently reviewing R-452A for this end-use.

b. What is EPA’s final decision?

For new refrigerated food processing and dispensing equipment, EPA proposed to change as of January 1, 2021, the status of the following refrigerants from acceptable to unacceptable: HFC-227ea, KDD6, R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407A, R-407B, R-407C, R-407F, R-410A, R-410B, R-417A, R-421A, R-421B, R-422A, R-422B, R-422C, R-422D, R-424A, R-428A, R-434A, R-437A, R-438A, R-507A, RS-44 (2003 formulation). In this action, we are finalizing the status changes we proposed with no changes. The change of status determinations for new refrigerated food processing and dispensing equipment are summarized in Table 11.

TABLE 11—CHANGE OF STATUS DECISIONS FOR NEW RETAIL FOOD REFRIGERATION
[Refrigerated food processing and dispensing equipment]

End-use	Substitutes	Listing status
Retail food refrigeration (refrigerated food processing and dispensing equipment) (new only).	HFC-227ea, KDD6, R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407A, R-407B, R-407C, R-407F, R-410A, R-410B, R-417A, R-421A, R-421B, R-422A, R-422B, R-422C, R-422D, R-424A, R-428A, R-434A, R-437A, R-438A, R-507A, RS-44 (2003 formulation).	Unacceptable as of January 1, 2021.

i. How do these unacceptable refrigerants compare to other refrigerants for this end-use with respect to SNAP criteria?

For new refrigerated food processing and dispensing equipment, the substitutes that will remain listed as acceptable pose lower overall risk to human health and the environment than the refrigerants we are listing as unacceptable. Acceptable refrigerants include: FOR12A, FOR12B, HFC-134a, IKON A, IKON B, R-426A, RS-24 (2002 formulation), R-450A, R-513A, R-744,

SP34E, THR-02 and THR-03. In the proposed rule (81 FR 22855–22856; April 18, 2016) and SNAP Notice 31 (81 FR 32241; May 23, 2016), EPA provided information on the environmental and health risks presented by the alternatives that are being found unacceptable compared with other available alternatives that are listed as acceptable. Also, concurrent with this rule, EPA is listing R-448A, R-449A and R-449B acceptable for new refrigerated food processing and dispensing equipment. A technical support document¹³⁵ that provides the **Federal**

Register citations concerning data on the SNAP criteria (*e.g.*, ODP, GWP, VOC, toxicity, flammability) for acceptable alternatives, as well as those we are finding unacceptable, for new refrigerated food processing and dispensing equipment may be found in the docket for this rulemaking (EPA–HQ–OAR–2015–0663).

The refrigerants we are listing as unacceptable have GWPs ranging from 1,770 to 3,990. As shown in Table 12, acceptable alternatives have GWPs ranging from one to 1,510.

TABLE 12—GWP, ODP, AND VOC STATUS OF REFRIGERANTS IN NEW RETAIL FOOD REFRIGERATION
[Refrigerated food processing and dispensing equipment]^{1 2}

Refrigerants	GWP	ODP	VOC	Listing status
HFC-134a, R-448A, R-449A, R-449B, R-450A, R-513A, R-744	1–1,430	0	No	Acceptable.
FOR12A, FOR12B, IKON A, IKON B, R-426A, RS-24 (2002 composition), SP34E, THR-02, THR-03.	30–1,510	0—Not public ³	Yes ⁴	Acceptable.
R-407A, R-407B, R-407C, R-407F, R-410A, R-410B, R-421A	1,770–2,800	0	No	Unacceptable.
KDD6, R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-417A, R-422B, R-422D, R-424A, R-437A, R-438A, RS-44 (2003 composition).	1,810–2,730	0	Yes ⁴	Unacceptable.
HFC-227ea, R-404A, R-421B, R-507A	3,190–3,990	0	No	Unacceptable.
R-422A, R-422C, R-428A, R-434A	3,080–3,610	0	Yes ⁴	Unacceptable.

¹ The table does not include not-in-kind technologies listed as acceptable for the stated end-uses.

² HCFC-22 and several blends containing HCFCs are also listed as acceptable but their use is severely restricted by the phasedown in HCFC production and consumption.

³ The ODP of one or more alternatives is not published here in order to avoid disclosing information that is claimed as confidential business information.

⁴ One or more constituents of the refrigerant are VOC.

Some of the refrigerant blends not subject to this action, as well as several of the substitutes for which we are changing the listing from acceptable to unacceptable, include small amounts of VOC such as R-290 (propane) and R-600 (n-butane). These amounts are small, and for this end-use category are not expected to contribute significantly to ground-level ozone formation.¹³⁶ In the actions where EPA listed these refrigerants as acceptable, EPA concluded none of these refrigerants in this end-use pose significantly greater risk to ground-level ozone formation than other alternative refrigerants that do not meet the definition of VOC under CAA regulations (see 40 CFR 51.100(s)) or that are specifically excluded from

that definition for the purpose of developing SIPs to attain and maintain the NAAQS.

The refrigerants not subject to this action are highly volatile and typically evaporate or partition to air, rather than contaminating surface waters. Their effects on aquatic life are expected to be small and pose no greater risk of aquatic or ecosystem effects than those of the refrigerants that are subject to the proposed status change for this end-use.

For this end-use category, all of the refrigerants, including those which we are listing as unacceptable, are not flammable (*e.g.*, those listed under ASHRAE Standard 34–2013 are class 1 flammability). Additionally, as discussed at section VI.A.4.d.iii.(c) of

the proposed rule (81 FR 22856; April 18, 2016) and in SNAP Notice 31 (81 FR 32245–46; May 23, 2016), the toxicity of the refrigerants we are listing as unacceptable is comparable to that of other alternatives that are acceptable in this end-use.

In summary, because the risks other than GWP are not significantly different for the other available alternatives than for those we proposed to list as unacceptable, and because the GWPs for the refrigerants we proposed to list as unacceptable are significantly higher and thus pose significantly greater risk, we are listing the following refrigerants as unacceptable: HFC-227ea, KDD6, R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407A, R-407B, R-407C, R-

¹³⁵ EPA, 2016b. Tables of Alternatives for End-Uses Considered in the Final Rule, Protection of Stratospheric Ozone: Listing Modifications for

Certain Substitutes under the Significant New Alternatives Policy Program. September, 2016.

¹³⁶ ICF, 2014a. Assessment of the Potential Impact of Hydrocarbon Refrigerants on Ground Level Ozone Concentrations. February, 2014.

407F, R-410A, R-410B, R-417A, R-421A, R-421B, R-422A, R-422B, R-422C, R-422D, R-424A, R-428A, R-434A, R-437A, R-438A, R-507A, RS-44 (2003 formulation).

i. When will the status change?

EPA proposed and is establishing a change of status date for refrigerated food processing and dispensing equipment of January 1, 2021, which the Agency finds is a reasonable yet expeditious date by which the technical challenges can be met for a safe and smooth transition to alternatives particularly considering the need for equipment to comply with any sanitation and safety standards while continuing to maintain the properties, characteristics and quality of the food or beverage provided by the equipment. As discussed below and in our response to comments, EPA relied on information from an equipment manufacturer claimed as CBI that estimated different conversion periods based on two refrigerants—specifically three years for R-448A and five years for R-744—and the technical hurdles posed by those refrigerants. While current efforts are focused on using those two refrigerants, there are a number of other refrigerants listed as acceptable for this end-use that manufacturers may also choose to use. However, there is no information that suggests that a conversion period for these other refrigerants would be any quicker than that for R-448A and R-744.

To address what alternatives might be available and when, comments were provided by manufacturers and an association representing manufacturers regarding certain refrigerants not currently acceptable in this end-use category. Information was provided for R-448A and R-449A, two HFC/HFO blends designed to mimic the properties of R-404A, and one manufacturer and an association representing manufacturers requested we find them acceptable for this end-use category. As noted above, concurrent with this rule EPA is listing R-448A, R-449A, and R-449B acceptable in this end-use. EPA views the interest expressed by comments to be indicative of the progress being made in this end-use category and the likely future use of R-448A, R-449A, or R-449B. As noted above, information claimed as CBI indicates a transition to one of these refrigerants could occur by January 1, 2021, and was being planned by a manufacturer of equipment for this end-use category. EPA discussed the status of these HFC/HFO blends and the availability of their HFO components in a previous action (80 FR 42870; July 20, 2015). For instance, we concluded then that there was ample supply of these

refrigerants and we pointed out that Emerson, a major supplier of compressors and other components, was qualifying these refrigerants for use in its products. Others have followed suit. For instance, Tecumseh has approved R-449A as an acceptable alternative to R-404A and was in the process of releasing R-449A compressors for use in remote condensing units.¹³⁷ This technology and know-how could then likely translate into the refrigerated food processing and dispensing equipment market, thereby allowing a transition by the January 1, 2021, change of status date.

Information was also supplied by equipment manufacturers regarding the use of R-290 specifically or HCs generically in this equipment. An environmental organization indicated that equipment using R-290 is already being used in markets outside the United States and recommended finding R-290 and R-600a acceptable subject to use conditions. EPA has not received a submission for these refrigerants specifically for the refrigerated food processing and dispensing equipment end-use category. If in the future we decide to list these as acceptable, they would be included in a Notice of Acceptability published in the **Federal Register**, or, if we were to propose finding them acceptable subject to use restrictions or unacceptable, we would publish a separate proposed rule.

Equipment manufacturers also submitted comments on some but not all of the acceptable refrigerants not proposed for status change. One manufacturer deemed HFC-134a as not appropriate for their equipment while a second manufacturer indicated that refrigerant is typically used for refrigerated (as opposed to freezing) applications in this end-use category. Based on these comments, EPA recognizes that HFC-134a is available for a portion of this end-use category, but additional time would be required for it, or other acceptable alternatives, to be considered available for all of this end-use category.

One manufacturer provided technical information regarding the challenges with using R-744 although as mentioned above information claimed as CBI indicated at least one equipment manufacturer was planning to transition to that refrigerant. A state agency indicated that low-GWP refrigerants including R-744 “are currently available for refrigeration in retail food.” Also, a

group of companies, Refrigerants, Naturally!, stated that “there are natural refrigerant alternatives available on the market” for dispensing equipment. The former comment discussed retail food refrigeration generally, rather than the refrigerated food processing and dispensing equipment category specifically. The latter comment only mentioned “dispensing equipment” and did not mention equipment that may also process food and beverages as well as dispensing it. As such EPA views these statements as indicative of the availability of alternatives for a portion but not necessarily all of the equipment within this end-use category.

EPA finds however that the progress using R-744 is far enough along to consider that it will be available for the vast majority, if not all, of the equipment in this end-use category that are using refrigerants subject to status change by January 1, 2021. As noted in the proposal (81 FR 22856; April 18, 2016), the Coca-Cola Company, which purchases equipment in this and other retail food refrigeration end-use categories, has announced their plans to convert to non-HFC technologies for all new cold-drink equipment by 2015, and selected R-744 as its refrigerant of choice.¹³⁸ The Coca-Cola Company has already placed over 1.4 million HFC-free units globally (80 FR 42919–42920; July 20, 2015) and it was reported that the company would only “narrowly miss” its 2015 target to be HFC-free.¹³⁹ The demand created by this company for R-744 in this end-use category (as well as for commercial refrigeration equipment in other end use categories addressed in a previous rule) is expected to increase the availability of R-744 components over the next several years. The time provided by the status change date will allow other components to be developed, for example to provide R-744 compressors designed for this end-use category rather than the “continuous, longer run systems” as mentioned by an equipment manufacturer. Further, as this company purchases equipment from other suppliers, EPA expects that similar equipment, and the components used by such equipment, will become more

¹³⁸ Coca-Cola, 2014. “Coca-Cola Installs 1 Millionth HFC-Free Cooler Globally, Preventing 5.25MM Metrics Tons of CO₂.” January 22, 2014. This document is accessible at <http://www.coca-colacompany.com/press-center/press-releases/coca-cola-installs-1-millionth-hfc-free-cooler-globally-preventing-525mm-metrics-tons-of-co2>.

¹³⁹ Refrigeration and Air Conditioning Magazine, 2015. “Coca Cola to narrowly miss HFC-free global refrigeration target.” March 20, 2015. This document is accessible at www.racplus.com/news/cocacola-to-narrowly-miss-hfc-free-global-refrigerationtarget/8680290.article.

¹³⁷ Tecumseh, 2016. “Tecumseh Outlines Position on Refrigerant Transition.” January 25, 2016. This document is accessible at <http://www.tecumseh.com/en/North-America/Newsroom/Press-Releases/2016/2016-AHR-Press-Release>.

widely available in the market. While today's action allows less time than the five-year transition time estimated by a manufacturer in information claimed as CBI for a full transition of R-404A equipment to R-744, EPA believes based on experience to date and the market built by the demand created by the Coca-Cola Company will allow for a faster transition than the commenter estimated.

Based on this information claimed as CBI and other comments as discussed above, we find that a January 1, 2021, change of status date is necessary to provide a reasonable yet expeditious time for the transition to acceptable alternatives to occur.

c. How is EPA responding to comments?

EPA received several comments from individuals and organizations with various interests in the refrigerants industry. Comments addressed the proposed status change date of January 1, 2021, the refrigerants proposed for status change, the technical challenges of using refrigerants remaining acceptable and other refrigerants that may be listed as acceptable in the future, energy efficiency, and other rules and standards that may apply to equipment in this end-use category.

Commenters included AHRI, an industry organization; Arkema and Chemours, chemical producers; CARB, a state agency; EIA, NRDC and IGSD, environmental organizations; and Stoelting, Tecumseh and UTC, equipment and component manufacturers. Additional comments claimed as CBI were submitted.

We have grouped comments together and responded to the issues raised by the comments in the sections that follow, or in a separate Response to Comments document which is included in the docket for this rule (EPA-HQ-OAR-2015-0663).

i. Substitutes and End-Use Proposed

Comment: UTC was in general agreement with how EPA defined this end-use category, but pointed out that "soft-serve and other frozen dairy treats may not fall within the technical definition of ice-cream due to milk fat content." They also stated that "it appears a creamer dispenser (refrigerated unit dispensing creamer in a dosed amount) and bulk milk dispensers (refrigerated unit holding a container of milk that dispenses through a small nozzle when the handle is lifted) would fit in this category as well."

Response: As noted previously in section VI.A.7.a.i, EPA agrees that the type of equipment identified by the commenter falls within this end-use.

Comment: UTC, Refrigerants Naturally!, Chemours, EIA, NRDC, and IGSD agreed with EPA's proposal to change the status of refrigerants for this end-use category.

Response: EPA thanks the commenters for the comments.

Comment: AHRI and UTC both claimed that the number of currently listed acceptable substitutes is limited and that EPA should list R-448A and R-449A as acceptable for this end-use category. Tecumseh suggested listing those two refrigerants and R-452A as acceptable.

Response: As shown in Table 12, multiple refrigerants are acceptable for this end-use category. After the proposal was published, but before the comment period closed, EPA added another alternative to the list of acceptable refrigerants in this end-use category, specifically R-513A. R-448A, R-449A, R-449B, and R-452A have been submitted to the SNAP Program for review. Concurrent with this rule, EPA is finding R-448A, R-449A, and R-449B acceptable for new refrigerated food processing and dispensing equipment. EPA has not proposed or made a final listing decision for R-452A in the refrigerated food processing and dispensing equipment end-use category. If in the future we decide to list this as acceptable, it would be included in a Notice of Acceptability published in the **Federal Register**. Likewise, if we were to propose finding it acceptable, subject to use restrictions or unacceptable, we would publish a separate proposed rule.

Comment: Responding to EPA's statement in the preamble to the proposed rule that currently HCs such as R-290, R-600a and R-443A are not listed as acceptable in this end-use category, UTC and Stoelting identified technical challenges affecting the potential use of these refrigerants in this end-use category. EIA recommended that EPA find R-290 and R-600a acceptable, subject to use conditions as soon as possible. They indicated that manufacturers are already making R-290 refrigerated dispensing systems abroad pointing to equipment offered by several companies, and felt this demonstrates a change in status is feasible.

Response: EPA did not propose and is not taking action regarding the use of HCs in this end-use category at this time. In any future action EPA may take addressing the use of HCs in this end-use, EPA would consider relevant technical information such as the availability of equipment operating on R-290 in markets outside the United States.

Comment: An initiative of a group of companies encouraged EPA to find

HFC-134a unacceptable "for systems where there are environmentally safe, low GWP alternatives." Information claimed as CBI indicated that a manufacturer plans to transition from HFC-134a after converting its R-404A equipment.

Response: EPA did not propose to change the status of HFC-134a for this end-use category and we are not taking such action today. While we recognize that there are plans to transition from HFC-134a by at least one manufacturer, the information provided did not offer sufficient basis to determine when alternatives would be available for the limited applications within this end-use category that rely on HFC-134a.

ii. Change of Status Date

Comment: Three commenters submitted information regarding the technical challenges of using certain refrigerants that have been submitted to EPA for review but for which EPA has not made a listing decision. UTC stated that the time to transition different products "may vary based on technical challenges with product sensory characteristics and differences in dispense rate requirements." They indicated that a challenge for using R-448A, which they proposed should be found acceptable, existed with the compressor discharge temperature which might reduce the compressor reliability. Stoelting requested an extension (of unspecified time) or exemption to continue to use R-404A. They stated that "R-448 or R-449 have an inherent temperature glide of 8 °F [4.4 °C] or more" that causes two issues. They stated that they could not "account for the fractionation" of such refrigerants in equipment with flooded evaporators. They also stated that meeting the temperature variances required (+/- 1 °F [0.56 °C]) would be difficult and lead to a "too cold/firm" region and a "too warm/soft" region. Information submitted and claimed as CBI estimated that at least three years was needed to transition to R-448A, if it is found acceptable.

Response: EPA recognizes that challenges exist with any transition and based on the technical information provided for this end-use EPA is establishing a change of status date of January 1, 2021. EPA notes that there are refrigerants currently listed as acceptable that would alleviate or eliminate the concern regarding temperature glide that Stoelting mentioned. For instance, R-744 as a pure substance does not have a temperature glide, although separate limitations were discussed by UTC as explained in the following comment.

Also, while R-450A is zeotropic, it has a low temperature glide that presumably can be addressed based on past experience with R-404A, another low-glide zeotropic blend. In addition, R-513A is an azeotrope with no temperature glide.

With respect to the other issues concerning R-448A discussed by UTC, concurrent with this rule, EPA is listing R-448A as acceptable in this end-use. As noted above, information provided and claimed as CBI indicates a transition to R-448A is feasible by the change of status date established.

Comment: UTC emphasized that sufficient time is needed to transition equipment to refrigerants not subject to status change. They described multiple challenges with using R-744, which is currently listed as acceptable. One challenge they described is the additional space required in the heat exchangers and that this additional space requirement must be balanced with the need to minimize increases in footprints which would be difficult to accommodate in many foodservice settings that utilize this equipment. The commenter further indicated the challenges with “compressor availability, compressor operating envelope, refrigerant controls availability (in our capacity range), footprint, and cost.” Another challenge with R-744 noted was the need to design for higher operating pressures and a more complex cooling cycle. The commenter also stated that additional work on the compressor designs was needed to develop models that are suited for the varying cooling demands of this type of equipment as opposed to other applications where R-744 compressors are used. For example, UTC stated that “R-744 compressors have been traditionally designed for continuous, longer run system.” CARB however stated that R-744 is currently available for retail food refrigeration, arguing for a 2020 status change date, while information claimed as CBI indicated at least one equipment manufacturer was already planning to convert to R-744 in the future. This information claimed as CBI by an equipment manufacturer estimated that they would need at least a five-year timeframe to transition to R-744.

Response: EPA agrees that some challenges exist when converting to R-744, but the technical progress to date in using this refrigerant in various applications indicates these challenges can be met by the change of status date. Although some components are available, R-744 components have not yet become widely available and could not currently satisfy the entire market

for this end-use category by CARB’s suggested January 1, 2020 date. Nonetheless, although specific comments suggesting the solutions to the technical concerns raised were not provided, the transition by the Coca-Cola Company and other comments indicate that such solutions exist and can be implemented. As discussed in section VI.A.7.b.ii above, EPA finds that R-744 will be available for most if not all of the equipment in this end-use category by the change of status date, and sees various paths forward in the case that it is not fully available for all such equipment.

iii. Relationship With Other Rules

Comment: In response to EPA’s request for comment on applicable DOE energy conservation standards for equipment in this end-use category, UTC indicated that there are currently no DOE directives or requirements for this equipment. They also indicated the American Society for Testing and Materials (ASTM International) was developing a test standard for this equipment, implying such a standard might form the basis of future DOE rulemaking. They also indicated that European rules covering ice-cream and shake machines are being drafted.

Response: EPA thanks the commenter for this information regarding the development of testing standards and the current status of DOE and European requirements for this equipment. We did not consider possible future action by ASTM or DOE in establishing a change of status date for this end-use category, but if one or both those actions occur, EPA could consider it at that time.

iv. Industry Standards and Codes

Comment: UTC provided a list of multiple industry standards, including ones from the Canadian Standards Association (CSA,) UL, and IEC that apply to this equipment. The commenter did not indicate how the information was related to the proposal.

Response: EPA thanks the commenter for the information regarding standards.

8. Change of Listing Status for Certain HFC Refrigerants for New Household Refrigerators and Freezers

a. Background

i. What is the affected end-use?

Household refrigerators, freezers and combination refrigerator/freezers are intended primarily for residential use, although they may be used outside the home. The designs and refrigeration capacities of equipment vary widely. Household refrigerators and freezers are

composed of three main categories of equipment. Household freezers only offer storage space at freezing temperatures, while household refrigerators only offer storage space at non-freezing temperatures. Products with both a refrigerator and freezer in a single unit are most common. In addition to the three main categories of equipment, other small refrigerated household appliances exist (*i.e.*, chilled kitchen drawers, wine coolers, and mini-fridges) that are also within this end use. Household refrigerators and freezers have all refrigeration components integrated, and for the smallest types, the refrigeration circuit is entirely brazed or welded. These systems are charged with refrigerant at the factory and typically require only an electricity supply to begin operation.

The 2014 ASHRAE Handbook of Refrigeration provides an overview of food preservation in regards to household refrigerators and freezers. Generally, a storage temperature between 32 and 39 °F (0 to 3.9 °C) is desirable for preserving fresh food. Humidity and higher or lower temperatures are more suitable for certain foods and beverages. Wine chillers, for example, are frequently used for storing wine, and have slightly higher optimal temperatures from 45 to 65 °F (7.2 to 18.3 °C). Freezers and combination refrigerator-freezers that are designed to store food for long durations have temperatures below 8 °F (–13.3 °C) and are designed to hold temperatures near 0 to 5 °F (–17.7 to –15 °C). In single-door refrigerators, the optimum conditions for food preservation are typically warmer than this due to the fact that food storage is not intended for long-term storage.

DOE energy conservation standards apply to household refrigerators and freezers, as discussed in section VI.A.9.b.ii.

i. What refrigerants are used in household refrigerators and freezers?

The following alternatives are currently acceptable for new household refrigerators and freezers: FOR12A, FOR12B, HFC-134a, HFC-152a, IKON A, IKON B, KDD6, R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-290, R-404A, R-407C, R-407F, R-410A, R-410B, R-417A, R-421A, R-421B, R-422A, R-422B, R-422C, R-422D, R-424A, R-426A, R-427A, R-428A, R-434A, R-437A, R-438A, R-441A, R-450A, R-513A, R-507A, R-600a, RS-24 (2002 formulation), RS-44 (2003 formulation), SP34E, THR-02 and THR-03. Of those, R-290, R-441A and R-600a are acceptable, subject to use conditions.

Currently, the most commonly used refrigerant in the United States for household refrigerators and freezers is R-134a, an HFC with a GWP of 1,430. However, throughout many parts of the world, R-600a with a GWP of approximately four is the most commonly used refrigerant and there are ongoing efforts to help facilitate the adoption and continued use of R-600a in this industry globally.¹⁴⁰ The European Union (EU) banned the use of HFCs with a GWP greater than 150 (which includes R-134a) for household refrigerators and freezers as of January 1, 2015.¹⁴¹ R-600a has been used in Europe for approximately two decades. Throughout parts of Asia, Africa, and South America, R-600a is the dominant refrigerant for this end-use. In its 2014 assessment report,¹⁴² the TEAP's

Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee (RTOC) projects that by 2020 about 75 percent of new household refrigerators globally will use R-600a, a small percentage will use HFOs, and the rest will use HFC-134a. There are other alternatives that may be determined to work well in this end use. For example, R-450A and R-513A, which EPA has listed as acceptable for use in this end-use (79 FR 62863, October 21, 2014; 80 FR 42053, July 16, 2015, respectively), were designed to match the characteristics and performance of HFC-134a.

In addition to R-600a, EPA previously found a number of other flammable HC refrigerants including R-290 and R-441A and R-600a as acceptable, subject to use conditions in household refrigerators

and freezers (76 FR 78832, December 20, 2011; 80 FR 19454, April 10, 2015).

b. What is EPA's final decision?

For new household refrigerators and freezers, EPA proposed to change as of January 1, 2021, the status of the following refrigerants from acceptable to unacceptable: FOR12A, FOR12B, HFC-134a, KDD6, R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407C, R-407F, R-410A, R-410B, R-417A, R-421A, R-421B, R-422A, R-422B, R-422C, R-422D, R-424A, R-426A, R-428A, R-434A, R-437A, R-438A, R-507A, RS-24 (2002 formulation), RS-44 (2003 formulation), SP34E, and THR-03. In this action, we are finalizing the status changes as proposed. The change of status determinations for new household refrigerators and freezers:

TABLE 13—CHANGE OF STATUS DECISIONS FOR HOUSEHOLD REFRIGERATORS AND FREEZERS

End-use	Substitutes	Listing status
Household refrigerators and freezers (new only).	FOR12A, FOR12B, HFC-134a, KDD6, R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407C, R-407F, R-410A, R-410B, R-417A, R-421A, R-421B, R-422A, R-422B, R-422C, R-422D, R-424A, R-426A, R-428A, R-434A, R-437A, R-438A, R-507A, RS-24 (2002 formulation), RS-44 (2003 formulation), SP34E, and THR-03.	Unacceptable as of January 1, 2021.

i. How do these unacceptable refrigerants compare to other refrigerants for this end-use with respect to SNAP criteria?

Other refrigerants for new household refrigerators and freezers are HFC-152a, IKON A, IKON B, THR-02; R-513A, R-450A, R-290, R-441A and R-600a. In the proposed rule, EPA provided information on the environmental and health risks presented by the

alternatives that are being found unacceptable compared with other alternatives listed as acceptable (81 FR 22858; April 18, 2016). In addition, a technical support document¹⁴³ that provides the **Federal Register** citations concerning data on the SNAP criteria (e.g., ODP, GWP, VOC, toxicity, flammability) for acceptable alternatives as well as those we are finding unacceptable for new household

refrigerators and freezers may be found in the docket for this rulemaking (EPA-HQ-OAR-2015-0663).

The refrigerants we are listing as unacceptable through this action have insignificant ODP and they have GWPs ranging from 920 to 3,990. As shown in Table 14, the other alternatives, listed as acceptable or as acceptable, subject to use conditions, have GWP ranging from three to 630.

TABLE 14—GWP, ODP, AND VOC STATUS OF REFRIGERANTS IN NEW HOUSEHOLD REFRIGERATORS AND FREEZERS^{1 2}

Refrigerants	GWP	ODP	VOC	Listing status
IKON A, IKON B, R-290, R-441A, R-600a, THR-02	3–560	0—Not public ³	Yes ⁴	Acceptable.
HFC-152a	124	0	No	Acceptable.
R-450A, R-513A	600–630	0	No	Acceptable.
HFC-134a	1,430	0	No	Unacceptable.
FOR12A, FOR12B, R-426A, RS-24 (2002 composition), SP34E, THR-03	920–1,510	0—Not public ³	Yes ⁴	Unacceptable.
R-407C, R-407F, R-410A, R-410B, R-421A	1,770–2,630	0	No	Unacceptable.
KDD6, R-125/290/134a/600a (55/1/42.5/1.5), R-417A, R-422B, R-422D, R-424A, R-437A, R-438A, RS-44 (2003 composition).	1,810–2,730	0	Yes ⁴	Unacceptable.
R-404A, R-421B, R-507A	3,190–3,990	0	No	Unacceptable.
R-422A, R-422C, R-428A, R-434A	3,080–3,610	0	Yes ⁴	Unacceptable.

¹ The table does not include not-in-kind technologies listed as acceptable for the stated end-uses.

² HCFC-22 and several blends containing HCFCs are also listed as acceptable but their use is severely restricted by the phasedown in HCFC production and consumption.

³ The ODP of one or more alternatives is not published here in order to avoid disclosing information that is claimed as confidential business information.

⁴ One or more constituents of the refrigerant are VOC.

¹⁴⁰ ORNL, 2015. ORNL's JUMP Challenge: JUMP in to Advance Tech Innovation! Presented by Brian Fricke, Oak Ridge National Laboratory. November 17, 2015.

¹⁴¹ EU, 2014. Regulation (EU) No 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006. Available online at:

http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2014.150.01.0195.01.ENG.

¹⁴² RTOC, 2015. 2014 Report of the Refrigeration, Air-Conditioning and Heat Pumps Technical Options Committee. Available at: <http://conf.montreal-protocol.org/meeting/mop/mop-27/presession/Background%20Documents%20are%20>

<available%20in%20English%20only/RTOC-Assessment-Report-2014.pdf>.

¹⁴³ EPA, 2016b. Tables of Alternatives for End-Uses Considered in the Final Rule, Protection of Stratospheric Ozone: Listing Modifications for Certain Substitutes under the Significant New Alternatives Policy Program. September, 2016.

Three substitutes that remain acceptable, subject to use conditions, R-290, R-600a, and R-441A, are HCs or a blend of HCs. R-290 and R-600a are VOCs while R-441A is a blend composed primarily of compounds that are VOC. EPA's analysis indicates that their use as refrigerants in this end-use is not expected to contribute significantly to ground level ozone formation.¹⁴⁴ In the action in which EPA listed these refrigerants as acceptable, subject to use conditions (80 FR 19454; April 10, 2015), EPA concluded none of these refrigerants as used in this end-use pose significantly greater risk to ground-level ozone formation than other alternative refrigerants that are not VOCs or that are specifically excluded from the definition of VOC under CAA regulations (see 40 CFR 51.100(s)) addressing the development of SIPs to attain and maintain the NAAQS.

The refrigerants not subject to this action are highly volatile and typically evaporate or partition to air, rather than contaminating surface waters. Their effects on aquatic life are expected to be small and pose no greater risk of aquatic or ecosystem effects than those of the refrigerants that are subject to the status change for this end-use.

With the exception of HFC-152a, R-290, R-600a and R-441A, all other refrigerants listed as acceptable, including those we are listing as unacceptable, are not flammable. R-290 and R-600a, which are HCs, and R-441A, which is a blend of HCs, are classified as A3 refrigerants by ASHRAE Standard 34–2013, indicating that they have low toxicity and high flammability, while HFC-152a is classified as an A2 refrigerant, indicating that it has low toxicity and low flammability. To address flammability, EPA listed these R-290, R-441A and R-600a as acceptable, subject to use conditions. The use conditions include conditions consistent with industry standards, limits on charge size, and requirements for warnings and markings on equipment to inform consumers and technicians of potential flammability hazards. Our assessment and listing decisions (76 FR 78832; December 20, 2011 and FR 80 19454; April 10, 2015) found that the overall risk, including the risk due to flammability with the use conditions, is not significantly greater than for other refrigerants listed as acceptable at that time. EPA found HFC-152a acceptable for new household refrigerators and

freezers in the original SNAP rule indicating “[a]lthough HFC-152a is flammable, a risk assessment demonstrated it could be used safely in this end-use” (59 FR 13081; March 18, 1994). Toxicity is not a significant concern for the refrigerants we are listing as unacceptable. Their toxicity is comparable to that of other alternatives that are acceptable in this end-use. The refrigerants subject to the status change and the refrigerants not subject to the status change, if listed under ASHRAE 34 (2013), are classified as Class A refrigerants (lower toxicity).

In summary, because the risks other than GWP are not significantly different for the other available alternatives than for those we proposed to list as unacceptable, and because the GWPs for the refrigerants we proposed to list as unacceptable are significantly higher and thus pose significantly greater risk, we are listing the following refrigerants as unacceptable: FOR12A, FOR12B, HFC-134a, KDD6, R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407C, R-407F, R-410A, R-410B, R-417A, R-421A, R-421B, R-422A, R-422B, R-422C, R-422D, R-424A, R-426A, R-428A, R-434A, R-437A, R-438A, R-507A, RS-24 (2002 formulation), RS-44 (2003 formulation), SP34E, and THR-03.

ii. When will the status change?

As proposed, EPA is establishing a change of status date for new household refrigerators and freezers of January 1, 2021. There are technical challenges that must be met for a safe and smooth transition to alternatives, particularly considering the likely use of one or more of the flammable alternatives. The primary step that must occur for a transition is product design work for alternative refrigerants, drawing from current models used both in the United States and elsewhere. For those designing with flammable refrigerants, this would include complying with the use conditions EPA established when listing those refrigerants as acceptable (76 FR 78832; December 20, 2011, and FR 80 1954; April 10, 2015). Although some models have recently and others are currently transitioning,

EPA recognizes that manufacturers will need time to continue product design work for alternative refrigerants, drawing from current models used both in the United States and elsewhere.

Household refrigerators are subject to DOE energy conservation standards and will need to be tested to demonstrate compliance with those standards.¹⁴⁵

EPA noted in a previous action that “we do not have a practice in the SNAP program of including energy efficiency in the overall risk analysis” but also pointed out that “[w]e do, however, consider issues such as technical needs for energy efficiency (e.g., to meet DOE standards) in determining whether alternatives are ‘available.’” (80 FR 42921; July 20, 2015). Hence, we find that the need for household refrigerator and freezers to meet DOE energy efficiency standards plays a part in determining the availability of alternatives and factors into our decision on the applicable change of status date.

With a change of status date of 2021, the evidence presented indicates that current models—already meeting the current DOE standards—when redesigned for alternative refrigerants are expected to continue to meet those existing standards. In fact, comments indicate an increase in energy efficiency with some of the acceptable alternatives, some of which have been implemented in products both in the U.S. market and globally. See for example comments from Electrolux and NRDC.

Furthermore, as the typical compliance period for DOE energy efficiency regulations is three years from the date issued, a status change date over four years from today gives manufacturers should provide a more than adequate period of time to redesign models to meet such standards with an alternative refrigerant. This time frame also allows manufacturers time to redesign models considering the use conditions that must be met if a flammable acceptable alternative is chosen, as discussed above.

We understand however that there may be limitations with regard to the availability of testing facilities in the event that, in the midst of this implementation of new models with alternative refrigerants, the energy efficiency requirements were to change in a manner that required redesigning models to meet the new efficiency standards DOE has not initiated the process under which new energy efficiency standards would be promulgated. Commenters have suggested that this process could begin as early as 2017 with an eventual compliance date of 2024 or 2025. Therefore, at this point in time it is not evident that there will be any constraint on laboratory availability to meet the January 1, 2021, status change date in this rule. Should DOE finalize new energy efficiency standards for household refrigerators-freezers in the next few years, EPA could consider at that time whether laboratory availability

¹⁴⁴ ICF, 2014a. Assessment of the Potential Impact of Hydrocarbon Refrigerants on Ground Level Ozone Concentrations. February, 2014.

¹⁴⁵ DOE's previous energy conservation rulemaking for this end-use was finalized in 2011 with a compliance date of September 15, 2014 (76 FR 57516; September 15, 2011).

issues might affect the transition to alternative refrigerants by the 2021 change of status date.

c. How is EPA responding to comments?

EPA received several comments from organizations with various interests in the household refrigerators and freezers end-use. Several commenters commented on the proposed January 1, 2021, change of status date. Other comments focused on substitutes and end-use proposed, industry standards and codes, and general comments such as the need for technician training.

Commenters included AHAM, a trade association; and three equipment manufacturers, Whirlpool, Sub Zero, and Electrolux. EPA also received comments from Arkema and Chemours, chemical producers; NRDC, IGSD and EIA, environmental organizations; UL, a safety consulting and certification company; and CARB, a state agency.

We have grouped comments together and responded to the issues raised by the comments in the sections that follow, or in a separate Response to Comments document which is included in the docket for this rule (EPA-HQ-OAR-2015-0663).

i. Substitutes and End-Use Proposed

Comment: AHAM noted that although alternatives have been approved for and can be used in refrigerators and freezers, the only viable alternative is R-600a and there are no available “drop-ins.” AHAM also noted that while the appliance industry is moving to replace HFC refrigerants in their products and has produced and sold hundreds of millions of units safely around the world using HC alternatives, factories must be reengineered, and education, logistics and disposal systems would need to be established to manage the safe transportation, servicing and disposal of flammable refrigerants in North America. Whirlpool also commented that major manufacturing changes are required across the industry to achieve widespread use of flammable refrigerants. Three environmental organizations, NRDC, IGSD, and EIA, along with a state government agency, CARB, and a chemical producer, Chemours, supported EPA’s proposal to change the status of HFC-134a in this end-use.

Response: EPA appreciates comments submitted in support of the proposed rule and thanks commenters. As to AHAM’s comments that there are no “drop-in” substitutes for this end use, although EPA prefers not to use the term “drop-in,” it is sometimes used by various parties to refer to the circumstance where one refrigerant can

be used in place of another without any modification to the relevant piece of refrigeration equipment. While equipment manufacturers may prefer to use HC refrigerants as they do in other markets, EPA believes that R-450A and R-513A may meet the characteristics that AHAM uses to define “drop-in” replacements. These are non-flammable and were developed to have characteristics similar to R-134a. That said, EPA finds that the change of status date provides sufficient time for redesigning to use HC refrigerants if so preferred by equipment manufacturers.

ii. Change of Status Date

Comment: Chemours, a chemical producer, supported the change of status for the refrigerants proposed to be listed as unacceptable, noting that it has sufficient supply of commercial replacement solutions with comparable or improved energy efficiency compared to the substitutes subject to the proposed status change. UL commented on the proposed change of status for HFC-134a for use in this end-use, stating it did not expect to be adversely impacted by any testing or retesting of refrigerators and freezers due to proposed provision.

Response: EPA acknowledges UL’s statement that under the proposed timeline for the change of status of R-134a they do not anticipate any difficulty in providing laboratory capacity to perform any testing needed for newly designed refrigerators and freezers and we have considered this information in determining an appropriate change of status date. In addition, we considered whether there was sufficient manufacturing capacity for substitutes by Chemours and other chemical producers in order to meet the established change of status date and determined that production would be more than sufficient for a January 1, 2021, change of status date.

Comment: Several commenters commented on the proposed January 1, 2021, change of status date for household refrigerators and freezers. AHAM and Sub Zero suggested that a complete transition date should be no earlier than 2024. AHAM noted that, while the industry is moving to replace HFC refrigerants in products, this transition process is expensive, time consuming, and industry faces technical challenges. AHAM and Whirlpool suggested that the proposed change of status date would create significant difficulties in designing products with flammable refrigerants while also meeting DOE energy conservation standards and charge size limitations for flammable refrigerants in the UL

refrigerators and freezers safety standard. AHAM and Sub Zero suggested there would be a small environmental impact from moving the change of status date to 2024. Whirlpool also recommended a transition date of 2024 due to the design and engineering changes that would be necessary. Electrolux noted that they could transition out of HFC based refrigerants by January 1, 2021, if the charge size limit on HC refrigerants could be increased. NRDC, IGSD, and EIA urged EPA to maintain the proposed status change date of January 1, 2021, and noted requests for extended delays are completely unwarranted given that refrigerator manufacturers have offered models with R-600a for over a decade outside the United States.

Response: EPA appreciates points raised by AHAM, Sub Zero, and Whirlpool and understands that challenges exist; however we do not agree that additional time beyond what was proposed is needed. We understand that time is needed for adapting certain model designs to the U.S. market but do not believe the commenters have provided sufficient information to indicate that more time than what EPA proposed would be needed. Although the comments did not provide a detailed analysis of what steps are required to complete a transition and how long each step takes, and whether steps can occur simultaneously or must occur in series, we find that much component equipment development can occur at the same time as other product design work. In other words, as certain components become available, appropriate units could be redesigned using those components, prototypes could be built and tested, and final designs could be manufactured. While redesigns and prototypes are developed, additional components can be developed as needed for other designs. Indeed, once product models are designed, testing and certification could take place while additional models are designed.

We agree with NRDC, IGSD, and EIA that a status change date of January 1, 2021, can be met, and will allow sufficient time for manufacturers to redesign any products that require additional engineering to meet this rule. EPA notes that R-600a is currently being used in more than 500 million household refrigerator and freezer units worldwide, including some units in the United States.¹⁴⁶ Additionally, although changing the charge size limit for hydrocarbon refrigerants as mentioned by Electrolux is beyond the scope of this

¹⁴⁶ (TEAP, 2015).

rule, many manufacturers have already identified a portion of their products that they could redesign using R-290 under the existing limit. EPA notes that refrigeration and AC equipment manufacturers are not required to use any of the flammable refrigerants listed as acceptable, subject to use conditions in this action; we expect that those who choose to do so will plan accordingly for any changes required at the factory and in the designs of the products they manufacture. We note that R-450A and R-513A, which are not subject to status change, will not require as many changes to the equipment design particularly since these are nonflammable and operate with similar characteristics to HFC-134a.

Regarding the comment that there would be little environmental impact by delaying the change of status date until 2024, we do not consider that as part of the analysis for determining the appropriate change of status date. We consider environmental effects, as part of the SNAP review criteria for determining whether safer alternatives are available. Once we have determined that other alternatives can be used that pose less risk we look at the technical challenges of a transition and the availability of alternatives to identify a reasonable but expeditious change of status date that reflects when alternatives can be used broadly within the end-use. Regarding Arkema's specific suggestion for a change of status date of 2025, EPA does not agree that equipment being hermetically sealed justifies a later change of status date. As noted, EPA has determined that other alternatives pose less risk than those for which the status is being changed can reasonably be used earlier than 2025. Even assuming that the commenter is correct that alternatives may be used in a manner that would pose even less risk at a later date, such an assumption would not justify delaying the change of status date. Manufacturers could still choose to manufacture new equipment that is hermetically sealed in 2025 and beyond.

iii. Industry Standards and Codes

Comment: AHAM, Whirlpool, NRDC, IGSD, and EIA discussed charge size limitations for flammable refrigerants in the UL refrigerators and freezers safety standard. Whirlpool and Electrolux noted the need for a new safety standard that would replace the current UL standard that has established the charge size limit of HC-based refrigerants to 57 g. Electrolux suggested that this charge size limit should be harmonized with the IEC 60335-2-40 standard in place in the European Market at 150 g. Arkema

stated that building codes do not yet support use of flammable materials at a sufficient charge size. CARB mentioned the \$5.2 million commitment announced on June 2, 2016, by DOE, AHRI, and ASHRAE discussed previously to fund vital research that will establish a more robust fact base about the properties and uses of flammable refrigerants. This new research program will help provide the technical knowledge needed to facilitate and accelerate the safe use of these refrigerants. NRDC and IGSD commented that, in addition to finalizing the change of status date for HFC-134a in new household refrigerators and freezers, EPA should revisit the charge size limit of 57 g for HC refrigerants used in any refrigerator, freezer, or combination refrigerator and freezer for each circuit. NRDC and IGSD also recommended that UL and AHAM "review the technical justification for such a wide gulf between U.S. and international safety standards and close it as soon as possible." Similarly, EIA commented that "the current UL 250 charge size limit of 57 g of R-600a is effectively and unnecessarily prohibiting market penetration of low-GWP hydrocarbon systems in the U.S. . . . Even with the current overly restrictive UL standard in place, manufacturers have R-600a based systems on the U.S. market, though the charge size is a major restriction to refrigerator volume, or substantially increases the price if dual compressor systems are used to make a standard sized U.S. refrigerator." EIA recommended that, while the UL 471 harmonization process to replace UL 250 continues, EPA should recognize the 150 g charge size limit under the currently recognized International Electrochemical Commission (IEC) standard (IEC 60335-2-89) as an acceptable use condition for the sale of household refrigerators and freezers using HCs in the United States. EIA believes this will help support the proposed change of status date of January 1, 2021, for HFC-134a. EIA referenced their October 2015 petition to the Agency requesting that EPA incorporate by reference the IEC standard 60335-2-89 as the basis for charge size limitations as use conditions for R-290 and R-600a in household refrigerators and freezers.

Response: EPA understands the interest in reconsidering safe charge limits and the potential for UL and IEC standards to be harmonized. EPA understands that there are efforts in this direction underway. EPA is encouraged by the June 2016 announcement by

DOE, ASHRAE and AHRI and understands that other stakeholders have been invited to join this effort. While there may be opportunities to make changes to applicable standards, and subsequently change the use conditions that currently apply, such changes are beyond the scope of this rule. If and when those standards are harmonized, EPA could consider whether to revise the SNAP listing consistent with the new standards. This action is based on the Agency's view that the other alternatives including those acceptable to use conditions are feasible for use, as demonstrated by several manufacturers, including GE and BOSCH. We understand that other manufacturers are earlier in the process of designing equipment using alternatives that remain acceptable and EPA has established a change of status date of January 1, 2021 to allow time for manufacturers to address the technical challenges.

iv. Other Suggestions or Requests

Comment: AHAM recommended that service personnel must be trained to adequately protect themselves and consumers from activities that may be routine for handling equipment with non-flammable refrigerants but that are not protective when servicing equipment with flammable HC refrigerants. AHAM commented that repairing leaks or replacing/filling refrigerant lines will involve new training techniques that must be developed and communicated.

Response: EPA is not taking action in this rulemaking regarding the use of flammable refrigerants for this end-use and thus this comment is outside the scope of this rulemaking. However, we note that we are aware that at least two organizations—RSES and the ESCO Institute—have developed technician training programs in collaboration with refrigeration equipment manufacturers and users that address safe use of flammable refrigerant substitutes. In addition, EPA has reviewed several training programs provided as part of SNAP submissions from persons interested in flammable refrigerant substitutes. The Agency intends to update the test bank for technician certification under CAA section 608 as we have done previously, and will consider including additional questions on flammable refrigerants. By adding such questions to the test bank, EPA would supplement but would not replace technician training programs currently provided by non-government entities. EPA will seek additional information and guidance on how best to incorporate this content through a

separate process outside the scope of this final rule.

B. Motor Vehicle Air Conditioning

1. Background

The vehicle types that are addressed in this action include limited types of HD vehicles, specifically, MDPVs,¹⁴⁷ HD trucks, and complete HD vans.¹⁴⁸ EPA has previously listed HFO-1234yf as acceptable, subject to use conditions, in light-duty (LD) motor vehicles and trucks (76 FR 17490; March 29, 2011).

The types of HD vehicles addressed in this action are in many ways more similar to LD vehicles than they are to the HD vehicles with a higher gross

vehicle weight rating (GVWR), which is a measure of the combined curb (empty) weight and cargo carrying capacity of the truck. Table 15 outlines the HD vehicle weight classifications commonly used. MDPVs,¹⁴⁹ HD pickup trucks, and HD vans are Class 2b and 3 vehicles with GVWRs between 8,501 and 14,000 lb. These vehicle types are similar to LD vehicles technologically and most are manufactured in a similar manner to LD vehicles by companies with major light-duty markets in the United States.¹⁵⁰ Ford, General Motors, and Fiat Chrysler Automobiles (FCA) produce approximately 100 percent of HD pickup trucks and approximately 95 percent of

HD vans, with Daimler and Nissan producing the remaining approximately five percent of HD vans.¹⁵¹ In many cases, these types of HD vehicles are versions of their LD counterparts.¹⁵² For example, the Silverado 1500, Ram 1500, and Ford F-150 are the LD counterparts of the HD Silverado 2500/3500, Ram 2500/3500, and Ford F-250/F-350/F-450 pickup trucks.¹⁵³ The primary difference between HD pickup trucks and vans and their LD counterpart vehicles is that HD pickups and vans are occupational or work vehicles that are designed for much higher towing and payload capabilities compared to LD pickups and vans.

TABLE 15—VEHICLE WEIGHT CLASSIFICATION

Class	2b	3	4	5	6	7	8
GVWR (lb)	8,501–10,000	10,001–14,000	14,001–16,000	16,001–19,500	19,501–26,000	26,001–33,000	>33,000

All types of HD vehicles can be sold as “complete” or “incomplete” vehicles (76 FR 57259–60; September 15, 2011). Complete vehicles are sold by vehicle manufacturers to end-users with no secondary manufacturer making substantial modifications prior to registration and use. Incomplete vehicles are sold by vehicle manufacturers to secondary manufacturers without the primary load-carrying device or container attached. See section VI.B.1 of the proposed rule for additional information on HD vehicles and the vehicle types within the MVAC end-use that are addressed in this action.

Section 608(c) of the CAA prohibits the knowing venting, release or disposal of all refrigerants by any person maintaining, servicing, repairing or disposing of an appliance or IPR in a manner which permits the refrigerant to enter the environment, except for certain substitute refrigerants that have been specifically exempted from this venting prohibition under CAA section 608(c)(2). MVAC end-of-life disposal and recycling specifications are also covered under section 608 of the CAA and our regulations issued under that

section of the Act, which are codified at subpart F of 40 CFR part 82.

Additionally, CAA section 609 establishes standards and requirements regarding servicing of MVAC systems. Under section 609, no person repairing or servicing motor vehicles for consideration¹⁵⁴ may perform any service on an MVAC that involves the refrigerant without properly using approved refrigerant recovery or recovery and recycling equipment and no such person may perform such service unless such person has been properly trained and certified. This action will not have a direct impact on EPA’s regulations under section 609. For further information on the relationship between this action and other federal rules, see section VI.B.6 of the proposed rule (81 FR 22866–67; April 18, 2016).

2. What is EPA’s final decision?

As proposed, EPA is listing HFO-1234yf as acceptable, subject to use conditions, in MVAC systems for newly manufactured MDPVs, HD pickup trucks, and complete HD vans. The use conditions are detailed in section VI.B.2.b, “What are the final use conditions?”. EPA sought comment and

information on listing HFO-1234yf as acceptable subject to use conditions for some incomplete HD vans. One commenter provided information to EPA and EPA will consider that information to determine whether to take further action regarding the listing of HFO-1234yf for use in incomplete HD vans.

As explained in section VI.B.1, section 608 of the CAA prohibits the knowing venting, release or disposal of all refrigerants by any person maintaining, servicing, repairing or disposing of an appliance or IPR in a manner which permits the refrigerant to enter the environment, except for certain substitute refrigerants that have been specifically exempted from this venting prohibition. Because HFO-1234yf has not been exempted from the venting prohibition in any end use, such knowing releases of HFO-1234yf in the course of maintaining, servicing, repairing or disposing of MVAC systems of MDPVs, HD pickup trucks, and complete HD vans addressed in this action is prohibited.

¹⁴⁷ Defined at 40 CFR 86.1801–03.

¹⁴⁸ MVAC systems provide passenger comfort cooling for LD cars and trucks, HD vehicles (large pick-ups, delivery trucks, recreational vehicles, and semi-trucks), off-road vehicles, buses, and rail vehicles. EPA is not addressing other types of HD vehicles, off-road vehicles, buses, or trains in this action.

¹⁴⁹ MDPVs are classified as HD vehicles based on their GVWR, but due to their similarities to LD vehicles they are subject to the GHG emissions standards established for LD trucks.

¹⁵⁰ This is more broadly true for HD pickup trucks than vans because every manufacturer of HD pickup trucks also makes LD pickup trucks, while only some heavy-duty van manufacturers also make light-duty vans (80 FR 40148; July 13, 2015).

¹⁵¹ EPA, 2015. Draft Regulatory Impact Analysis: Proposed Rulemaking for Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles—Phase 2. EPA-420-D-15-900. June 2015. Available at <http://www3.epa.gov/otaq/climate/documents/420d15900.pdf>.

¹⁵² ICCT, 2015. International Council on Clean Transportation: Regulatory Considerations for Advancing Commercial Pickup and Van Efficiency Technology in the United States. Available online at: <http://www.theicct.org/us-commercial-pickups-vans-efficiency-technology>.

¹⁵³ ICF, 2015. Market Characterization of the U.S. Motor Vehicle Air Conditioning Industry, U.S. Foams Industry, U.S. Aerosols Industry, and U.S. Commercial Refrigeration Industry. July, 2015.

¹⁵⁴ Service for consideration means receiving something of worth or value to perform service, whether in money, credit, goods, or services.

a. How does HFO-1234yf compare to other refrigerants for these MVAC applications with respect to SNAP criteria?

Available refrigerants for newly manufactured MDPVs, HD pickup trucks, and complete HD vans include HFC-134a, HFC-152a,¹⁵⁵ and CO₂.¹⁵⁶ There are also several blend refrigerants that are listed as acceptable for new HD MVAC systems, subject to use conditions, including the HFC blends SP34E and R-426A (also known as RS-24) and the HCFC blends, R-416A (also known as HCFC Blend Beta or FRIGC FR12), R-406A, R-414A (also known as HCFC Blend Xi or GHG-X4), R-414B (also known as HCFC Blend Omicron), HCFC Blend Delta (also known as Free Zone), Freeze 12, GHG-X5, and HCFC Blend Lambda (also known as GHG-HP). HFC-134a is the refrigerant most widely

used today in HD MVAC systems; however, given the change of status for HFC-134a for LD vehicles, it is likely that the manufacturers of these similar vehicle types will also consider transitioning to another alternative which is listed as acceptable for LD vehicles. All MVAC refrigerants that are acceptable for use are listed as acceptable subject to use conditions. For each listed refrigerant, the use conditions require labeling and the use of unique fittings and are subject to additional use conditions mitigating flammability and toxicity as appropriate to the alternative.

In section VI.B.3 of the proposed rule (81 FR at 22860–65; April 18, 2016), EPA provided information on the environmental and health properties of HFO-1234yf and the available alternative in this end-use in this action. In addition, EPA's risk assessments for

HFO-1234yf and a technical support document¹⁵⁷ that provides the **Federal Register** citations concerning data on the SNAP criteria (e.g., ODP, GWP, VOC, toxicity, flammability) for acceptable alternatives in the relevant end-uses may be found in the docket for this rulemaking (EPA–HQ–OAR–2015–0663). In summary, HFO-1234yf has a GWP of one to four. HFO-1234yf has a GWP similar to or lower than the GWP of other alternatives for the HD vehicle types addressed in this action. For example, its GWP is significantly lower than that of HFC-134a, the refrigerant most widely used in these vehicles today, which has a GWP of 1,430. HFC-152a,¹⁵⁸ and CO₂¹⁵⁹ have GWPs of 124 and one, respectively. The refrigerant blends acceptable for use in MVAC systems for the HD vehicle types addressed in this action have GWPs ranging from 1 to 1,510.

TABLE 16—GWP, ODP, AND VOC STATUS OF HFO-1234yf COMPARED TO OTHER REFRIGERANTS IN MVAC SYSTEMS OF NEWLY MANUFACTURED MDPVs, HD PICKUP TRUCKS, AND COMPLETE HD VANS^{1 2}

Refrigerants	GWP	ODP	VOC status	Listing status
HFO-1234yf	1–4	0	No	Acceptable, subject to use conditions.
CO ₂ , HFC-152a, HFC-134a	1–1,430	0	No	Acceptable.
IKON A, R-416A, R-426A, SP34E	30–1,510	0-Not public ³	Yes ⁴	Acceptable.

¹ The table does not include not-in-kind technologies listed as acceptable for the stated end-use.

² HCFC-22 and several blends containing HCFCs are also listed as acceptable but their use is severely restricted by the phasedown in HCFC production and consumption.

³ The ODP of one or more alternatives is not published here in order to avoid disclosing information that is claimed as confidential business information.

⁴ One or more constituents of the blend are VOC.

HFO-1234yf does not deplete the ozone layer. Likewise, HFC-134a, HFC-152a, CO₂ and the HFC blends SP34E and R-426A do not deplete the ozone layer; the HCFC blends have ODPs ranging from 0.012 to 0.056. HFO-1234yf, HFC-134a, HFC-152a, and CO₂ are exempt from the definition of VOC under CAA regulations (see 40 CFR 51.100(s)) addressing the development of SIPs to attain and maintain the NAAQS. The HFC blends and some of the HCFC blends have one or more components that are VOCs and that are

not exempt from the definition in 40 CFR 51.100(s).

A potential environmental impact of HFO-1234yf is its atmospheric decomposition to trifluoroacetic acid (TFA, CF₃COOH). TFA is a strong acid that may accumulate on soil, on plants, and in aquatic ecosystems over time and that may have the potential to adversely impact plants, animals, and ecosystems.¹⁶⁰ Simulations have found that the amount of TFA in rainfall produced from a transition of all mobile air conditioners in the continental United States to HFO-1234yf has been

estimated to be double or more the values observed in the United States in 2009 from all sources, natural and artificial (*i.e.*, HFC-134a) sources.¹⁶¹ In comparison, the amount of TFA produced from HFO-1234yf is expected to be higher than that of other fluorinated refrigerants in this end-use.

In support of the 2011 listing decision for HFO-1234yf in LD vehicles, EPA analyzed potential TFA concentrations from a full transition to HFO-1234yf in all MVAC applications, not limited to LD vehicles.^{162 163 164 165 166} The analysis

¹⁵⁵ HFC-152a is listed as acceptable, subject to use conditions, for new vehicles only at 40 CFR part 82 subpart G; final rule published June 12, 2008 (73 FR 33304).

¹⁵⁶ CO₂ is listed as acceptable, subject to use conditions, for new vehicles only at 40 CFR part 82 subpart G; final rule published June 6, 2012 (77 FR 33315).

¹⁵⁷ EPA, 2016b. Tables of Alternatives for End-Uses Considered in the Final Rule, Protection of Stratospheric Ozone: Listing Modifications for Certain Substitutes under the Significant New Alternatives Policy Program. September, 2016.

¹⁵⁸ HFC-152a is listed as acceptable, subject to use conditions, for new vehicles only at 40 CFR part 82 subpart G; final rule published June 12, 2008 (73 FR 33304).

¹⁵⁹ CO₂ is listed as acceptable, subject to use conditions, for new vehicles only at 40 CFR part 82 subpart G; final rule published June 6, 2012 (77 FR 33315).

¹⁶⁰ Other fluorinated compounds also decompose into TFA, including HFC-134a.

¹⁶¹ Luecken et al., 2009. Ozone and TFA impacts in North America from degradation of 2, 3, 3, 3-tetrafluoropropene (HFO-1234yf), a potential greenhouse gas replacement. Environmental Science & Technology 2009. The document is accessible at: [http://www.researchgate.net/profile/Robert_Waterland/publication/40481734_Ozone_and_TFA_impacts_in_North_America_from_degradation_of_2333-Tetrafluoropropene_\(HFO-1234yf\)_a_potential_greenhouse_gas_replacement/links/00b7d514ca9595bf5e000000.pdf](http://www.researchgate.net/profile/Robert_Waterland/publication/40481734_Ozone_and_TFA_impacts_in_North_America_from_degradation_of_2333-Tetrafluoropropene_(HFO-1234yf)_a_potential_greenhouse_gas_replacement/links/00b7d514ca9595bf5e000000.pdf).

¹⁶² ICF, 2009a. Revised Final Draft Assessment of the Potential Impacts of HFO-1234yf and the Associated Production of TFA on Aquatic Communities and Local Air Quality.

¹⁶³ ICF, 2010a. Summary of HFO-1234yf Emissions Assumptions.

¹⁶⁴ ICF, 2010b. Summary of Updates to the Venting Model that Impacted HFO-1234yf Emissions Estimates.

¹⁶⁵ ICF, 2010c. Revised Assessment of the Potential Impacts of HFO-1234yf and the Associated Production of TFA on Aquatic Communities, Soil and Plants, and Local Air Quality.

Continued

found a maximum projected concentration of TFA in rainwater of approximately 1,700 ng/L. This maximum projected concentration identified in EPA's analysis, 1700 ng/L,¹⁶⁷ was roughly 34 percent higher than that projected in a 2009 peer reviewed article.¹⁶⁸ The differences in projected TFA concentrations in water is a reflection of EPA's reliance on higher emission estimates.¹⁶⁹ Even when relying on more conservative emission estimates, a concentration of 1700 ng/L corresponds to roughly 1/600th of the No-Observed-Adverse-Effect-Level (NOAEL) for the most sensitive algae species, which is also well below the NOAEL for the most sensitive aquatic animal species.¹⁷⁰

Taking into consideration the analysis conducted in support of the 2011 listing decision, which was based on conservative emissions assumptions and a transition from HFC-134a to HFO-1234yf for all MVAC systems (not limited to LD vehicles), and the research that has been conducted since, EPA concludes that the use of HFO-1234yf in the HD vehicle types addressed in this action will not pose a significant risk to the environment from atmospheric decomposition to TFA.

HFO-1234yf is a flammable refrigerant classified as A2L under ASHRAE 34–2013. HFC-134a and CO₂ are nonflammable refrigerants, while HFC-152a is slightly more flammable than HFO-1234yf with an ASHRAE classification of A2. The blends listed as acceptable are not flammable.

EPA compared worker exposures to a workplace exposure limit of 250 ppm¹⁷¹

over an 8-hour time-weighted average for long-term occupational exposure to HFO-1234yf. For short-term occupational exposure to HFO-1234yf, we compared worker exposure to an acute exposure limit of 98,211 ppm, divided by a margin of exposure of 30, for a value of 3,270 ppm over 30 minutes.^{172 173} Concerning workplace exposure, we expect that professional technicians have proper training and certification and have the proper equipment and knowledge to minimize their risks due to exposure to refrigerant from an MVAC system. Thus, worker exposure to HFO-1234yf is expected to be low. If workers service MVAC systems using certified refrigerant recovery equipment after receiving training and testing, exposure levels to HFO-1234yf are estimated to be on the order of 4 to 8.5 ppm on an 8-hour time-weighted average (as compared with a 250 ppm workplace exposure limit¹⁷⁴)

2008–0664–0041. We used a factor of 1.9 to account for differences in blood concentrations between animals and humans, and a margin of exposure or collective uncertainty factor of 30. Uncertainty factors of 3 were assigned for animal to human extrapolation, and 10 for variability within the human population. The long-term workplace exposure limit was calculated as follows: 4000 ppm (animal exposure) \times 1.9 (ratio of estimated human exposure/animal exposure) \times 1/3 (UF for animal to human extrapolation) \times 1/10 (UF for variability within the human population) exposure = 250 ppm. This value was compared against 8-hour average concentrations. See EPA–HQ–OAR–2008–0664–0036 and EPA–HQ–OAR–2008–0664–0038.

¹⁷² This was based on a NOAEL of 51,690 ppm from the study, “Sub-acute (2-week) Inhalation Toxicity Study with HFO-1234yf in rats,” EPA–HQ–OAR–2008–0664–0020 through-0020.4, a factor of 1.9 to account for differences in blood concentrations between animals and humans and a margin of exposure or collective uncertainty factor of 30. Uncertainty factors of 3 were assigned for animal to human extrapolation, and 10 for variability within the human population. The short-term workplace exposure value was calculated as follows: 51,690 ppm (animal exposure) \times 1.9 (ratio of estimated human exposure/animal exposure) = 98,211 ppm. This value was then divided by the expected exposure in each scenario, and compared against the target margin of exposure of 30. See EPA–HQ–OAR–2008–0664–0036 and EPA–HQ–OAR–2008–0664–0038.

¹⁷³ For comparison, the SAE CRP used exposure limits of 500 ppm over 8 hours and 115,000 ppm over 30 minutes to evaluate risks for these same time periods. These are based on the 8-hr Workplace Environmental Exposure Limit (WEEL) for HFO-1234yf and for short-term exposure, assuming a NOAEL of approximately 405,800 ppm from the study, “Acute (4-hour) inhalation toxicity study with HFO-1234yf in rats.” Note that EPA disagrees with the finding that the acute inhalation toxicity study found a NOAEL. We consider this study to show adverse effects at all levels because of the presence of grey discoloration in the lungs of the test animals. In order to ensure sufficient protection, EPA's risk assessment used a NOAEL from a subacute study instead of a LOAEL from an acute study.

¹⁷⁴ This was based on a NOAEL of 4000 ppm from the study, “An Inhalation Prenatal Developmental Toxicity Study of HFO-1234yf (2,3,3,3-Tetrafluoropropene) in Rabbits,” EPA–HQ–OAR–

and 122 ppm on a 30-minute average (as compared with a short-term exposure level of 98,211 ppm divided by a margin of exposure of 30, for a value of 3270 ppm over 30 minutes^{175 176}).^{177 178} We also analyzed exposure levels during manufacture and final disposition at vehicle end-of-life, and found that they would be no higher than 28 ppm on a 15-minute average or 8.5 ppm on an 8-hour time-weighted average.¹⁷⁹ The manufacture, use, and disposal or recycling of HFO-1234yf MVAC systems are not expected to present a toxicity risk to workers. Other alternatives such as HFC-134a and HFC-152a also do not present a toxicity risk to workers in the same scenarios; therefore, HFO-1234yf

2008–0664–0041. We used a factor of 1.9 to account for differences in blood concentrations between animals and humans, and a margin of exposure or collective uncertainty factor of 30. Uncertainty factors of 3 were assigned for animal to human extrapolation, and 10 for variability within the human population. The long-term workplace exposure limit was calculated as follows: 4000 ppm (animal exposure) \times 1.9 (ratio of estimated human exposure/animal exposure) \times 1/3 (UF for animal to human extrapolation) \times 1/10 (UF for variability within the human population) exposure = 250 ppm. This value was compared against 8-hour average concentrations. See EPA–HQ–OAR–2008–0664–0036 and EPA–HQ–OAR–2008–0664–0038.

¹⁷⁵ This was based on a NOAEL of 51,690 ppm from the study, “Sub-acute (2-week) Inhalation Toxicity Study with HFO-1234yf in rats,” EPA–HQ–OAR–2008–0664–0020 through-0020.4, a factor of 1.9 to account for differences in blood concentrations between animals and humans and a margin of exposure or collective uncertainty factor of 30. Uncertainty factors of 3 were assigned for animal to human extrapolation, and 10 for variability within the human population. The short-term workplace exposure value was calculated as follows: 51,690 ppm (animal exposure) \times 1.9 (ratio of estimated human exposure/animal exposure) = 98,211 ppm. This value was then divided by the expected exposure in each scenario, and compared against the target margin of exposure of 30. See EPA–HQ–OAR–2008–0664–0036 and EPA–HQ–OAR–2008–0664–0038.

¹⁷⁶ For comparison, the SAE CRP used exposure limits of 500 ppm over 8 hours and 115,000 ppm over 30 minutes to evaluate risks for these same time periods. These are based on the 8-hr Workplace Environmental Exposure Limit (WEEL) for HFO-1234yf and for short-term exposure, assuming a NOAEL of approximately 405,800 ppm from the study, “Acute (4-hour) inhalation toxicity study with HFO-1234yf in rats.” Note that EPA disagrees with the finding that the acute inhalation toxicity study found a NOAEL. We consider this study to show adverse effects at all levels because of the presence of grey discoloration in the lungs of the test animals. In order to ensure sufficient protection, EPA's risk assessment used a NOAEL from a subacute study instead of a LOAEL from an acute study.

¹⁷⁷ EPA, 2009b. Risk Assessment: PMN 07–0601. Available at: <http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2008-0664-0036>.

¹⁷⁸ ICF International, 2009b. Risk Screen on Substitutes for CFC–12 in Motor Vehicle Air Conditioning: Substitute: HFO-1234yf. Available online at: <http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2008-0664-0038>.

¹⁷⁹ Ibid.

¹⁶⁶ ICF, 2010d. Sensitivity Analysis CMAQ results on projected maximum TFA rainwater concentrations and maximum 8-hr ozone concentrations.

¹⁶⁷ ICF, 2010d. Sensitivity Analysis CMAQ results on projected maximum TFA rainwater concentrations and maximum 8-hr ozone concentrations.

¹⁶⁸ Luecken et al., 2009. Ozone and TFA impacts in North America from degradation of 2, 3, 3, 3-tetrafluoropropene (HFO-1234yf), a potential greenhouse gas replacement. Environmental Science & Technology 2009. The document is accessible at: [http://www.researchgate.net/profile/Robert_Waterland/publication/40481734_Ozone_and_TFA_impacts_in_North_America_from_degradation_of_2333-Tetrafluoropropene_\(HFO-1234yf\)_a_potential_greenhouse_gas_replacement/links/00b7d514ca9595bf5e000000.pdf](http://www.researchgate.net/profile/Robert_Waterland/publication/40481734_Ozone_and_TFA_impacts_in_North_America_from_degradation_of_2333-Tetrafluoropropene_(HFO-1234yf)_a_potential_greenhouse_gas_replacement/links/00b7d514ca9595bf5e000000.pdf).

¹⁶⁹ ICF, 2010d. Sensitivity Analysis CMAQ results on projected maximum TFA rainwater concentrations and maximum 8-hr ozone concentrations.

¹⁷⁰ ICF, 2009a. Revised Final Draft Assessment of the Potential Impacts of HFO-1234yf and the Associated Production of TFA on Aquatic Communities and Local Air Quality.

¹⁷¹ This was based on a NOAEL of 4000 ppm from the study, “An Inhalation Prenatal Developmental Toxicity Study of HFO-1234yf (2,3,3,3-Tetrafluoropropene) in Rabbits,” EPA–HQ–OAR–

poses the same or less risk than other alternatives.

As explained in section VI.B.3 of the proposed rule (81 FR at 22860–65; April 18, 2016), to evaluate environmental, flammability, and toxicity risks resulting from the use of HFO-1234yf in new MDPVs, HD pickup trucks, and complete HD vans, the Agency relied on EPA's analysis conducted in support of the 2011 listing decision for HFO-1234yf for LD vehicles. EPA was able to rely on the 2011 analysis of HFO-1234yf in LD vehicles in support of this rule because the MVAC systems, vehicle designs, and the potential for exposure for the HD vehicle types for which EPA is listing HFO-1234yf as acceptable, subject to use conditions, in this action are identical or very similar to those of LD vehicles. In addition, we considered risk assessments performed by OEMs and independent consultants on the use of HFO-1234yf in LD vehicles through SAE Cooperative Research Programs (CRPs) and found these were consistent with our analysis. Based on that analysis, at proposal, EPA concluded HFO-1234yf did not pose a significantly greater due to environmental effects, flammability or toxicity than the other alternatives when used in accordance with use conditions established as part of the listing decision. The refrigerants to which HFO-1234yf was compared in the 2011 action for LD vehicles are the same refrigerants available for use in the vehicle types included in this action.

Based on the consideration of all of SNAP criteria, EPA has determined that HFO-1234yf does not pose significantly greater risk than the other alternatives, when used in accordance with use conditions, for use in newly manufactured MDPVs, HD pickup trucks, and complete HD vans. Further information on these analyses and EPA's risk assessments are available in the docket for this rulemaking (EPA–HQ–OAR–2015–0663).

b. What are the final use conditions?

All MVAC refrigerants listed as acceptable are subject to use conditions requiring labeling and the use of unique fittings. EPA is listing HFO-1234yf as acceptable, subject to use conditions, because the use conditions are necessary to ensure that use of HFO-1234yf will not have a significantly greater overall impact on human health and the environment than other alternatives for use in MDPVs, HD pickup trucks, and complete HD vans. EPA is requiring the same use conditions for HFO-1234yf in these HD vehicle types as are required for the use of HFO-1234yf in newly manufactured LD vehicles. Because of the similarities

in the MVAC systems used for these vehicles, these use conditions will ensure use of HFO-1234yf in MDPVs, HD pickup trucks, and complete HD vans does not pose significantly greater risk than use of other alternatives.

The first use condition requires that MVAC systems designed to use HFO-1234yf must meet the requirements of SAE J639, "Safety Standards for Motor Vehicle Refrigerant Vapor Compression Systems." This standard sets safety standards that include unique fittings; a warning label indicating the refrigerant's identity and that it is a flammable refrigerant; and requirements for engineering design strategies that include a high-pressure compressor cutoff switch and pressure relief devices. This use condition also requires that for connections with refrigerant containers for use in professional servicing, use fittings must be consistent with SAE J2844 (revised January 2013), which specifies quick-connect fittings that are different from those for any other refrigerant. The low-side service port and connections will have an outside diameter of 14 mm (0.551 inches) and the high-side service port will have an outside diameter of 17 mm (0.669 inches), both accurate to within 2 mm. Under SAE J2844 (revised January 2013), containers of HFO-1234yf for use in professional servicing of MVAC systems must have a left-handed screw valve with a diameter of 0.5 inches and Acme (trapezoidal) thread with 16 threads per inch. The SAE standards did not include and EPA did not receive a submission for unique fittings for small containers of HFO-1234yf refrigerant prior to the publication of the proposed rule.

Based on EPA's analysis of the safety study and consistent with the conclusion EPA drew at the time of EPA's listing decision for HFO-1234yf in LD vehicles, EPA believes that the safety requirements that are included in SAE J639 sufficiently mitigate risks of both HF generation and refrigerant ignition (*e.g.*, flammability and toxicity) (March 29, 2011; 76 FR 17488) for MDPVs, HD pickup trucks, and complete HD vans subject to this action. HFO-1234yf is mildly flammable (class 2L) and, like other fluorinated refrigerants, can decompose to form the toxic compound HF when exposed to flame or to sufficient heat. For example, SAE J639 provides for a pressure relief device designed to minimize direct impingement of the refrigerant and oil on hot surfaces and for design of the refrigerant circuit and connections to avoid refrigerant entering the passenger cabin. The pressure release device ensures that pressure in the system will

not reach an unsafe level that might cause an uncontrolled leak of refrigerant, such as if the AC system is overcharged. The pressure release device will reduce the likelihood that refrigerant leaks would reach hot surfaces that might lead to either ignition or formation of HF. Designing the refrigerant circuit and connections to avoid refrigerant entering the passenger cabin ensures that if there is a leak, the refrigerant is unlikely to enter the passenger cabin. Keeping refrigerant out of the passenger cabin minimizes the possibility that there would be sufficient levels of refrigerant to reach flammable concentrations or that HF would be formed and transported where passengers might be exposed.

The second use condition requires the manufacturer of MVAC systems and vehicles to conduct Failure Mode and Effects Analysis (FMEA) as provided in SAE J1739 (adopted 2009) and keep records of the FMEA on file for three years from the date of creation. SAE J1739 (adopted 2009) describes a FMEA as "a systematic group of activities intended to: (a) Recognize and evaluate the potential failure of a product/process and the effects and causes of that failure, (b) identify actions that could eliminate or reduce the change of the potential failure occurring, and (c) document the process." Through the FMEA, OEMs determine the appropriate protective strategies necessary to ensure the safe use of HFO-1234yf across their vehicle fleet. It is standard industry practice to perform the FMEA and to keep it on file while the vehicle is in production and for several years afterwards. As with the previous use condition, this use condition is intended to ensure that new MDPVs, HD pickup trucks, and complete HD vans manufactured with HFO-1234yf MVAC systems are specifically designed to minimize release of the refrigerant into the passenger cabin or onto hot surfaces that might result in ignition or in generation of HF.

c. When will the listing apply?

EPA is establishing a listing date as of January 3, 2017. Based on information the Agency possessed at the time of the proposal and additional information submitted during the comment period regarding the technical feasibility of transitioning the fleet of HD vehicles and refrigerant supply, we conclude that this date, the same as the effective date of this regulation, allows for the safe use of this substitute at the earliest opportunity.

3. How is EPA responding to comments?

EPA received comments from organizations with various interests in the MVAC industry on the proposed listing of HFO-1234yf as acceptable, subject to use conditions, in newly manufactured MDPVs, HD pickup trucks, and complete HD vans. All commenters supported the proposed listing decision and effective date of 30 days after date of publication of the rule in the **Federal Register**. However, EIA raised concerns about continued growth of the use of HFO-1234yf as an MVAC refrigerant based on environmental impacts. Some commenters indicated that the industry is already in the process of transitioning to HFO-1234yf in response to EPA's Light-Duty Greenhouse Gas (LD GHG) Rule and policy incentives. One commenter also indicated that production capacity of HFO-1234yf is sufficient to meet the increased demand under this rule. Other comments were in reference to the environmental impacts of the proposed listing of HFO-1234yf, the relationship of the proposed rule with other federal rules, and status changes for R-134a in end uses beyond LD vehicles.

The Alliance of Automobile Manufacturers (AAM), a trade association, submitted comments on behalf of twelve car and light truck manufacturers including BMW Group (BMW), FCA, Ford Motor Company, General Motors Company, Jaguar Land Rover, Mazda, Mercedes-Benz USA, Mitsubishi Motors, Porsche Cars, Toyota, Volkswagen Group and Volvo Cars. EPA also received comments from two chemical producers, Chemours and Honeywell; three environmental organizations, NRDC, IGSD, and EIA; and a state agency, CARB.

We have grouped comments together and responded to the issues raised by the comments in the sections that follow, or in a separate Response to Comments document which is included in the docket for this rule (EPA-HQ-OAR-2015-0663).

a. Substitute and End-Uses Proposed

Comment: AAM, Chemours, Honeywell, NRDC, IGSD, EIA, and CARB supported the listing of HFO-1234yf as acceptable, subject to use conditions, in MDPVs, HD pickup trucks, and complete HD vans. AAM commented that their member companies have been adopting HFO-1234yf for passenger cars and light duty trucks and would like to make use of HFO-1234yf for other vehicle types.

Response: EPA appreciates the support for finding HFO-1234yf as

acceptable, subject to use conditions, as proposed.

Comment: EIA and NRDC commented that EPA should list HFO-1234yf in all types of on-road and off-road vehicles, rather than only in MDPVs, HD pickup trucks, and complete HD vans. To support their argument, the commenters stated that these additional vehicle types are not materially different.

Response: EPA appreciates EIA's suggestions regarding the listing of HFO-1234yf for use in HD vehicle types not covered in this rule and will take them into consideration as the Agency considers any additional listing changes under the SNAP program.

b. SNAP Review Criteria

Comment: AAM and Chemours supported EPA's use of the 2011 analysis of HFO-1234yf in LD vehicles to support the listing of HFO-1234yf in the HD vehicles in this action. AMM commented that it is "appropriate for EPA to have applied the HFO-1234yf risk analysis performed for light duty vehicles to these additional categories of vehicles, which do not pose significantly higher risks." Additionally, Chemours commented that EPA's use of the 2011 analysis was reasonable because the systems evaluated are very similar to light duty systems.

Response: EPA appreciates the support.

Comment: EIA commented on the environmental impacts of the atmospheric decomposition of HFO-1234yf to TFA. EIA commented that the studies EPA relied upon to support the proposed listing of HFO-1234yf "projected maximum rainwater concentrations of TFA from certain emission assumptions, but did not "take into account the much higher potential for high levels of accumulation of TFA in urban surface and landscape waters, particularly those bodies where inflows of water accumulate but have little or no outlet other than evaporation." EIA cited a 2015 Peking University¹⁸⁰ study showing increases in TFA concentrations between 2002 and 2012 in urban landscape waters, other water bodies, and snow samples in the region in and around Beijing. EIA stated that "more research is needed to understand whether continued growth in automobile and HFC consumption and the transition of this sector and others to HFO-1234yf would lead to concentrations of TFA that could pose a significant risk to aquatic ecosystems."

¹⁸⁰ Zhai Z., J. Wu, X. Hu, L. Li, L. Guo, B. Zhang, J. Hu, and J. Zhang: A 17-fold increase of trifluoroacetic acid in landscape waters of Beijing, China during the last decade, *Chemosphere*, 129, 110–117, 2015.

EIA also recommended that EPA conduct similar studies on TFA concentrations in bodies of water (e.g., vernal pools) in the United States, given that they are critical to the life cycle of amphibians, reptiles, insects, and other aquatic animals, and to contact the authors of the Peking University study.

Response: EPA appreciates the additional information provided by EIA on the atmospheric decomposition of HFO-1234yf to TFA. EPA's analysis was based on conservative emissions assumptions and a transition from HFC-134a to HFO-1234yf for all MVAC systems. As mentioned previously, even when relying on these conservative emission estimates, a concentration of 1700 ng/L corresponds to roughly 1/600th of the NOAEL for the most sensitive algae species, which is also well below the NOAEL for the most sensitive aquatic animal species.

Research on TFA has been conducted since the 2011 final rule listing HFO-1234yf as acceptable for LD vehicles and the information shows no greater risk than our earlier analysis. As EPA indicated in their comments, the 2015 study by Zhai et al. reported a 17-fold increase in TFA concentration in landscape waters in Beijing, China, over the period 2002–2012. The authors associated the increase of TFA concentrations with the increased HFC-134a emissions in China (factor of 5.5 from 2005 to 2015) although no model evaluation was conducted. In an earlier combined observation and modeling study in China, only 14 percent of annual total TFA deposition flux was attributable to HFC-134a, with the balance from unknown sources.¹⁸¹ This value is an upper limit because it was obtained using the upper limit of the TFA yield from HFC-134a.¹⁸² Despite the observed 17-fold increase, the TFA concentrations measured by Zhai et al. in surface waters (up to 0.828 $\mu\text{g L}^{-1}$) and in tap water (0.155 $\mu\text{g L}^{-1}$) in 2012 are comparable to TFA concentrations measured in other countries (e.g., 0.012–0.328 $\mu\text{g L}^{-1}$ in rivers, 0.037–0.36 $\mu\text{g L}^{-1}$ in lakes, and 0.016–0.123 $\mu\text{g L}^{-1}$ in drinking water in Switzerland in 1996–1997.¹⁸³ The study by Zhai et al. shows

¹⁸¹ Wu, J., J. Martin, Z. Zhai, K. Lu, L. Li, X. Fang, H. Jin, J. Hu, and J. Zhang. Airborne trifluoroacetic acid and its fraction from the degradation of HFC-134a in Beijing, China. *Environ. Sci. Technol.*, 10.1021/es4050264, 2014.

¹⁸² Wallington, T. J., J. J. Orlando and G. S. Tyndall, O. J. Nielsen: Comment on "Airborne Trifluoroacetic Acid and Its Fraction from the Degradation of HFC-134a in Beijing, China", *Environ. Sci. Technol.*, 48, 9948–9948, DOI: 10.1021/es502485w, 2014.

¹⁸³ Berg, M., S.R. Muller, J. Muhlemann, A. Wiedmer, and R.P. Schwarzenbach: Concentrations and mass fluxes of chloroacetic acids and

that the emissive use of HFC-134a and emissions of unknown anthropogenic TFA precursors¹⁸⁴ have increased TFA concentrations in surface bodies of water. Since HFO-1234yf has a shorter atmospheric lifetime (several days) and higher TFA yield (100%) than HFC-134a, its substitution for HFC-134a is expected to further increase TFA concentrations in precipitation and in bodies of water near large sources.

Additionally, a 2014 study by Kazil, et al. analyzed TFA deposition in the United States assuming 100 percent of all MVAC systems use HFO-1234yf. The results indicated that rainwater TFA concentrations, while varying strongly geographically, will on average be low compared to the levels at which toxic effects are observed in aquatic systems. The UNEP Ozone Secretariat also provided a summary of key information pertaining to TFA based on the 2014 Assessment Reports of the Environmental Effects Assessment Panel (EEAP) and the Scientific Assessment Panel (SAP) of the Montreal Protocol. The brief states, "While it is well established that TFA is a ubiquitous natural component in rivers, lakes, and other surface water bodies, uncertainties remain regarding anthropogenic sources, long-term fate and abundances as these are linked to current and future use and emissions of HFCs, HCFCs, and HFOs. Based on estimates to 2040, increases are predicted to remain relatively low and are therefore not expected to be a significant risk to human health or detrimental to the environment. Projected future increased loadings of TFA to playas, land-locked lakes, and the oceans due to continued use of HCFCs, HFCs, and replacement products such as HFOs are still judged to present negligible risks for aquatic organisms and humans." The UNEP background document also states that TFA and its salts "do not bioconcentrate in aquatic organisms, and do not biomagnify in the food chain. Thus they present negligible risk to organisms higher on the food chain, including humans." See the docket for this rulemaking for additional information on TFA projections in the environment.

c. Relationship With Other Rules

Comment: AAM and Chemours commented that EPA should use incentives similar to the LD GHG Rule

to encourage transition to low-GWP solutions in medium and heavy-duty vehicles. Chemours indicated that automakers in the United States, Canada, Mexico, EU, Japan, and South Korea are deploying HFO-1234yf in a range of models, largely in response to policy incentives including the US light-duty vehicle tailpipe GHG standards and the EU Mobile Air Conditioning Directive. To support their argument, AAM provided comments submitted by the American Automotive Council's (AAC) on EPA's Heavy-Duty Greenhouse Gas (HD GHG) Phase 2 proposed rule and encouraged the Agency to adopt a credit allowance mechanism to "incentivize the quicker adoption of HFO-1234yf and leakage improvements for HD pickup trucks and complete HD vans." AAM stated that "the opportunities for fuel savings and GHG emission reductions on these medium and heavy duty vehicles are even greater, per vehicle, than on light duty vehicles given the larger refrigerant charge sizes, higher fuel consumption engines, longer vehicle lifetimes and greater lifetime VMT in these heavier vehicle categories."

Response: This comment is outside the scope of this rulemaking. We note that as part of the Model Year (MY) 2017–2025 LD GHG rule,¹⁸⁵ EPA established the availability of credits for the use of alternative refrigerants with lower GWPs than that of HFC-134a. In this action, EPA is listing HFO-1234yf as acceptable, subject to use conditions, for MDPVs which are included in the MY 2017–2025 LD GHG rule; therefore, vehicle manufacturers will be able to obtain credits for the use of HFO-1234yf in these vehicles as allowed for in the MY 2017–2025 LD GHG rule. The LD GHG standards do not require any specific means of compliance, so manufacturers have the flexibility to either switch refrigerants or to comply with the standards by other means.¹⁸⁶

d. Status Change for Other Refrigerants

Comment: CARB, Honeywell, NRDC, and IGSD suggested that EPA change the status of HFC-134a and other high-GWP alternatives to unacceptable in MVAC systems for newly manufactured MDPVs, HD pickup trucks, and HD vans. These commenters indicated that HFC-134a is unacceptable for LD vehicles and changing the status of HFC-134a for HD vehicles could result in significant reductions in carbon equivalent emissions. NRDC and IGSD

commented that similar to the listing of HFC-134a as unacceptable for newly manufactured light-duty vehicles beginning in Model Year 2021, EPA should establish a similar status change date for HFC-134a in MDPVs, HD pickup trucks, and complete HD vans to secure additional climate benefit at negligible additional risk. Honeywell commented that if EPA were to change the status of HFC-134a to unacceptable for these HD vehicle types, avoided emissions could be approximately one million MtCO₂eq annually. CARB and Honeywell suggested that EPA should change the status of HFC-134a for these applications and also suggested a change of status date of MY 2021. In support, these commenters claimed it is feasible for the industry can transition to low-GWP alternatives by MY 2021 based on the following: Stakeholder input suggest OEMs need two to three years to evaluate safe and effective implementation of low-GWP alternatives and another two to three years to adopt necessary changes; substitutes exist for mobile air conditioning systems, including HFO-1234yf; international policy is driving global auto manufacturers to transition to alternatives other than HFC-134a by the end of 2016 and U.S. car manufacturing can apply the lessons learned from global manufactures to transition U.S. vehicles to non-HFC-134a alternatives; several U.S. car manufactures are already selling vehicle models that use HFO-1234yf systems; and commercial scale HFO-1234yf production plants are operating and supply will continue to increase.

Response: EPA did not propose to change the status of HFC-134a in MVAC systems for newly manufactured HD vehicles; therefore, the Agency is not establishing a change of status date as part of the final rule. EPA appreciates the comments submitted and will take them into consideration when the Agency considers any additional changes of status under the SNAP program.

Comment: NRDC and IGSD commented that EPA should take steps to ensure that new vehicles designed for HFO-1234yf are not serviced or recharged with HFC-134a. The commenters stated that HFC-134a will remain approved to service existing motor vehicles and, therefore, it is possible to modify new vehicles to recharge with HFC-134a. NRDC and IGSD recommended that EPA enact "stronger, more comprehensive and enforceable rules to discourage and prohibit" the modification of new HFO-1234yf systems with HFC-134a. Specifically, the commenters

trifluoroacetic acid in rain and natural waters in Switzerland. *Environ. Sci. Technol.* 34, 2675–2683, 2000.

¹⁸⁴ Wu, J., J. Martin, Z. Zhai, K. Lu, L. Li, X. Fang, H. Jin, J. Hu, and J. Zhang. Airborne trifluoroacetic acid and its fraction from the degradation of HFC-134a in Beijing, China. *Environ. Sci. Technol.*, 10.1021/es4050264, 2014.

¹⁸⁵ 77 FR 62624, 62807–810 (October 15, 2012); see also 75 FR 25325, 25431–32 (May 7, 2010) (discussing the same issue for MY 2012–2016 light-duty vehicles).

¹⁸⁶ 77 FR 62804–809

recommended that the Agency “classify refrigerant-containing components as part of the emission control system, which would make it illegal to substitute refrigerants or unqualified replacement parts.” They also suggested that EPA require OEMs to apply tamper-proof seals to refrigerant charge ports, similar to the plastic seals used on pharmaceutical products, to identify tampering and alert service technicians, owners, or potential buyers to the possibility that a refrigerant other than HFO-1234yf is in the system.

Response: The SNAP listings for all MVAC refrigerants require the use of unique fittings for each alternative refrigerant. These fittings are found at attachment points on the car itself, on all recovery and recycling equipment, on can taps and other charging equipment, and on all refrigerant containers. The purpose of these fittings is to prevent cross-contamination. Using an adapter or deliberately modifying a fitting to use a different refrigerant is a violation of these use conditions. The commenter did not identify other methods to discourage and prohibit use of HFC-134a in systems designed from HFO-1234yf or how EPA could otherwise strengthen the current conditions that discourage cross-contamination of refrigerants in MVAC. See section VI.B.6.e of the July 2015 final rule for a response to several comments on servicing CFC-12, HFC-134a, and the lower-GWP alternative refrigerant MVAC systems. EPA will consider updating the information on our Web site, as appropriate.

e. Other Suggestions or Requests

Comment: Honeywell recommended that EPA consider listing high-GWP substances as unacceptable for use in refrigerated transport, as early as January 1, 2019, in a future rulemaking. Honeywell stated that two leading manufacturers of mobile refrigeration systems have introduced systems that utilize refrigerants with GWPs below 2,200 and have been selling these systems for more than a year. They also commented that there are commercially available refrigerant options with a GWP of less than 1,500, including R-448A, R-449A, R-134a, R-450A, R-513A and CO₂.

Response: EPA appreciates receiving this information and will consider the comments as it evaluates possible future actions.

Comment: EIA commented that CO₂ is listed as an acceptable substitute in HD vehicles and should also be listed as acceptable in the end-uses covered in this action as well.

Response: EPA notes that CO₂ is currently listed as acceptable, subject to

use conditions, for use in all MVAC applications for new equipment, including newly manufactured MDPVs, HD pickup trucks, and complete HD vans.

Comment: CARB commented that they are aware of Chemours’ SNAP application for the use of HFO-1234yf in various heavy-duty vehicle classifications and encouraged EPA to expedite the review and determination process upon receiving the application.

Response: EPA appreciates the commenter’s suggestion. EPA is reviewing the submission from Chemours regarding the use of HFO-1234yf in other heavy duty vehicle classes.

C. Foam Blowing Agents

1. Change of Listing Status for Certain HFC Foam Blowing Agents for Rigid PU Spray Foam

a. Background

In the NPRM published on August 6, 2014, EPA proposed to change the listings from acceptable to unacceptable for HFC-134a and blends thereof, and the HFC blend Formacel TI for spray foam as of January 1, 2017 (79 FR 46149). After considering the comments received on the proposed rule, EPA deferred taking final action on spray foam in the final rule. See sections V.D.2.a and V.D.3.b of the preamble to the final rule (80 FR 42870; July 20, 2015).

In the past, EPA combined spray foam, commercial refrigeration foam, sandwich panels, and marine flotation foam within a single end-use: Rigid PU commercial refrigeration, spray, and sandwich panels. However, because of differences in the exposure and fire safety characteristics of these uses as well as the fact that different alternatives are generally used for each of these applications, EPA more recently created separate end-use listings for each of these applications. See 80 FR 42870; July 20, 2015. Commercial refrigeration and sandwich panels include insulation for walls, pipes (including “pipe-in-pipe”), metal doors, vending machines, refrigerated and unrefrigerated coolers, refrigerated transport vehicles, and other laboratory and commercial refrigeration equipment, as well as foam for taxidermy. These foams may be injected or applied using “pour-in-place” equipment, depending on the agent used and on whether the formulation is pressurized. Marine flotation foam includes buoyancy or flotation foam used in construction of boats and ships. These foams typically are injected into a cavity in the boat wall from a two-

canister (A- and B-side) system under lower pressures and they provide structure as well as buoyancy. The end-use affected here, rigid PU spray foam, hereafter called “spray foam,” includes insulation for roofing, walls, doors, and other construction uses, as well as foam for building breakers for pipelines. These foams are rigid with closed cells that still contain the foam blowing agent, which can contribute to the foam’s ability to insulate. Spray foam may have similar chemistry to other rigid PU end-uses, but it differs by being sprayed onto a surface in the location where it is to be used, either when constructing a new building or when adding insulation to an existing building, rather than being injected or poured or being produced in a manufacturing facility. As a result, it may be more difficult to provide engineered ventilation during application of spray foam than for other foam end-uses. In addition to federal rules and guidance applying to the application of spray foam, insulation foam used in construction (e.g., high-pressure two-component spray foam) must meet insulation value requirements in state and local building codes.

We have identified three distinct and separate spray foam applications for this end-use: (1) High-pressure two-component, (2) low-pressure two-component, and (3) one-component foam sealants.

High-pressure two-component spray foam products are pressurized 800–1600 psi during manufacture, are sold in pressurized containers as two parts (i.e., A-side and B-side), and are sprayed in the field for thermal insulation and air sealing of buildings and in roofing applications. High-pressure two-component spray foam is blown and applied *in situ* using high-pressure pumps to propel the foam components, and thus, may use liquid blowing agents without an additional propellant. Common liquid foam blowing agents used in high-pressure two-component spray foam include HFC-245fa; blends of HFC-365mfc with at least four percent HFC-245fa; and commercial blends of HFC-365mfc with seven to 13 percent HFC-227ea and the remainder HFC-365mfc. This type of spray foam is applied by professionals who wear personal protective equipment (PPE) while applying high-density foam insulation for roofing or walls. High-pressure two-component spray foam comprises the largest portion of the spray foam market.

Low-pressure two-component spray foam products are pressurized to less than 250 psi during manufacture, are

sold in pressurized containers as two parts (*i.e.*, A-side & B-side), and are also sprayed in the field for thermal insulation and air sealing of buildings. Low-pressure two-component spray foams are typically applied *in situ* relying upon a gaseous foam blowing agent that also serves as a propellant; pumps typically are not needed. This type of spray foam has primarily used the gaseous blowing agent HFC-134a; the Foams Technical Options Committee has also identified CO₂ and water as options. Low-pressure two-component spray foam is usually applied by home improvement

contractors to fill in cracks and gaps in a residence using kits that are available for sale.¹⁸⁷

One-component foam sealants are packaged in aerosol cans and are applied *in situ* using a gaseous foam blowing agent that is also the propellant for the aerosol formulation. This end-use category primarily uses light saturated HCs as the blowing agent, as well as HFCs such as HFC-134a and HFC-152a. This type of spray foam may be used by consumers and by home improvement contractors in order to seal cracks and leaks in a residence, as well as used for pest management.

b. What is EPA's final decision?

EPA proposed to change the status of the following HFCs and HFC blends that have previously been listed as acceptable foam blowing agents for use in spray foam: HFC-134a, HFC-245fa, and blends thereof; blends of HFC-365mfc with at least four percent HFC-245fa; commercial blends of HFC-365mfc with seven to 13 percent HFC-227ea and the remainder HFC-365mfc; and Formacel TI.¹⁸⁸ In this action, we are finalizing the status changes that we proposed with no changes. The change of status determinations for rigid PU spray foam are summarized in Table 17.

TABLE 17—CHANGE OF STATUS DECISIONS FOR FOAM BLOWING AGENTS IN RIGID PU SPRAY FOAM

End-use	Substitutes	Listing status
Rigid PU: Spray foam—high-pressure two-component.	HFC-134a, HFC-245fa, and blends thereof; blends of HFC-365mfc with at least four percent HFC-245fa, and commercial blends of HFC-365mfc with seven to 13 percent HFC-227ea and the remainder HFC-365mfc; and Formacel TI.	Acceptable subject to narrowed use limits for military or space- and aeronautics-related applications* as of January 1, 2020. Unacceptable for all applications other than military or space- and aeronautics-related applications as of January 1, 2020.
Rigid PU: Spray foam—low-pressure two-component.	HFC-134a, HFC-245fa, and blends thereof; blends of HFC-365mfc with at least four percent HFC-245fa, and commercial blends of HFC-365mfc with seven to 13 percent HFC-227ea and the remainder HFC-365mfc; and Formacel TI.	Unacceptable for all uses as of January 1, 2025. Acceptable subject to narrowed use limits for military or space- and aeronautics-related applications* as of January 1, 2021. Unacceptable for all applications other than military or space- and aeronautics-related applications as of January 1, 2021.
Rigid PU: Spray foam—one component foam sealants.	HFC-134a, HFC-245fa, and blends thereof; blends of HFC-365mfc with at least four percent HFC-245fa, and commercial blends of HFC-365mfc with seven to 13 percent HFC-227ea and the remainder HFC-365mfc; and Formacel TI.	Unacceptable for all uses as of January 1, 2025. Unacceptable as of January 1, 2020.

* Under the narrowed use limit, an end user must make reasonable efforts to ascertain that other alternatives are not technically feasible due to performance or safety requirements.

i. How do these unacceptable blowing agents compare to other blowing agents for these end-uses with respect to SNAP criteria?

Over the past ten years, the number of available alternative blowing agents for spray foam has increased. A number of new foam blowing agents with low GWPs, both fluorinated and non-fluorinated, have been introduced during the past several years.

In the proposed rule, EPA provided information on the environmental and health risks presented by the alternatives that are being found unacceptable compared with other available alternatives that are listed as acceptable (81 FR 22869–71; April 18, 2016). In addition, a technical support document¹⁸⁹ that provides the **Federal Register** citations concerning data on the SNAP criteria (*e.g.*, ODP, GWP,

VOC, toxicity, flammability) for acceptable alternatives, as well as those we are finding unacceptable in the relevant end-uses, may be found in the docket for this rulemaking (EPA–HQ–OAR–2015–0663). In summary, the risks other than GWP for the acceptable alternatives are not significantly different from the risks for the alternatives than for the blowing agents we are proposing to list as unacceptable, and the GWPs for the blowing agents we are proposing to list as unacceptable are significantly higher and thus pose significantly greater risk. The HFCs that we are listing as unacceptable for rigid PU spray foam have GWPs ranging from 1,030 for HFC-245fa to 1,430 for HFC-134a. The HFC blends that we are listing as unacceptable have GWPs that vary depending on the specific composition; the range of GWPs for blends is 740 to

1,030 for blends of HFC-365mfc with at least four percent HFC-245fa, 900 to 1,100 for commercial blends of HFC-365mfc with seven to 13 percent HFC-227ea and the remainder HFC-365mfc, and 1,330 to approximately 1,500 for Formacel TI.

Acceptable alternatives for all three spray foam applications include CO₂, water, Exxsol blowing agents, ecomate, HFC-152a, HFO-1234ze(E), and *trans*-1-chloro-3,3,3-trifluoroprop-1-ene. As shown in Table 18, these alternatives have GWPs ranging from zero to 124. In addition, for one-component foam sealants only, light saturated HCs are acceptable, with GWPs in the range of three to 15. For high-pressure two-component spray foam only, HFO-1336mzz(Z) is acceptable, with a GWP of approximately nine. These GWPs are significantly lower than the GWPs of 740 to 1,500 for the HFC and HFC blend

¹⁸⁷ Low-pressure two-component spray foam kits should only be used by trained professionals. The polyurethanes industry has guidance on how to use low pressure kits available at: <http://spraypolyurethane.org/spf-chemical-health-and-safety->

[training and at http://spraypolyurethane.org/Main-Menu-Category/Weatherization-Contractors/Installing-SPF](http://spraypolyurethane.org/Main-Menu-Category/Weatherization-Contractors/Installing-SPF).

¹⁸⁸ We note that neat HFC-365mfc has never been listed as acceptable for use in spray foam.

¹⁸⁹ EPA, 2016b. Tables of Alternatives for End-Uses Considered in the Final Rule, Protection of Stratospheric Ozone: Listing Modifications for Certain Substitutes under the Significant New Alternatives Policy Program. September, 2016.

substitutes subject to the proposed change of status.

TABLE 18—GWP, ODP, AND VOC STATUS OF FOAM BLOWING AGENTS IN RIGID POLYURETHANE HIGH-PRESSURE TWO-COMPONENT SPRAY FOAM, LOW-PRESSURE TWO-COMPONENT SPRAY FOAM, AND RIGID PU ONE-COMPONENT FOAM SEALANTS ^{1 2}

Blowing agents	GWP	ODP	VOC	Listing status
Rigid PU High-Pressure Two-Component Spray Foam				
HFC-134a, HFC-245fa, and blends thereof; blends of HFC-365mfc with at least four percent HFC-245fa, and commercial blends of HFC-365mfc with seven to 13 percent HFC-227ea and the remainder HFC-365 mfc; and Formacel® TI.	740–1,500	0	No	Acceptable, subject to narrow use limits ² or unacceptable.
CO ₂ ; Ecomate; Formic Acid; HFC-152a; HFO-1234ze; <i>trans</i> -1-chloro-3,3,3-trifluoroprop-1-ene (Solstice™ 1233ze(E)) ¹ ; Water.	0–124	0–0.00034	No	Acceptable.
Formic Acid; HFO-1336mzz(Z)	>1–9	0	Yes	Acceptable.
Rigid PU Low-Pressure Two-Component Spray Foam				
HFC-134a, HFC-245fa, and blends thereof; blends of HFC-365mfc with at least four percent HFC-245fa, and commercial blends of HFC-365mfc with seven to 13 percent HFC-227ea and the remainder HFC-365mfc; and Formacel® TI.	740–1,500	0	No	Acceptable, subject to narrow use limits ² or unacceptable.
CO ₂ ; Ecomate; HFC-152a; HFO-1234ze; <i>trans</i> -1-chloro-3,3,3-trifluoroprop-1-ene; Water.	0–124	0–0.00034	No	Acceptable.
Formic Acid; HFO-1336mzz(Z)	>1–9	0	Yes	Acceptable.
Rigid PU One-Component Foam Sealants				
HFC-134a, HFC-245fa, and blends thereof; blends of HFC-365mfc with at least four percent HFC-245fa, and commercial blends of HFC-365mfc with seven to 13 percent HFC-227ea and the remainder HFC-365mfc; and Formacel® TI.	740–1,500	0	No	Unacceptable.
CO ₂ ; Ecomate; HFC-152a; HFO-1234ze; Methyl Formate; <i>trans</i> -1-chloro-3,3,3-trifluoroprop-1-ene; Water.	0–124	0–0.00034	No	Acceptable.
Formic Acid; HFO-1336mzz(Z); Saturated Light HCs C3–C6	>1–9	0	Yes	Acceptable.

¹ The table does not include not-in-kind technologies listed as acceptable for the stated end-uses or additives combined with other acceptable blowing agents.

² For military or space- and aeronautics-related applications.

All of the HFCs and HFC blends we are listing as unacceptable consist of compounds that are non-ozone-depleting. Only one of the alternatives in these three spray foam applications—*trans*-1-chloro-3,3,3-trifluoroprop-1-ene—contains chlorine and has an ODP, which is 0.00024 to 0.00034. Estimates of its maximum potential impact on the ozone layer indicate a statistically insignificant impact, comparable to that of other substitutes in the same end-use that are considered to be non-ozone-depleting.^{190 191}

All of the HFCs and HFC blends we are listing as unacceptable consist of compounds that are excluded from the definition of VOC under CAA regulations (see 40 CFR 51.100(s))

addressing the development of SIPs to attain and maintain the NAAQS. The other alternatives, with the exception of light saturated HCs (for one-component foam sealants only),¹⁹² and HFO-1336mzz(Z) (for high-pressure two-component spray foam only), contain compounds that are not VOC (*i.e.*, water) or are excluded from the definition of VOC under CAA regulations (see 40 CFR 51.100(s)) addressing the development of SIPs to attain and maintain the NAAQS (*e.g.*, CO₂, component of ecomate, HFO-1234ze(E), *trans*-1-chloro-3,3,3-trifluoroprop-1-ene). Based on the small anticipated usage of HCs, and due to existing state regulations under SIPs affecting aerosol products that may include HCs as the blowing agent in one-component foam sealants, we do not expect this alternative to have a significantly greater impact on local air

quality than other available alternatives in these applications. The manufacturer of HFO-1336mzz(Z) has petitioned EPA to exempt HFO-1336mzz(Z) from the definition of VOC under those regulations. As provided in our decisions listing these substitutes as acceptable, we determined that emissions of these alternatives in this end-use would not pose a significantly greater risk than that posed by other available alternatives.

All of the HFCs and HFC blends with specific compositions that we are listing as unacceptable are nonflammable. There has been use of blends of HFC-134a and HFC-152a, composition unspecified, in the past; those blends may be flammable depending on the exact composition. Such blends are unacceptable under this final rule as blends of HFC-134a.

Of the other alternatives, ecomate is the only one that is flammable. The manufacturers of ecomate™ have developed training to teach users of high-pressure two-component spray foam about the flammability hazards of

¹⁹⁰ Wang D., Olsen S., Wuebbles D. 2011. "Preliminary Report: Analyses of tCFP's Potential Impact on Atmospheric Ozone." Department of Atmospheric Sciences, University of Illinois, Urbana, IL. September 26, 2011.

¹⁹¹ Patten and Wuebbles, 2010. "Atmospheric Lifetimes and Ozone Depletion Potentials of *trans*-1-chloro-3,3,3-trichloropropylene and *trans*-1,2-dichloroethylene in a three-dimensional model." *Atmos. Chem. Phys.*, 10, 10867–10874, 2010.

¹⁹² EPA has also listed the hydrocarbon blowing agent brand Exxsol blowing agents as acceptable for all rigid PU spray foam applications. However, the manufacturer of that blowing agent has withdrawn this agent from the market.

these flammable foam blowing agents in this end-use and how to minimize flammability risks.^{193 194} As we determined at the time that we listed ecomate as acceptable, it can be used in these spray foam applications in a manner that ensures it would not pose significantly greater risk than other available substitutes.

Toxicity must be considered and addressed with all of the alternatives in this end-use, with the possible exception of water. Both the HFC substitutes we are listing as unacceptable and the other alternatives have workplace exposure limits, either as regulatory requirements (*i.e.*, OSHA PEL) or as a recommendation (*e.g.*, AIHA WEEL, ACGIH TLV or manufacturer recommended workplace exposure limits). Proper training, use of PPE, and use of ventilation should be adhered to when applying spray foam. As we determined at the time that we listed each of these substitutes as acceptable, they can be used in these spray foam applications consistent with the relevant workplace exposure limits. For further information, see docket EPA-HQ-OAR-2015-0663.

ii. Narrowed Use Limits for Military or Space- and Aeronautics-Related Applications

EPA is establishing a time-limited exception to the unacceptability determination for military or space- and aeronautics-related applications when used in low pressure two-component and high pressure two-component spray foam. Specifically, EPA is finalizing a narrowed use limit that expires on January 1, 2025. As provided in section VI.C.1.b.iii, the vast majority of applications for spray foams are anticipated to be able to transition to acceptable alternatives by January 1, 2020, for high-pressure two-component spray foam and as of January 1, 2021, for low-pressure two-component spray foam. However, for the military, there are several unique performance requirements related to weapon systems that require extensive testing and qualification prior to adoption of alternatives for the currently used foams. The same is true for other specialty applications with unique military requirements such as undersea; aerospace; and chemical, biological, and

radiological warfare systems. In the case of space- and aeronautics-related applications, the challenging operational environment and the lengthy requalification process associated with human-rated space flight systems require a longer transition time than would otherwise apply.

Users of a restricted agent within the narrowed use limits category must make a reasonable effort to ascertain that other substitutes or alternatives are not technically feasible. Users are expected to undertake a thorough technical investigation of alternatives to the otherwise restricted substitute. Although users are not required to report the results of their investigations to EPA, users must document these results, and retain them in their files for the purpose of demonstrating compliance.

Users should include the following documentation to demonstrate compliance with the narrowed use applications. This information includes descriptions of:

- Process or product in which the substitute is needed;
- Substitutes examined and rejected;
- Reason for rejection of other alternatives, *e.g.*, performance, technical or safety standards; and/or
- Anticipated date other substitutes will be available and projected time for switching.

iii. When will the status change?

Except for the narrow use limits addressed above, EPA is changing the listings from acceptable to unacceptable (1) in high-pressure two-component spray foam and in one-component foam sealants as of January 1, 2020, and (2) in low-pressure two-component spray foam as of January 1, 2021. The change of status applies to the following blowing agents: HFC-134a, HFC-245fa, and blends thereof; blends of HFC-365mfc with at least four percent HFC-245fa, and commercial blends of HFC-365mfc with seven to 13 percent HFC-227ea and the remainder HFC-365mfc and Formacel TI. The Agency is aware of several companies that have begun to transition.¹⁹⁵ However, a change of status date of January 1, 2020, is necessary for high-pressure two-component spray foam to allow sufficient opportunity for affected entities to address the technical issues associated with using a different foam blowing agent, including the time

required for reformulation (about one year), and the time required for testing and certification of the final commercial product (one to one and a half years). Part of the process of testing and certification for high-pressure two-component and low-pressure two-component spray foam used for building insulation includes verifying sufficient insulation value to meet building code requirements. Some studies have indicated that CO₂ may provide less insulation value to an insulation foam, pound for pound, than HFCs. Recent information on some of the newer fluorinated foam blowing agents with low GWPs, such as HFO-1234ze(E), HFO-1336mzz(Z), and *trans*-1-chloro-3,3,3-trifluoroprop-1-ene, indicates these foam blowing agents provide comparable or greater insulation value than their HCFC and HFC predecessors. Thus, requirements to meeting building code requirements for insulation value will not impede a transition to alternatives.

To allow sufficient time for manufacturers of low-pressure two-component spray foam kits to complete working through the technical challenges of alternatives, as well as time for existing kits to be distributed, purchased, and used by the end user, we are establishing a change of status date of January 1, 2021. A change of status date of January 1, 2021, is necessary for low-pressure two-component to address the technical issues associated with using a different foam blowing agent. Based on information from several companies developing low-pressure two-component spray foam products, the process of reformulation has been more difficult than for high-pressure two-component spray, because it must have a significantly longer shelf life. The product manufacturer must have time to determine a workable reformulation, a process that is expected to last up to two years. The products then need to be tested, which is expected to take approximately one to one and a half years. This includes testing both the formulation in separate containers (A- and B-side) and ensuring the long-term stability of the final blown foam once the two parts are mixed to blow the foam. Based on those technical hurdles, we are establishing a reasonable but expeditious change of status date of January 1, 2021 for low-pressure two-component spray foam.

For one-component foam sealants, we believe a reasonable time for reformulation is one year and for testing is one to two years. Testing for this application should be shorter than that required for low-pressure two-

¹⁹³ UNEP, 2013. Report of the Technology and Economic Assessment Panel, Volume 2: Decision XXIV/7 Task Force Report, Additional Information on Alternatives to ODS. September, 2013.

¹⁹⁴ FTOC, 2011. Report of the Rigid and Flexible Foams Technical Options Committee, 2010 Assessment. This document is accessible at: http://ozone.unep.org/Assessment_Panels/TEAP/Reports/FTOC/FTOC-2010-Assessment-Report.pdf.

¹⁹⁵ Public and private sector commitments made at the White House Roundtable on October 15, 2015 is available at: <https://www.whitehouse.gov/the-press-office/2015/10/15/fact-sheet-obama-administration-and-private-sector-leaders-announce>.

component spray foam because testing is required only for a final formulation in an aerosol can for one-component foam sealants and because no certification testing would be required for the one-component foam sealant, unlike for high-pressure two-component foam. We are establishing a change of status date of January 1, 2020, after which date, no more one-component foam sealants (cans) may be manufactured using the specified HFC blowing agents; the manufacturer may sell and the end user may continue to use cans that were manufactured prior to January 1, 2020. We limit the applicability of the use prohibition on closed cell foam products (discussed in section VI.C.3), so that it does not apply to closed cell foam products produced through the use of a one-component spray foam manufactured prior to the status change date.

c. How is EPA responding to comments?

EPA received several comments from individuals and organizations with various interests in foam blowing agents and spray foam in particular. Comments were in reference to the descriptions of the applications in the preamble to the proposed rule, the proposed change of status dates, and the narrowed use limits for military and space- and aeronautics uses of certain HFC blowing agents. Most commenters supported the proposed listing decisions, with some opposing or suggesting different change of status dates. Commenters supported the narrowed use exemption for military and space- or aeronautics-related uses. Some commenters suggested a similar narrowed use limit for a polyurethane preformed composites, and suggested either providing a separate listing for this specific use or as including it under the low pressure two-component spray foam application.

Commenters included the American Chemistry Council's Center for the Polyurethanes Industry (CPI) and Spray Foam Coalition (SFC), organizations representing the foam industry; BASF and Dow, two major systems houses; Foam Supplies, Honeywell and Chemours, suppliers of alternative foam blowing agents; Clayton Corporation, a manufacturer of low-pressure two-component spray polyurethane foam kits; Structural Composites and Compsys, manufacturers of a specialized composite foam product for boats and refrigerated trailers; the National Marine Manufacturing Association (NMMA), an organization representing manufacturers of boats; the National Aeronautics and Space Administration (NASA); and

environmental organizations, NRDC and IGSD.

We have grouped comments together and responded to the issues raised by the comments in the sections that follow, or in a separate Response to Comments document which is included in the docket for this rule (EPA-HQ-OAR-2015-0663).

i. Substitutes and End-Uses Proposed

Comment: BASF and Dow supported EPA's distinctions between different types of rigid PU spray foam, including low-pressure two-component spray PU foams, high-pressure two-component spray PU foams, and one-component spray foam. They stated that the distinctions are important because the different applications require different chemistries and result in different challenges for formulators. BASF gave a variety of examples of formulation challenges for specific blowing agents and applications.

Response: EPA appreciates the support for the distinctions between these three applications.

ii. Change of Status Dates

Comment: CPI, SFC, Clayton Corporation, and Dow Chemical Company all stated that EPA should clearly state that the end-use change of status decisions apply to the act of a manufacturer combining the component chemicals (*i.e.*, polyol, blowing agent, catalyst) in their plant to form the polyol resin blends and packaging the blends into a drum, canister, or can that is sold to end users. Clayton Corporation noted that advantages to this approach include greater transparency for enforcement, efficient raw material management by the manufacturers, improved production planning for compliance with the regulatory control, avoidance of "abandoned" inventories in the supply chain, and clarity to the marketplace that resin blends made prior to the change of status dates can still be used without restrictions.

Response: EPA proposed that for high pressure two-component spray foam kits and for low pressure two-component spray foam kits, the change of status date would apply to both the manufacture of the kits and the use of those kits by the end user. For one-component foam, EPA proposed that the change of status date would apply to the manufacture of the one-component foam canisters but that end users could still purchase and use one-component foam canisters manufactured before the change of status date to apply the foam sealant. EPA adopted a different approach for one-component foams

because such products are often manufactured well-before their "use-by" dates; they are manufactured in bulk and marketed to consumers at hardware and other stores where they may have a fairly long shelf-life (up to a year); and are typically purchased by the general public and may be used by the purchaser well after the purchase date. Thus, for the one-component canisters it would be much more difficult to plan for and avoid stranded inventory, which would then need to be disposed of, for this end-use. Moreover, because these products are widely used by the general public and may not be used at or near the time of purchase because of their longer shelf-life, it is significantly more difficult to ensure that users are aware of the regulations and also to ensure compliance by the end user. EPA has taken a similar approach for aerosol products that are largely purchased by individual consumers rather than businesses. See, *e.g.*, 79 FR 46139, August 6, 2014; 80 FR 42884, July 20, 2015. Similar issues apply to low pressure two-component foam kits, such as extended shelf lives. In contrast, high pressure two-component spray foam kits are primarily marketed to businesses; high pressure two-component spray foam kits are frequently formulated on-demand, are typically used much closer to their purchase date, and typically do not have a long shelf-life. In this final rule, the change of status date applies to the manufacture of the one-component foam canisters or low pressure two-part spray foam kit, and end users may still purchase and use one-component foam canisters or low pressure two-part spray foam kits manufactured after the change of status dates.

Comment: Clayton Corporation suggested making the change of status date January 1, 2021, after which low-pressure two-component spray polyurethane foam kits containing HFCs cannot be manufactured. This commenter stated that this change of status date is necessary for low pressure two-component spray foam manufacturers, based on when the HFO stability research and certification listings would be completed. Dow stated that a January 1, 2021 change of status date for low pressure two-component spray foams is a target that will be difficult to achieve. BASF supported EPA's proposed change of status date for low pressure spray foam. Chemours strongly encouraged EPA to establish a change of status date of January 1, 2023 or later for low pressure two-component spray foams. They claimed such date should not be until multiple low-GWP alternatives with appropriate technical

performance qualities become commercially available and they noted that there were stability issues and uncertainties about the only low-GWP alternative currently commercially available. Honeywell expressed concern that if the change of status date is later than January 1, 2019, EPA's action could slow down the momentum that is already supporting adoption of low-GWP alternatives. NRDC and IGSD supported EPA's decision to establish change of status dates of January 1, 2020, for one-component foam sealants and high pressure two-component spray foam and January 1, 2021, for low pressure two-component spray foam.

Response: EPA disagrees with those commenters who claim a status change date later than January 1, 2021, for low pressure two-component spray is necessary. One manufacturer of low pressure two-component spray foam kits has successfully used HFO-1234ze(E) as a blowing agent for at least one of its products, demonstrating that the technical challenges with stability of that HFO are surmountable with sufficient research and development.¹⁹⁶ We also note that there are other commercially available alternatives for this end-use in addition to HFO-1234ze(E); as mentioned in the preamble to the NPRM, the Foams Technical Option Committee has also identified CO₂ and water as options (81 FR 22869), and both are acceptable substitutes. The approximate four-year period before the change of status date will allow sufficient time for manufacturers of low-pressure two-component spray foam kits to complete working through the technical challenges of alternatives, allowing for two years for reformulation and one to one and a half years for testing. Setting a change of status date of January 1, 2019, would not allow sufficient time for identifying, reformulating and testing alternatives for the various product types being manufactured.

Comment: Dow Chemical Company and BASF commented that the proposed change of status date for high pressure two-component spray foam of January 1, 2020, is appropriate. Chemours Company stated that the change of status date for high-pressure two-component spray foam systems should be January 1, 2021, to allow for additional supply of alternatives and to allow foam manufacturers sufficient time for conversion to lower GWP alternatives. Honeywell stated the transition for high pressure two-component spray foam can occur a year earlier, by January 1, 2019, asserting that

this was the quickest and easiest application, taking six to 18 months. NRDC and IGSD supported EPA's decision to ban manufacture of rigid polyurethane spray foams between 2020 and 2021.

Response: To date, a number of foam supply houses and spray foam applicators have successfully used *trans*-1-chloro-3,3,3-trifluoroprop-1-ene as a blowing agent in high pressure two-component spray foam and they have generally had lead times of one to two years to work through the transition. A change of status date approximately three years from now should provide sufficient lead time to transition other products, including both reformulation of products (one-half to one and a half years) and certification testing (one to one and a half years). Another alternative, HFO-1336mzz(Z), is expected to become commercially available in mid-2017; we expect that a change of status date of January 1, 2019, would not provide enough time for both reformulation of products with alternatives and testing. January 1, 2020, will allow more than two years to develop foam blowing formulations using HFO-1336mzz(Z) and test them, and will allow for additional supply of blowing agent. In addition, there are other acceptable alternatives available for this end-use, e.g., ecomate.

Comment: BASF supported the proposed change of status date for one-component spray foam of January 1, 2020.

Response: EPA appreciates the support for the proposed change of status date and we are adopting it in the final rule.

Comment: NAFEM commented that the change of status date for the blowing agent HFC-134a does not provide manufacturers with sufficient time to integrate new blowing agents into their products. The transition away from HFC-134a requires additional capital investments, dedicated research and development resources, employee training, product testing and certification. Therefore, NAFEM requests that HFC-134a be listed as an acceptable alternative for ten years after the rule is finalized, and under no circumstances should the change of status date be earlier than 2022.

Response: NAFEM does not specify the end-use for which it submitted this comment. While the commenter lists actions they claim would be needed in order to transition from HFC-134a to another alternative, they have not provided any detail regarding the time it would take for the various actions. Moreover, as noted in our response to comment above regarding the change of

status date for low pressure two-component spray foam, a manufacturer has successfully transitioned to other alternatives. For one component spray foam, one manufacturer has committed to converting 95 percent of its one component spray foam products from HFCs to HFOs and hydrocarbons by summer 2016 and a second manufacturer has committed to transitioning to use of hydrocarbons as a blowing agent in one to two years from now.¹⁹⁷ HFC-134a is not currently used in high-pressure two-component spray foam systems.

iii. SNAP Review Criteria

Comment: Foam Supplies, Inc., the supplier of the alternative ecomate, supported EPA's proposal to change the listing status of HFC blowing agents in the spray foam applications in the proposed rule from acceptable to unacceptable. The commenter mentioned a number of potential advantages of using ecomate in spray foam, including thermal efficiencies comparable to or better than foam blown with HFCs; ability to use with existing spray foam dispensing equipment; competitive pricing; shipping and handling requirements the same as for HFC foam systems; availability of systems that meet fire resistance and other safety specifications for various industry and building codes; and recent increases in production capacity. Foam Supplies, Inc. described ecomate as an environmentally benign blowing agent (no GWP, no ozone depletion potential and VOC exempt) that is readily available to replace HFC blowing agents in polyurethane spray foam.

Response: We appreciate the support for the proposed rule and for the update about the recent increases in manufacturing capacity of ecomate and other features of this substitute that allow it to be available for use in rigid PU spray foam.

Comment: NAFEM commented that EPA has failed to recognize important complications with the blowing agents that it now proposes as acceptable alternatives. NAFEM member Unified Brands describes such complications in their comments on the August 2014 proposal for a different rule, specifically mentioning the alternatives pentane, water-based blowing agents and methyl formate:

¹⁹⁷ FACT SHEET: Obama Administration and Private-Sector Leaders Announce Ambitious Commitments and Robust Progress to Address Potent Greenhouse Gases. October 15, 2015. Accessible online at: <https://www.whitehouse.gov/the-press-office/2015/10/15/fact-sheet-obama-administration-and-private-sector-leaders-announce>.

¹⁹⁶ Kline et al., 2015.

Pentane based blowing agents are strong candidates due to their insulation performance, but require all foam fixtures and processes to be redeveloped due to the flammable nature of the refrigerant. Water-based blowing agents are environmentally friendly, but suffer from poorer insulation performance and also are more affected by processing temperature which requires improved control of fixture temperatures. Methyl formate is also environmentally friendly, but has had significant shrinkage issues once units have been placed in the field. This agent requires very specific foaming processes to be developed to ensure proper stability of the foam over time. While viable alternatives do exist, the amount of testing and factory/process upgrades required make it impossible to transition to any replacement by January 1, 2017.

Response: We note that these comments submitted by Unified Brands on this action are the same comments it submitted on a different rule, which addressed commercial refrigeration foam. It is difficult to determine how these comments relate to the specific action in this proposal regarding spray foam. As an initial matter, EPA is not taking action listing the mentioned foam blowing alternatives for these three foam blowing applications. We note that

pentane is not currently listed as an acceptable blowing agent for use in two-component spray foams and the concerns raised by the commenter all relate to its use in a refrigerated system and not to spray foam primarily used for building construction. Methyl formate has not been listed as acceptable in the three applications addressed in this rule; the blowing agent ecomate, which contains methyl formate, is listed as acceptable. Water-based blowing agents are listed as acceptable in the three applications addressed in this rule. The concerns raised by the commenter can be taken into consideration by the manufacturer in determining the appropriate alternative to use for any specific foam-blowing kit or canister.

2. Revision to Change of Status Date of Certain HFCS and HFC Blends for Space- and Aeronautics-Related Foam Applications

a. Background

In the July 2015 final rule, EPA established narrowed use limits for certain HFCs and HFC blends for military and space- and aeronautics-related uses in all end-uses except for

rigid PU spray foam, allowing continued use of those blowing agents until January 1, 2022. The specific foam blowing agents and end-uses are codified in appendix U to subpart G of 40 CFR part 82. Based on recent discussions with other government agencies, the most recent U.S. space flight program is still being developed, and it now appears that it may not be possible to qualify all foams needed with alternative foam blowing agents by the January 1, 2022, change of status date established in the July 2015 final rule. The qualification process is necessary to ensure the safety of space vehicles.

b. What is EPA's final decision?

As proposed, EPA is revising the date upon which certain HFCs and HFC blend foam blowing agents for space- and aeronautics-related applications change status from acceptable, subject to narrowed use limits, to unacceptable. EPA is revising the change of status date to January 1, 2025, for space- and aeronautics-related applications. Military uses will continue to have a January 1, 2022, change of status date.

TABLE 19—REVISIONS TO CHANGE OF STATUS DATES FOR FOAM BLOWING AGENTS

End-use	Substitutes	Listing status*
Rigid Polyurethane: Appliance.	HFC-134a, HFC-245fa, HFC-365mfc and blends thereof; Formacel TI, and Formacel Z-6.	Acceptable subject to narrowed use limits for military or space- and aeronautics-related applications* and unacceptable for all other uses as of January 1, 2020. Unacceptable for military uses as of January 1, 2022 and unacceptable for space- and aeronautics-related applications as of January 1, 2025.
Rigid Polyurethane: Commercial Refrigeration and Sandwich Panels.	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; Formacel TI, and Formacel Z-6.	Acceptable subject to narrowed use limits for military or space- and aeronautics-related applications* and unacceptable for all other uses as of January 1, 2020. Unacceptable for military uses as of January 1, 2022 and unacceptable for space- and aeronautics-related applications as of January 1, 2025.
Rigid Polyurethane: Marine Flotation Foam.	HFC-134a, HFC-245fa, HFC-365mfc and blends thereof; Formacel TI, and Formacel Z-6.	Acceptable subject to narrowed use limits for military or space- and aeronautics-related applications* and unacceptable for all other uses as of January 1, 2020. Unacceptable for military uses as of January 1, 2022 and unacceptable for space- and aeronautics-related applications as of January 1, 2025.
Rigid Polyurethane: Slabstock and Other.	HFC-134a, HFC-245fa, HFC-365mfc and blends thereof; Formacel TI, and Formacel Z-6.	Acceptable subject to narrowed use limits for military or space- and aeronautics-related applications* and unacceptable for all other uses as of January 1, 2019. Unacceptable for military uses as of January 1, 2022 and unacceptable for space- and aeronautics-related applications as of January 1, 2025.
Rigid Polyurethane and Polyisocyanurate Laminated Boardstock.	HFC-134a, HFC-245fa, HFC-365mfc and blends thereof.	Acceptable subject to narrowed use limits for military or space- and aeronautics-related applications* and unacceptable for all other uses as of January 1, 2017. Unacceptable for military uses as of January 1, 2022 and unacceptable for space- and aeronautics-related applications as of January 1, 2025.
Flexible Polyurethane	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof.	Acceptable subject to narrowed use limits for military or space- and aeronautics-related applications* and unacceptable for all other uses as of January 1, 2017. Unacceptable for military uses as of January 1, 2022 and unacceptable for space- and aeronautics-related applications as of January 1, 2025.

TABLE 19—REVISIONS TO CHANGE OF STATUS DATES FOR FOAM BLOWING AGENTS—Continued

End-use	Substitutes	Listing status *
Integral Skin Polyurethane ...	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; Formacel TI, and Formacel Z-6.	Acceptable subject to narrowed use limits for military or space- and aeronautics-related applications* and unacceptable for all other uses as of January 1, 2017. Unacceptable for military uses as of January 1, 2022 and unacceptable for space- and aeronautics-related applications as of January 1, 2025.
Polystyrene: Extruded Sheet	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; Formacel TI, and Formacel Z-6.	Acceptable subject to narrowed use limits for military or space- and aeronautics-related applications* and unacceptable for all other uses as of January 1, 2017. Unacceptable for military uses as of January 1, 2022 and unacceptable for space- and aeronautics-related applications as of January 1, 2025.
Polystyrene: Extruded Boardstock and Billet (XPS).	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; Formacel TI, Formacel B, and Formacel Z-6.	Acceptable subject to narrowed use limits for military or space- and aeronautics-related applications* and unacceptable for all other uses as of January 1, 2021. Unacceptable for military uses as of January 1, 2022 and unacceptable for space- and aeronautics-related applications as of January 1, 2025.
Polyolefin	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; Formacel TI, and Formacel Z-6.	Acceptable subject to narrowed use limits for military or space- and aeronautics-related applications* and unacceptable for all other uses as of January 1, 2020. Unacceptable for military uses as of January 1, 2022 and unacceptable for space- and aeronautics-related applications as of January 1, 2025.
Phenolic Insulation Board and Bunstock.	HFC-143a, HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof.	Acceptable subject to narrowed use limits for military or space- and aeronautics-related applications* and unacceptable for all other uses as of January 1, 2017. Unacceptable for military uses as of January 1, 2022 and unacceptable for space- and aeronautics-related applications as of January 1, 2025.

* Under the narrowed use limit, use is limited to military or space- and aeronautics-related applications where reasonable efforts have been made to ascertain that other alternatives are not technically feasible due to performance or safety requirements.

c. How is EPA responding to comment?

EPA received comments from NASA and Boeing, two end-users of foams used in space- and aeronautics uses, addressing the descriptions of the applications in the preamble to the proposed rule, the proposed change of status dates, and the narrowed use limits for military and space- and aeronautics uses of certain HFC blowing agents. Both commenters supported the proposed modification to the change of status date for space and aeronautics.

We have grouped comments together and responded to the issues raised by the comments in the sections that follow, or in a separate Response to Comments document which is included in the docket for this rule (EPA-HQ-OAR-2015-0663).

Comment: NASA and Boeing supported EPA's proposed modification of the date on which the status of acceptable subject to narrowed use limits would change to unacceptable. NASA stated that being able to use HFC-blown foams in space- and aeronautics-related applications through 2024 will help ensure crew safety and vehicle reliability while providing additional time to seek and qualify substitute foams in technologically-challenging applications such as space vehicle

thermal protection and cryoinsulation. Boeing stated that suppliers of foams used in military or aerospace hardware may face significant obstacles meeting a host of performance and safety requirements imposed by Boeing, the military services, NASA or FAA and agreed that testing of blowing agents for these niche markets may require more time than for mass-market commercial items, due to customer and regulatory agency approval requirements.

Response: EPA appreciates the support.

3. Change of Listing Status for Methylene Chloride in Foams

a. Background

Methylene chloride, also known as dichloromethane, has the chemical formula CH_2Cl_2 and the CAS Reg. No. 75-09-2. EPA initially listed this substitute as acceptable for flexible PU foam in the initial SNAP rule (79 FR 13044; March 18, 1994). In the April 18, 2016, proposed rule, EPA proposed to change the listing status of methylene chloride from acceptable to unacceptable in flexible PU foam, integral skin PU foam, and polyolefin foam. Flexible PU includes foam in furniture, bedding, chair cushions, and shoe soles. Integral skin PU includes car

steering wheels, dashboards, and shoe soles. Polyolefin includes foam sheets and tubes.

Since EPA's initial listing decision for methylene chloride in flexible PU foam, the Agency has separately issued a residual risk standard under section 112 of the CAA for flexible PU foam production. (*National Emission Standards for Hazardous Air Pollutants Residual Risk and Technology Review for Flexible Polyurethane Foam Production*, (79 FR 48073; August 15, 2014). In that regulation, EPA examined the risk posed by emissions from source regulated under a maximum achievable technology (MACT) standard for flexible polyurethane foam manufacturing. EPA determined that it was necessary to tighten the MACT standard to reduce the level of risk posed by emissions of methylene chloride from the regulated sources. In the residual risk standard, EPA prohibited the use of methylene chloride as an auxiliary blowing agent in flexible PU slabstock foam production operations at major sources. Relying on the risk analysis performed for the MACT risk review, EPA proposed to change the status of methylene chloride from acceptable to unacceptable in flexible PU foam. In addition, because methylene chloride is

the only blowing agent in the integral skin PU foam and polyolefin foam end-uses that is carcinogenic, EPA proposed that it posed greater overall risk to human health and the environment and proposed to change the status of	methylene chloride from acceptable to unacceptable in those end-uses. b. What is EPA's final decision? As provided in Table 20, EPA is changing the status of methylene	chloride from acceptable to unacceptable when used as a blowing agent in the production of flexible PU foam. At this time, we are not finalizing a change of status for integral skin PU foam and polyolefin foam.
---	---	--

TABLE 20—CHANGE OF STATUS DECISIONS FOR FLEXIBLE PU, INTEGRAL SKIN PU, AND POLYOLEFIN FOAM BLOWING AGENTS

End-use	Substitute	Listing status
Flexible PU	Methylene chloride	Unacceptable as of 30 days after date of publication of a final rule.
Integral Skin PU	Methylene chloride	Acceptable.
Polyolefin	Methylene chloride	Acceptable.

EPA initially proposed to change the listing status of methylene chloride from acceptable to unacceptable in flexible PU foam in order to be consistent with the revisions to the MACT that prohibited the use of HAP in slabstock flexible PU foam production operations at major sources. EPA is relying on the risk analysis performed as part of the risk review for the MACT, and which served as the basis for its decision to revise the MACT, to support its determination in this rule that the toxicity risk from methylene chloride in this end-use is significant and that there are other alternatives that pose an overall lower risk based on our analysis under the SNAP review criteria. See 81 FR at 22876, April 18, 2016. As a policy matter, the Agency considers it inappropriate to continue to list as acceptable a substitute that is prohibited in this end-use under other environmental regulations. At best, continuing to list a prohibited substance as acceptable is misleading to the public as to whether the substitute is available and may be used; it also may lead to a misallocation of resources if there are any users of HFCs in this end-use that are transitioning away by January 1, 2017, as required under appendix U to 40 CFR part 82 subpart G.

For integral skin PU and polyolefin foams, we also proposed to change the listing status of methylene chloride from

acceptable to unacceptable on the basis that methylene chloride poses significantly greater risks than the other alternatives available for this end-use because it is the only acceptable alternative in these end-uses that is a carcinogen and thus poses a significantly greater toxicity risk. Based on public comments urging EPA to do additional risk assessment before reaching such a conclusion for these two end-uses that are not subject to the MACT standard and were not part of the risk review of the MACT standard, we are not finalizing a change of status for methylene chloride in integral skin PU and polyolefin foams in this action.

i. How does methylene chloride compare to other blowing agents for the flexible PU end-use with respect to SNAP criteria?

In the proposed rule, EPA provided information on environmental and health risks of methylene chloride and other available alternatives (81 FR 22875–76; April 18, 2016). In addition, a technical support document¹⁹⁸ that provides the **Federal Register** citations concerning data on the SNAP criteria (e.g., ODP, GWP, VOC, toxicity, flammability) for methylene chloride and for these other, acceptable alternatives may be found in the docket for this rulemaking (EPA–HQ–OAR–2015–0663).

Methylene chloride contains chlorine and thus could have an ODP. We are unaware of a calculated ODP for methylene chloride in the peer-reviewed literature, but it has historically been considered negligibly small.¹⁹⁹ Recent research indicates that emissions of methylene chloride from multiple industrial sources have been increasing and could have a detectable impact on the ozone layer,²⁰⁰ despite the historical assumption of negligible ODP. For flexible PU, available substitutes include acetone, CO₂, ecomate™, HFC-152a, HFO-1336mzz(Z), methylal, saturated light HCs (C3–C6),²⁰¹ *trans*-1-chloro-3,3,3-trifluoroprop-1-ene, and water. Of the other available alternatives for flexible PU, only *trans*-1-chloro-3,3,3-trifluoroprop-1ene contains chlorine has an ODP, which is 0.00024 to 0.00034. Estimates of its maximum potential impact on the ozone layer indicate a statistically insignificant impact, comparable to that of other substitutes in the same end-use that are considered to be non-ozone-depleting.^{202 203}

Methylene chloride has a GWP of approximately nine. As shown in Table 21, other acceptable alternatives have GWPs that are comparable or lower than methylene chloride's GWP of nine except for HFC-152a, which has a GWP of 124.

¹⁹⁸ EPA, 2016b. Tables of Alternatives for End-Uses Considered in the Final Rule, Protection of Stratospheric Ozone: Listing Modifications for Certain Substitutes under the Significant New Alternatives Policy Program. September, 2016.
¹⁹⁹ INCHEM, 1996. International Programme on Chemical Safety. Environmental Health Criteria 164. Methylene chloride, second edition. World Health Organization, 1996. This document is accessible online at <http://www.inchem.org/documents/ehc/ehc/ehc164.htm>.
²⁰⁰ Hossaini, et al., 2015. R. Hossaini, M. P. Chipperfield, S. A. Montzka, A. Rap, S. Dhomse, W.

Feng. Efficiency of short-lived halogens at influencing climate through depletion of stratospheric ozone. *Nature Geoscience*, 2015. This document is accessible online at <http://DOI:10.1038/ngeo2363> and is reported in “New ozone-destroying gases on the rise; not controlled by treaty.” ScienceDaily. 16 February 2015. This document is accessible online at <http://www.sciencedaily.com/releases/2015/02/150216130241.htm>.
²⁰¹ EPA has also listed the hydrocarbon blowing agent brand Exxsol blowing agents as acceptable for flexible PU foam. However, the manufacturer of that

blowing agent has withdrawn this agent from the market.
²⁰² Wang D., Olsen S., Wuebbles D. 2011. “Preliminary Report: Analyses of tCFCP’s Potential Impact on Atmospheric Ozone.” Department of Atmospheric Sciences. University of Illinois, Urbana, IL. September 26, 2011.
²⁰³ Patten and Wuebbles, 2010. “Atmospheric Lifetimes and Ozone Depletion Potentials of *trans*-1-chloro-3,3,3-trichloropropylene and *trans*-1,2-dichloroethylene in a three-dimensional model.” *Atmos. Chem. Phys.*, 10, 10867–10874, 2010.

TABLE 21—GWP, ODP, AND VOC STATUS OF METHYLENE CHLORIDE COMPARED TO OTHER FOAM BLOWING AGENTS IN FLEXIBLE PU FOAMS¹

Blowing agents	GWP	ODP	VOC	Listing status
Methylene Chloride	9	unknown	No	Unacceptable.
Acetone; CO ₂ Ecomate; HFC-152a; Methylal; <i>trans</i> -1-chloro-3,3,3-trifluoroprop-1-ene; Water.	0–124	0–0.00034	No	Acceptable.
AB Technology; HFO-1336mzz(Z); Methylal; Saturated Light HCs C3–C6 ¹	>1–9	0	Yes	Acceptable.

¹ The table does not include not-in-kind technologies listed as acceptable for the stated end-uses or additives combined with other acceptable blowing agents.

Methylene chloride does not meet the definition of VOC under CAA regulations (see 40 CFR 51.100(s)) and is excluded from that definition for the purpose of developing SIPs to attain and maintain the NAAQS. With the exception of HCs, HFO-1336mzz(Z), and methylal, the other alternatives also contain compounds that are excluded from the definition of VOC. The manufacturer of HFO-1336mzz(Z) has petitioned EPA to exclude HFO-1336mzz(Z) from the definition of VOC under those regulations. As provided in our decisions listing these substitutes as acceptable, we determined that emissions of these alternatives in this end-use would not pose a significantly greater risk than that posed by other available alternatives.

Methylene chloride exhibits no flash point under standard testing conditions and thus is considered nonflammable, although it does exhibit lower and upper flammability limits of 13 percent and 23 percent, respectively. Of the various alternatives, ecomate, HFC-152a, HCs, and methylal are flammable, and the others are nonflammable. The flammability hazards of the flammable compounds in this end-use can be adequately addressed in the process of meeting OSHA regulations and fire codes.

Health effects of concern with methylene chloride include cancer, liver, and kidney effects (longer-term exposure) and neurotoxic effects (acute exposure), in addition to irritation to the skin, eyes, and respiratory tract. Other alternatives for this end-use have potential health effects such as impacts on body weight, mononuclear infiltration of heart tissue, neurotoxic effects, and irritation to the skin, eyes, and respiratory tract; no other alternatives in this end-use have evidence of cancer as a health effect. Toxicity is not a significant concern in the workplace for methylene chloride or for the other available alternatives because they may be used for blowing flexible PU foam consistent with required or recommended workplace exposure limits. In the initial SNAP rulemaking, EPA listed methylene

chloride as acceptable in this end-use, citing the presence of the OSHA regulations as sufficient to address workplace risk.

Information regarding general population risk indicated the highest cancer risk for methylene chloride of all the alternatives for this end-use and provided no summary information on non-cancer risks for methylene chloride. Since that time, as part of the CAA section 112 HAP program, EPA performed a risk analysis for the flexible polyurethane foam production source category to determine the risk from emissions of hazardous air pollutants, primarily methylene chloride. Based on that risk analysis, EPA determined that although methylene chloride emissions did not pose an unacceptable health risk within the meaning of section 112(f) for the general population, there was a both a cancer and a non-cancer health risk that could be reduced at low cost. Specifically, EPA determined to ban the use of HAP blowing agents containing methylene chloride in order to protect public health with an ample margin of safety. 79 FR 48073; August 15, 2014. None of the other alternative blowing agents are regulated as hazardous air pollutants under the CAA. Based on the analysis and the conclusions from the section 112 HAP program analysis and in light of the toxicity information for other available substitutes, EPA has determined that methylene chloride poses significantly greater risk than other available substitutes in this end use. We note that we are not aware of any use of this blowing agent in this end-use and no commenters indicated that it was currently being used in this end-use.

ii. When will the status change?

The status of methylene chloride in flexible PU foam is changing to unacceptable as of 30 days after this final rule is published in the **Federal Register**, January 3, 2017. This blowing agent has already been prohibited in flexible PU foam manufacturing operations for major sources by EPA's *National Emission Standards for Hazardous Air Pollutants (NESHAP)*

Residual Risk and Technology Review for Flexible Polyurethane Foam Production (79 FR 48073; August 15, 2014). Moreover, we received no comments indicating current use of methylene chloride in this end-use. Thus, we expect that the industry has already transitioned away from this substitute in that end-use.

c. How is EPA responding to comments?

EPA received comments from the Halogenated Solvents Industry Alliance (HSIA), a trade group representing the chlorinated solvents industry. Comments were in reference to EPA's authority generally for the changing the status of a substitute (responded to in section VII.B in this document) and the significance of the risk of methylene chloride. HSIA opposed EPA's proposed changes of status for methylene chloride in three foam end-uses.

We have grouped comments together and responded to the issues raised by the comments in the sections that follow, or in a separate Response to Comments document which is included in the docket for this rule (EPA-HQ-OAR-2015-0663).

i. SNAP Review Criteria

Comment: HSIA commented that changing the listing status of methylene chloride on the basis that it is an animal carcinogen is incompatible with the SNAP program principles and with all previous EPA regulation of toxic air contaminants. The commenter stated that under all relevant federal programs, before an agency can regulate on the basis of carcinogenicity, it must make a finding that the substance poses a significant risk that can be eliminated by the restriction.

Response: We disagree that this action is inconsistent with the SNAP program principles. Under section 612 of the Act, EPA is required to list a substitute as unacceptable where there are other "available" alternatives that pose less overall "risk to human health and the environment." Under sections 612 of the Act, it is not necessary to eliminate or have zero risk in order to regulate; rather risk is assessed based on

comparison to other alternatives and an alternative must be listed as unacceptable if there are other alternatives that “reduce the overall risk.” The SNAP principles reflect this statutory mandate. However, by prohibiting the use of methylene chloride in flexible polyurethane under this rule, we are eliminating the identified toxicity risk posed by that substitute in this end-use where other alternatives do not pose such a risk and where other risks are similar for both methylene chloride and other available substitutes. As to the commenter’s statement that Concerning the commenter’s statement referring to methylene chloride as an animal carcinogen, we note that the Agency considers methylene chloride “likely to be carcinogenic in humans,” based predominantly on evidence of carcinogenicity at two sites in two-year bioassays on mice, as per U.S. EPA (2005a) *Guidelines for Carcinogen Risk Assessment*.²⁰⁴ To the extent the commenter raises issues with EPA’s authority under other CAA programs, those programs are not at issue in this rulemaking.

Comment: HSIA stated that in 1994, EPA concluded after conducting risk screens that methylene chloride emissions from foam blowing in compliance with existing regulatory standards were within the range of acceptable carcinogenic risk. The instant proposal cites no piece of hazard, exposure, or risk information that has come to light over the past 22 years to change that assessment.

Response: We disagree that there has been no new assessment of the risk from methylene chloride for this end-use in the past 22 years. As noted, EPA recently performed a risk review for the flexible polyurethane foam production source category in which EPA evaluated the risk that remained from emissions from sources in this source category after promulgation of the MACT standard. Based on that analysis and to address risk, EPA concluded that it should tighten the MACT standard by banning the use of methylene chloride and six other HAP foam blowing agents. That same risk analysis supports EPA’s action here.

Comment: HSIA commented that EPA failed to account for other factors that may present a greater risk to human health besides carcinogenicity, such as

flammability, contribution to smog formation, and GWP.

Response: We disagree that we did not evaluate and consider the other SNAP review criteria in making our decision. Those criteria were discussed in detail at 81 FR at 22875–8– in the proposed rule and are also discussed above. As noted above, EPA determined that the risk based on the other criteria was not significantly different.

Comment: HSIA commented that, while Table 21 characterizes the ODP of methylene chloride as unknown, EPA has on numerous occasions determined that methylene chloride is “non-ozone-depleting.”

Response: As discussed in the preamble to the proposal, more recent data indicate that methylene chloride may have a measurable impact on the stratosphere. In addition, more recent studies using 3-dimensional atmospheric modeling have indicated that another halogenated HC, *trans*-1,2-dichloroethylene, which has two chlorine atoms like methylene chloride, has a small but measurable ODP of approximately 0.00024 and an atmospheric lifetime of 12.7 days.²⁰⁵ EPA has determined that the difference in ODP for the various alternatives in this end-use, including methylene chloride, is not significant and does not have a bearing on the change of status decision.

Comment: HSIA commented that EPA’s proposal ignored the distinction between hazard and risk, and thereby overturns several decades of EPA and other federal policy regarding the regulation of potential carcinogens and other toxic materials.

Response: For flexible PU foam, we are removing the acceptable listing for a substitute in order to be consistent with other federal regulations that now prohibit use of this substitute in this end-use based upon a risk assessment performed for the MACT standard. That risk assessment did consider risk and not just hazard (*i.e.*, the probability of an adverse health effect, and not just the potential adverse health effects that could occur, depending on exposure). We agree with the commenter that the proposal did not quantitatively analyze carcinogenic risk for the integral skin PU and polyolefin end-uses. Therefore, we are not finalizing our proposal to change the listing status of methylene chloride from acceptable to unacceptable in integral skin PU and polyolefin foams.

Comment: HSIA commented that hazardous air pollutants under CAA section 112, such as methylene chloride, are not addressed by the Montreal Protocol or Title VI, and that EPA lacks statutory authority to regulate toxic air contaminants under CAA section 612.

Response: EPA disagrees that the Agency lacks authority to regulate hazardous air pollutants under section 612 and the commenter fails to cite to any provision that would prohibit such regulation. Under section 612, EPA is required to review alternatives for ozone depleting substitutes and to list as unacceptable those that pose greater risk to human health or the environment than other available substitutes. There is nothing in section 612 that states or even suggests that EPA is to review only those substitutes that are not hazardous air pollutants and any definition of risk would include the types of risks posed by hazardous air pollutants, such as cancer risk, neurotoxicity, and reproductive toxicity. We note that EPA first listed methylene chloride as a substitute for ODS under section 612 in 1994 and the issue of EPA’s authority to do so was not raised at that time, nor has it been raised in the intervening years.

ii. Relationship to Other Rules

Comment: HSIA commented that the proposed change of status for methylene chloride is based in part on a NESHAP finding, which is based entirely on the CAA § 112(f)(2) requirement that EPA adopt “residual risk” standards that “provide an ample margin of safety to protect public health in accordance with [§ 112]. HSIA argued that the SNAP rule is not based on, nor should be based on, an “ample margin of safety.” This commenter also stated that the only relevant part of the NESHAP finding to the SNAP decision is that the residual risks to public health of seven environmental hazardous air pollutants, including methylene chloride, was found to be acceptable.

Response: EPA recognizes that the residual risk review of the MACT standard found the residual risks to public health of methylene and six other hazardous air pollutants from flexible polyurethane production facilities to be “acceptable.” Under section 112 of the CAA, where a risk is unacceptable, EPA is required to regulate emissions without consideration of cost. A determination that the risk is acceptable, however, is not a determination that there is no risk. EPA is also required to then determine whether the existing standards “provide an ample margin of safety to protect public health” or to protect against “an

²⁰⁴ Dichloromethane; CASRN 75–09–2 Integrated Risk Assessment System Chemical Summary Document. U.S. EPA, National Center for Environmental Assessment. Accessible online at https://cfpub.epa.gov/ncea/iris/iris_documents/documents/subst/0070_summary.pdf.

²⁰⁵ Patten and Wuebbles, 2010. “Atmospheric Lifetimes and Ozone Depletion Potentials of *trans*-1-chloro-3,3,3-trichloropropylene and *trans*-1,2-dichloroethylene in a three-dimensional model.” *Atmos. Chem. Phys.*, 10, 10867–10874, 2010.

adverse environmental effect.” EPA determined that it was necessary to ban the use of methylene chloride based foam blowing agents to protect public health with an ample margin of safety. For purposes of the SNAP review of toxicity risks, EPA relied on that risk analysis, which demonstrated a risk from use of methylene chloride based foam blowing agents. As explained more fully above, EPA determined that the overall risk posed by methylene chloride, based on the risk from toxicity, was more significant than the risk posed by other available alternatives for this end use.

4. Closed Cell Foam Products

a. Background

i. What are the affected end-uses?

The foam sector includes both closed cell and open cell foams. Closed cell foams are specifically designed to retain the foam blowing agent in the cells; in insulation foam products, the foam blowing agent continues to perform a function in providing thermal insulation, once the foam has already been blown. With open cell foams, the foam blowing agent completes its function once the foam is blown; almost all of the foam blowing agent escapes from the open cells prior to import, and any vestigial amounts remaining do not perform a function.

Foam blowing end-uses that contain closed-cell foams include rigid PU spray foam (all three applications described in section VI.C.1); rigid PU commercial refrigeration and sandwich panels; rigid PU marine flotation foam; rigid PU appliance foam; rigid PU slabstock and other; rigid PU and polyisocyanurate laminated boardstock; polystyrene: extruded boardstock and billet; polystyrene: extruded sheet; polyolefin; and phenolic insulation board and bunstock. Foam blowing end-uses containing open cell foams include flexible PU and integral skin PU. Open cell phenolic, and some other open cell foams also exist within the SNAP foam blowing end-uses that include closed cell foams. Integral skin foam may include a rigid surface with an interior flexible core.

ii. How do other stratospheric ozone protection requirements apply to foam products?

Several provisions of CAA Title VI and EPA’s implementing regulations are relevant to HCFC foam products. Under regulations implementing CAA section 611, EPA requires labeling of products that contain an ODS and those that are manufactured with an ODS. EPA determined that open cell foams blown

with an ODS must be labeled as a product manufactured with an ODS. (58 FR 8136, 8143–8150, February 11, 1993; 79 FR 64253, 64258–64259, October 28, 2014). In contrast, closed cell foam products blown with an ODS must be labeled as a product *containing* an ODS for labeling purposes. (58 FR 8136, 8150–8151, February 11, 1993; 79 FR 64253, 64258–64259, October 28, 2014). As of January 1, 2015, any product containing a closed cell foam blown with an HCFC must be labeled as a product containing an ozone-depleting substance under the regulations at 40 CFR 82.106 implementing CAA section 611.

Section 610 restricts sale and distribution and offers of sale and distribution of certain products containing or manufactured with CFCs and HCFCs.²⁰⁶ Section 610(d)(3)(A) explicitly provides an exception for foam insulation products containing HCFCs. EPA has implemented this restriction and the exception for HCFC foam insulation products through its Nonessential Products Ban regulations codified at 40 CFR part 82 subpart C.

CAA section 605(a) prohibits the introduction into interstate commerce or use of any class II substance effective January 1, 2015, unless such substance—

(1) has been used, recovered, and recycled;

(2) is used and entirely consumed (except for trace quantities) in the production of other chemicals;

(3) is used as a refrigerant in appliances manufactured prior to January 1, 2020; or

(4) is listed as acceptable for use as a fire suppression agent for nonresidential applications in accordance with section 612(c).

The section 605(a) implementing regulations codified at 40 CFR part 82, subpart A restrict the use of virgin HCFCs to air conditioning, refrigeration, and fire suppression applications, with minor exceptions. Thus, while the Nonessential Products Ban does not apply to HCFC insulating foams, section 605(a) and its implementing regulations prohibit the use of HCFCs for blowing foam in the United States. The combined effect of the Nonessential Products Ban and the section 605(a) implementing regulations is that HCFC foam insulation products may be imported, sold, and distributed in the United States but cannot be manufactured in the United States.

In the preamble to a July 11, 2000, SNAP proposed rule, EPA reviewed its

²⁰⁶ Section 610 does not address products containing or manufactured with substitutes.

authority under CAA section 610 and noted that HCFC insulating foams were exempt from regulation under that section of the statute. EPA stated that “Title VI of the Act thus does not provide EPA with the authority to prevent imports of products containing those foams” (65 FR 42653, 42656). EPA did not, however, base this statement on a full examination of the various authorities under Title VI. In taking final action on that proposal, EPA noted that while under section 610 it could not ban the *sale* of HCFC foam insulation products, section 610 “does not address EPA’s ability to regulate the transition from use of ODS to alternatives in the manufacturing of products such as foam.” EPA further noted: “Section 612 can restrict the use of a substitute in a product regardless of whether or not that product is considered nonessential under Section 610” (69 FR 58275, September 30, 2004).

b. What is EPA’s final decision?

As proposed, EPA is applying the unacceptability determinations in this action for foam blowing agents to closed cell foam products and products containing closed cell foam. In addition, EPA is applying all listings for foam blowing agents codified in the appendices to 40 CFR part 82 subpart G to such products. Use of closed cell foam products (e.g., manufactured rigid PU insulation or XPS boardstock) or products that contain closed cell foam (e.g., household and commercial appliances, boats) manufactured with an unacceptable foam blowing agent on or after the specified date is subject to the use prohibitions under SNAP. This includes, but is not limited to, incorporating a closed cell foam blown with an unacceptable blowing agent into a subsequent product and installing a closed cell foam product or product containing closed cell foam. Foam products or products containing foam manufactured prior to the specified date are not subject to the use prohibition whether manufactured in the United States or abroad.

i. How is EPA interpreting “use” of foam blowing agents in closed cells foams?

Section 612 requires EPA to promulgate regulations prohibiting the replacement of ODS with certain substitutes and to publish lists of the substitutes prohibited for specific uses as well as those found acceptable for those uses. EPA’s implementing regulations at 40 CFR 82.174 state, in part: “No person may use a substitute after the effective date of any

rulemaking adding such substitute to the list of unacceptable substitutes” (40 CFR 82.174(d)). The SNAP regulations define “use” of a substitute as including, but not being limited to, “use in a manufacturing process or product, in consumption by the end-user, or in intermediate uses, such as formulation or packaging for other subsequent uses.” (§ 82.172)

With respect to other sectors, EPA has treated use of a product manufactured with or containing a substance as constituting use of the substance where the product holds some amount of the substance, the substance continues to perform its intended function, and the substance is likely to be emitted in the United States either during use of the product or at the time of its disposal. For example, an aerosol can is manufactured to contain a substance as a propellant, and then that propellant leaks, is released by the end user during use of the aerosol can’s contents, or is emitted at the time of disposal if it has not already been used up. In the July 2015 rule, in changing the status of certain substances with respect to aerosols, EPA prohibited use of aerosol products containing those substances, while stating that products manufactured prior to the change of status date could still be used after that date (80 FR 42883). By analogy, we are now interpreting “use” of a foam blowing agent to include use of a closed cell foam product manufactured after the specified date. For such products, the foam blowing agent remains in the cells and continues to be used for the purpose of insulation during the lifetime of the product. Furthermore, emissions of the foam blowing agent occur at the time of disposal of the closed cell foam product. Thus, emissions from a closed cell product used in the United States can be expected to occur in the United States regardless of whether the product was manufactured domestically or abroad. This action ensures that products manufactured abroad and subsequently imported will be treated the same as products manufactured domestically. However, as noted above in section VI.C.1, the use prohibition does not apply to use of rigid PU one-component foam sealant cans or low pressure two-component spray foam kits that are manufactured prior to the change of status dates for those applications.

EPA is not treating use of an open cell foam product as constituting use of the foam blowing agent. The foam blowing agent in an open cell foam product does not continue to perform its intended function during the lifetime of the product. Except for insignificant

amounts remaining in the cells, emissions of the foam blowing agent occur at the time and place of manufacture. Therefore, we are differentiating between closed cell and open cell foam products for this purpose. This is consistent with the different treatment of closed and open cell foam products under the section 611 labeling regulations.

ii. When will use of closed cell foam products with unacceptable blowing agents be prohibited?

For changes of status finalized in this rule (section VI.C.1 and VI.C.2), the unacceptability determination applies to use of closed cell foam products and products that contain closed cell foam where the products are manufactured on or after the change of status date. As noted in the July 2015 rule with respect to MVAC and stand-alone refrigeration equipment (80 FR 42884), it is reasonable to allow use of products manufactured before the change of status date to avoid market disruption, creation of stranded inventory, and perverse incentives for releasing these substances to the environment. This applies also to products that are manufactured outside the United States before the change of status date and imported afterwards. Buyers should obtain documentation from importers that the imported products were manufactured or in inventory before the change of status date.

For alternatives that have already been listed as unacceptable with a change of status date of January 1, 2017,²⁰⁷ or earlier—namely, HCFC blowing agents listed as unacceptable in appendices K, M, Q, and U to 40 CFR part 82 subpart G, and HFC blowing agents listed as unacceptable for rigid PU and PIR boardstock, extruded polystyrene sheet, and phenolic foams in appendix U to 40 CFR part 82 subpart G—the unacceptability determination applies to use of closed cell foam products and products that contain closed cell foam manufactured on or after the date one year after the date of publication of a final rule. This timing is intended to allow importers and international manufacturers of such products time to adjust their manufacture and import plans. For substitutes listed as unacceptable with a change of status date after January 1, 2017—namely, HFC and HFC blend blowing agents listed as unacceptable in rigid PU slabstock and other; rigid PU

²⁰⁷ There will also be a change of status on January 1, 2017 for flexible PU and integral skin PU, but these are open cell foams and are not part of this rule for closed cell foams.

appliance foam; rigid PU commercial refrigeration and sandwich panels; rigid PU marine flotation foam; rigid PU spray foam; polyolefin; and polystyrene extruded boardstock and billet—the unacceptability determination applies both to use of an unacceptable foam blowing agent and to use of closed cell foam products and products that contain closed cell foam manufactured with an unacceptable foam blowing agent on or after the change of status date for each end-use (January 1 of 2019, 2020, or 2021).

c. How is EPA responding to comments?

EPA received several comments from individuals and organizations with various interests in foam blowing agents. Comments were in reference to EPA’s proposed application of unacceptability determinations of foam blowing agents to closed cell foam products and products containing closed cell foam manufactured with unacceptable blowing agents, to EPA’s authority for the proposed new interpretation, to the proposed change of status dates, and to questions about a specific application. Some commenters supported EPA’s proposed application of unacceptability to products, while others opposed that interpretation. Two commenters suggested different change of status dates from those EPA proposed, one suggesting an earlier date and the other suggesting a later date.

Commenters included CPI, an organization commenting on behalf of the polyurethanes industry; Honeywell and Chemours, suppliers of alternative foam blowing agents; Whirlpool, a manufacturer of appliances using foam insulation; Structural Composites and Comsys, manufacturers of a specialized composite foam product for boats and refrigerated trailers; NMMA, an organization representing manufacturers of boats; and environmental organizations, NRDC and IGSD.

We have grouped comments together and responded to the issues raised by the comments in the sections that follow, or in a separate Response to Comments document which is included in the docket for this rule (EPA-HQ-OAR-2015-0663).

i. Substitutes and End-Uses Proposed

Comment: Honeywell supported EPA’s proposal to allow the continued use of closed cell foam and products containing closed cell foam, where such foams were manufactured prior to the date on which the substitutes with which they were blown become unacceptable. The commenter stated

that this is particularly important for refrigerated containers and trailers that travel across international borders and are used in service for five to ten years, and then sold at the end of their life for use as storage, living space, or other applications. Honeywell commented that EPA should continue to allow a refrigerated trailer that was manufactured with an unacceptable foam blowing agent before the unacceptability date to be resold at the end of its life, which would come well after the change of status date.

Response: EPA agrees that allowing the use of closed cell foam products and products containing closed cell foam that were manufactured prior to the change of status date results in allowing refrigerated containers and trailers to be used for their useful life in refrigerated transport and then for reuse in other applications.

ii. Change of Status Date

Comment: Honeywell supported EPA's proposal to provide a transition period for closed cell foams, and products that contain such foams that were blown with a substance that is already unacceptable, such as an HCFC. The commenter stated, however, that the proposed date of one year after publication of the rule is longer than necessary and suggested the compliance date should instead be within 180 days after publication of the final rule. Honeywell suggested that a 180-day period would provide a reasonable amount of time for transition to acceptable solutions, since near "drop in" low-GWP alternatives are already commercial for closed-cell foam applications.

Response: EPA disagrees with the commenter and is finalizing the change of status date of one year after publication of a final rule, as proposed. EPA disagrees with Honeywell that a 180-day period is sufficient to allow importers and international manufacturers of such products time to adjust their manufacture and import plans. This would be giving less than half the time that EPA has given to any other sector or end-use for a change of status where a substitute is currently being used. EPA has heard from systems houses and end users that alternative foam blowing agents, including olefinic foam blowing agents, require significant time for development and are not "drop in" replacements (e.g., 80 FR 42925–6, 42928, July 20, 2015). At least one recently listed alternative foam blowing agent, HFO-1336mzz(Z), is not expected to be commercially available until after that timeframe. Further, the commenter has not supported their statement that

180 days should be sufficient. Thus, we do not see that it is appropriate to change the proposed change of status date.

Comment: Whirlpool suggested that EPA should grant the same lead-in period for use of imported products containing unacceptable HFC blowing agents as it granted for use of HFCs in domestic product manufacture. This commenter stated that manufacturers had just over 53 months from publication of the July 2015 rule to complete a transition of their domestic manufacturing lines and products manufactured on these lines before the January 1, 2020 change of status date (for appliance foam). Whirlpool requested that the change of status date be set to July 1, 2021, in order to provide an equitable transition period, assuming that this rule would be finalized in late 2016.

Response: EPA disagrees with the commenter and is finalizing the change of status dates as proposed. We disagree with Whirlpool that it is necessary or equitable for manufacturers of products outside the United States containing closed cell foams, such as appliances, to have until July, 2021, to continue using unacceptable HFC blowing agents for the U.S. market. Their domestic counterparts, in comparison, must stop using unacceptable HFC blowing agents as of January 1, 2020. EPA first signaled its interest in regulating use of foam products in an August 6, 2014, proposed rule (79 FR 46125, 46154) and did not withdraw that proposal. Manufacturers with both domestic and foreign manufacturing facilities have gained experience and knowledge with use of new blowing agents, and thus we expect that future transitions will be quicker. In addition, sufficient supplies of alternatives are anticipated to be on the market beginning in 2017 to allow product development, which was an important consideration when we set the change of status date for a number of rigid PU foam end-uses, including appliance foam, in the July 2015 rule (80 FR 42925–26). Thus, we consider that the proposed January 1, 2020, change of status date for appliances containing appliance foam blown with unacceptable alternatives still provides adequate time. For substitutes listed as unacceptable with a change of status date after January 1, 2017, the unacceptability determination applies to use of closed cell foam products and products that contain closed cell foam manufactured with an unacceptable foam blowing agent on or after the change of status date for each end-use (January 1 of 2019, 2020, or 2021).

iii. SNAP Authority, Interpretation, and Impacts

Comment: Chemours, Honeywell, NMMA, Compsys and Structural Composites, NRDC, and IGSD all supported EPA's proposal to prohibit the import of closed cell foams, and appliances containing them, that have been produced with and contain blowing agents whose status has been changed to unacceptable. They considered this to be fairer than the current situation, in which products containing foam blown with unacceptable foam blowing agents may be imported and sold in the United States while domestic manufacturers are prohibited from making and selling an identical product. Compsys and Structural Composites and Honeywell noted that EPA's proposal would remove the current incentive for U.S.-based manufacturers to move production outside of the United States in order to use less expensive substances with higher environmental impacts in nations that do not have such stringent requirements, thereby protecting the environment, U.S. jobs, and U.S.-based small businesses.

In contrast, CPI opposed EPA's proposal and urged EPA to reconsider or redefine its interpretation of use. This commenter raised concerns about potential unintended consequences and inconsistency in the treatment of foams produced domestically and overseas. CPI believed this interpretation leads to the possibility of prohibiting the import of products manufactured prior to the change of status date and thus treating imported products inconsistently with domestically-produced products manufactured prior to the change of status date. CPI believed that this inconsistency suggests that EPA's proposed action is beyond its authority under the CAA or contrary to the intent of the statute. CPI stated that they were unaware of any precedent or authority that would allow EPA to interpret "use" differently based on the location of a manufacturer's facility, and thus opposed EPA's reinterpretation of use for foam products. In addition, CPI elsewhere had suggested that EPA should consider the change of status date to be the date a manufacturer packages polyol resin blends, including the blowing agent, into a drum, canister, or can, and believed EPA's interpretation of "use" for products was inconsistent with that suggestion.

Response: EPA agrees with the first set of commenters that our proposed interpretation of "use" provides for more equitable treatment of domestic and foreign manufacturing. We also

find, as discussed by the commenters, that this interpretation of “use” will have environmental and other benefits. EPA clarifies that the use prohibition would not apply to closed cell foam products, or products containing such foams, manufactured with unacceptable blowing agents prior to the change of status date, whether the product was manufactured in the United States or abroad. Thus, EPA would be interpreting use the same way, irrespective of the location of the manufacturer’s facility. Concerning CPI’s suggestion that use should be based upon the date of manufacturing and packaging a polyol resin, see section IV.C.1.c.ii above. We note that the definition of use in the initial SNAP rule at 40 CFR 82.172 refers to use as “including but not limited to use in a manufacturing process or product, in consumption by the end-user, or in intermediate uses, such as formulation or packaging for other subsequent uses.”

D. Fire Suppression and Explosion Protection

1. Acceptable Listing of 2-BTP for Total Flooding and Streaming

a. Background

The fire suppression and explosion protection end-uses addressed in this action are total flooding and streaming. Total flooding systems, which historically employed halon 1301 as a fire suppression agent, are used in both

normally occupied and unoccupied areas. In the United States, approximately 90 percent of installed total flooding systems protect anticipated hazards from ordinary combustibles (*i.e.*, Class A fires), while the remaining ten percent protect against applications involving flammable liquids and gases (*i.e.*, Class B fires).²⁰⁸ It is also estimated that approximately 75 percent of total flooding systems protect electronics (*e.g.*, computers, telecommunications, process control areas) while the remaining 25 percent protect other applications, primarily in civil aviation (*e.g.*, engine nacelles/APUs, cargo compartments, lavatory trash receptacles), military weapons systems (*e.g.*, combat vehicles, machinery spaces on ships, aircraft engines and tanks), oil/gas and manufacturing industries (*e.g.*, gas/oil pumping, compressor stations), and maritime (*e.g.*, machinery space, cargo pump rooms). Streaming applications, which have historically used halon 1211 as an extinguishing agent, include portable fire extinguishers designed to protect against specific hazards.

b. What is EPA’s final decision?

EPA is listing 2-BTP as acceptable, subject to use conditions, for the total flooding end-use. The use condition requires that 2-BTP be used only in engine nacelles and APUs on aircraft in total flooding fire suppression systems.

In addition, EPA is listing 2-BTP as acceptable, subject to use conditions for the streaming end use. The use condition requires that 2-BTP be used as a streaming agent only for handheld extinguishers in aircraft.

i. How does 2-BTP compare to other fire suppressants for these end-uses with respect to SNAP criteria?

(a) Total Flooding

EPA has listed a number of alternatives as acceptable for the total flooding end-use. In the proposed rule (81 FR at 22824; April 18, 2016) EPA provided information on the environmental and health properties of 2-BTP and the various substitutes in this end-use. Additionally, EPA’s risk assessments for 2-BTP and a technical support document that provides the **Federal Register** citations concerning data on the SNAP criteria (*e.g.*, ODP, GWP, VOC, toxicity, flammability) for acceptable alternatives in the relevant end-uses are available in the docket for this rulemaking (EPA–HQ–OAR–2015–0663). In addition to halon 1301, the current market for total flooding systems also includes HCFCs, HFCs, inert gases, and a variety of NIK extinguishing agents (*e.g.*, powdered aerosols, foams, water).²⁰⁹ 2-BTP has an ODP of 0.0028, and the ODPs of other total flooding alternatives are zero to 0.048. 2-BTP has a GWP of 0.23–0.26. As shown in Table 22, the GWPs of other total flooding alternatives range from zero to 3,500.

TABLE 22—GWP, ODP, AND VOC STATUS OF 2-BTP COMPARED TO OTHER TOTAL FLOODING AND STREAMING AGENTS

Fire suppressants	GWP	ODP	VOC	Listing status
2-BTP	¹ 0.23–0.26	0.0028	Yes	Acceptable, subject to use conditions.
Total flooding				
FK-5-1-12mmy2 (C6 Perfluoroketone)	<1	0	Yes	Acceptable.
CF ₃ I	0.4	0.008	Yes	Acceptable.
CO ₂	1	0	No	Acceptable.
HCFC Blend A ²	1,546	0.048	No	Acceptable.
HFC-227ea	3,220	0	No	Acceptable.
HFC-125	3,500	0	No	Acceptable.
Water, Inert gases, Powdered aerosols A–E	0	0	No	Acceptable.
Streaming				
HCFC Blend B ³	77	0.00098	No	Acceptable.
HFC-227ea	3,220	0	No	Acceptable.
HFC-236fa	9,810	0	No	Acceptable.
FK-5-1-12mmy2 (C6 Perfluoroketone)	<1	0	Yes	Acceptable.
CF ₃ I	0.4	0.008	Yes	Acceptable.
CO ₂	1	0	No	Acceptable.
Water	0	0	No	Acceptable.

²⁰⁸ Wickham, 2002. Status of Industry Efforts to Replace Halon Fire Extinguishing Agents. March, 2002.

²⁰⁹ ICF, 2016h. Market Characterization for Fire Suppression, Comfort Cooling, Cold Storage, and Household Refrigeration Industries in the United States. Prepared for the U.S. Environmental Protection Agency. October 2015.

²¹⁰ Patten et al., 2012. Correction to “OH reaction rate constant, IR absorption spectrum, ozone depletion potentials and global warming potentials of 2-bromo-3,3,3-trifluoropropene,” J. Geophys. Res., 117, D22301, doi:10.1029/2012JD019051.

TABLE 22—GWP, ODP, AND VOC STATUS OF 2-BTP COMPARED TO OTHER TOTAL FLOODING AND STREAMING AGENTS—Continued

Fire suppressants	GWP	ODP	VOC	Listing status
H Galden HFPEs	2,790–6,230	0	No	Acceptable.

¹ GWP range represents GWPs for 30°N. to 60°N. and 60°S. to 60°N. emissions scenarios for a 100-year time horizon. A tropospherically well-mixed approximation of the GWP is equal to 0.59.²¹⁰

² HCFC Blend A is a blend consisting of HCFC-123 (4.75 percent), HCFC-22 (82 percent), HCFC-124 (9.5 percent), and D-limonene (3.75 percent).

³ HCFC Blend B is a proprietary blend consisting largely of HCFC-123.

In addition to ODP and GWP, EPA evaluated potential impacts of emissions of 2-BTP on local air quality. 2-BTP meets the definition of VOC under CAA regulations (see 40 CFR 51.100(s)) and is not excluded from that definition for the purpose of SIPs to attain and maintain the NAAQS. EPA compared the annual VOC emissions from the use of 2-BTP as a total flooding agent to other anthropogenic sources of VOC emissions considering both worst-case and more realistic scenarios. Under either scenario, emissions are a small fraction of a percentage (5.6×10^{-5} percent to 2.1×10^{-3} percent) of all anthropogenic VOC emissions in the United States in 2014.^{211 212} Given this emission level, we determined it was not necessary to perform an assessment of the effect of these emissions on ambient ozone levels; any effect would be insignificant. This is particularly true since use will be limited to aircraft and thus most releases of 2-BTP are expected to be at altitude, not in the lower troposphere. Other acceptable fire suppression agents currently in use in this end-use are also VOC (e.g., C6-perfluoroketone).

EPA evaluated the risks associated with potential exposures to 2-BTP during production operations and the filling of fire extinguishers as well as in the case of an inadvertent discharge of the system during maintenance activities on the fire extinguishing system. EPA's review of the human health impacts of 2-BTP, including the summary of available toxicity studies, is in the docket for this rulemaking (EPA-HQ-OAR-2015-0663).^{213 214}

²¹¹ ICF, 2016k. Significant New Alternatives Policy Program. Fire Extinguishing and Explosion Prevention Sector. Risk Screen on Substitutes for Total Flooding Systems in Unoccupied Spaces. Substitute: 2-bromo-3,3,3-trifluoropropene (2-BTP).

²¹² Based on the 2014 annual total VOC emissions for the United States (i.e., approximately 17.13×10^6 MT) as reported in the National Emissions Inventory (EPA, 2015).

²¹³ ICF, 2016j. Significant New Alternatives Policy Program. Fire Extinguishing and Explosion Prevention Sector. Risk Screen on Substitutes as a Streaming Agent in Civil Aviation Applications. Substitute: 2-bromo-3,3,3-trifluoropropene (2-BTP).

²¹⁴ ICF, 2016k. Significant New Alternatives Policy Program. Fire Extinguishing and Explosion

Exposure to 2-BTP is not likely during installation or servicing of 2-BTP total flooding systems for engines and APUs on aircraft. These are both considered to be unoccupiable areas, meaning personnel cannot physically occupy these spaces, thus reducing the risk from exposure to an inadvertent discharge. The risk of accidental activation of the fire extinguishing system while personnel are present near the protected space is low if proper procedures, including those of the 2-BTP system manufacturer as well as the aircraft manufacturer, are followed. Instructions on system installation and servicing included in manuals for the 2-BTP systems should be followed. In the case of an inadvertent discharge of the system during maintenance activities on the fire extinguishing system or surrounding equipment, the cowl doors that would be open to allow access to the area will allow personnel to immediately egress and avoid exposure. Protective gloves and tightly sealed goggles should be worn for installation and servicing activities, to protect workers in any event of potential discharge of the proposed substitute, accidental or otherwise. Filling or servicing operations should be performed in well-ventilated areas. EPA's evaluation indicates that the use of 2-BTP is not expected to pose a significant toxicity risk to personnel or the general population. The risks after exposure are common to many total flooding agents, including those already listed as acceptable under SNAP for this same end-use such as C6-perfluoroketone.

EPA is listing 2-BTP acceptable, subject to use conditions, as a total flooding agent for use in engine nacelles and APUs on aircraft because the overall environmental and human health risk posed by the substitute is lower than or comparable to the overall risk posed by other alternatives listed as acceptable in the same end-use.

Prevention Sector. Risk Screen on Substitutes for Total Flooding Systems in Unoccupied Spaces. Substitute: 2-bromo-3,3,3-trifluoropropene (2-BTP).

(b) Streaming Uses

EPA has listed a number of alternatives as acceptable for the streaming end-use. In the proposed rule (81 FR at 22824; April 18, 2016) EPA provided information on the environmental and health properties of 2-BTP and the various substitutes in this end-use. Additionally, EPA's risk assessments for 2-BTP and a technical support document that provides the **Federal Register** citations concerning data on the SNAP criteria (e.g., ODP, GWP, VOC, toxicity, flammability) for acceptable alternatives in the relevant end-uses are available in the docket for this rulemaking (EPA-HQ-OAR-2015-0663). In addition to halon 1211, the current market for streaming applications also includes HCFCs, HFCs, and a variety of other agents (e.g., dry chemical, CO₂, water).²¹⁵ Specific alternatives used for streaming uses include HCFC Blend B (with an ODP of roughly 0.01 and a GWP of roughly 80), HFC-227ea (with an ODP of zero and a GWP of 3,220), and C7 Fluoroketone (with an ODP of zero and a GWP of approximately one). The ODP, GWP, and VOC status of 2-BTP and other alternatives that are also used as streaming agents are described in Table 22.

Regarding local air quality impacts, EPA compared the annual VOC emissions from the use of 2-BTP as a streaming agent to other anthropogenic sources of VOC emissions considering both worst-case and more realistic scenarios, as described in the previous section. Other acceptable fire suppression agents currently in use as streaming agents are also VOC (e.g., C6-perfluoroketone, C7-fluoroketone).

EPA evaluated occupational and general population exposure at manufacture and at end-use to ensure that the use of 2-BTP as a streaming agent will not pose unacceptable risks to workers or the general public as discussed in the previous section. Also

²¹⁵ ICF, 2016h. Market Characterization for Fire Suppression, Comfort Cooling, Cold Storage, and Household Refrigeration Industries in the United States. Prepared for the U.S. Environmental Protection Agency. October 2015.

discussed previously, EPA has evaluated the risks associated with potential exposures to 2-BTP during production operations and the filling of fire extinguishers as well as in the case of an inadvertent discharge of the fire extinguisher during maintenance activities.

The risks after exposure are common to many streaming agents, including those already listed as acceptable under SNAP for this same end-use, such as C6-perfluoroketone.

EPA is listing 2-BTP acceptable, subject to use conditions, as a streaming agent on aircraft because the overall environmental and human health risk posed by the substitute is lower than or comparable to the overall risk posed by other alternatives listed as acceptable in the same end-use.

ii. What further information is EPA providing in the acceptability listing for 2-BTP?

In the "Further Information" column of the regulatory listings for total flooding agents, EPA is providing the following information:

- This fire suppressant has a relatively low GWP of 0.23–0.26 and a short atmospheric lifetime of approximately seven days.
- This agent is subject to requirements contained in a TSCA section 5(e) Consent Order and any subsequent TSCA section 5(a)(2) SNUR.
- For establishments manufacturing, installing, and servicing engine nacelles and auxiliary power units on aircraft using this agent:

(1) This agent should be used in accordance with the safety guidelines in the latest edition of the National Fire Protection Association (NFPA) 2001 Standard for Clean Agent Fire Extinguishing Systems;

(2) In the case that 2-BTP is inhaled, person(s) should be immediately removed and exposed to fresh air; if breathing is difficult, person(s) should seek medical attention;

(3) Eye wash and quick drench facilities should be available. In case of ocular exposure, person(s) should immediately flush the eyes, including under the eyelids, with fresh water and move to a non-contaminated area.

(4) Exposed person(s) should remove all contaminated clothing and footwear to avoid irritation, and medical attention should be sought if irritation develops or persists;

(5) Although unlikely, in case of ingestion of 2-BTP, the person(s) should consult a physician immediately;

(6) Manufacturing space should be equipped with specialized engineering controls and well ventilated with a local

exhaust system and low-lying source ventilation to effectively mitigate potential occupational exposure; regular testing and monitoring of the workplace atmosphere should be conducted;

(7) Employees responsible for chemical processing should wear the appropriate PPE, such as protective gloves, tightly sealed goggles, protective work clothing, and suitable respiratory protection in case of accidental release or insufficient ventilation;

(8) All spills should be cleaned up immediately in accordance with good industrial hygiene practices;

(9) Training for safe handling procedures should be provided to all employees that would be likely to handle containers of the agent or extinguishing units filled with the agent;

(10) Safety features that are typical of total flooding systems such as pre-discharge alarms, time delays, and system abort switches should be provided, as directed by applicable OSHA regulations and NFPA standards; use of this agent should also conform to relevant OSHA requirements, including 29 CFR 1910, subpart L, sections 1910.160 and 1910.162.

In the "Further Information" column of the regulatory listing for the streaming agent end use, EPA is providing the following information:

- This fire suppressant has a relatively low GWP of 0.23–0.26 and a short atmospheric lifetime of approximately seven days.
- This agent is subject to requirements contained in a Toxic Substance Control Act (TSCA) section 5(e) Consent Order and any subsequent TSCA section 5(a)(2) Significant New Use Rule (SNUR).
- For establishments manufacturing, installing and maintaining handheld extinguishers using this agent:

(1) Use of this agent should be used in accordance with the latest edition of NFPA Standard 10 for Portable Fire Extinguishers;

(2) In the case that 2-BTP is inhaled, person(s) should be immediately removed and exposed to fresh air; if breathing is difficult, person(s) should seek medical attention;

(3) Eye wash and quick drench facilities should be available. In case of ocular exposure, person(s) should immediately flush the eyes, including under the eyelids, with fresh water and move to a non-contaminated area.

(4) Exposed person(s) should remove all contaminated clothing and footwear to avoid irritation, and medical attention should be sought if irritation develops or persists;

(5) Although unlikely, in case of ingestion of 2-BTP, the person(s) should consult a physician immediately;

(6) Manufacturing space should be equipped with specialized engineering controls and well ventilated with a local exhaust system and low-lying source ventilation to effectively mitigate potential occupational exposure; regular testing and monitoring of the workplace atmosphere should be conducted;

(7) Employees responsible for chemical processing should wear the appropriate PPE, such as protective gloves, tightly sealed goggles, protective work clothing, and suitable respiratory protection in case of accidental release or insufficient ventilation;

(8) All spills should be cleaned up immediately in accordance with good industrial hygiene practices;

(9) Training for safe handling procedures should be provided to all employees that would be likely to handle containers of the agent or extinguishing units filled with the agent; and

(10) 2-BTP use as a streaming fire extinguishing agent in handheld extinguishers in aircraft should be in accordance with UL 711, Rating and Testing of Fire Extinguishers, the Federal Aviation Administration (FAA) Minimum Performance Standard for Hand-Held Extinguishers (DOT/FAA/AR-01/37), with regard to the size and number of extinguishers depending on the size of aircraft, and FAA Stratification and Localization of Halon 1211 Discharged in Occupied Aircraft Compartments (DOT/FAA/TC-14/50).

iii. When will the listing apply?

EPA is establishing a listing date as of January 3, 2017, the same as the effective date of this regulation, to allow for the safe use of this substitute at the earliest opportunity.

c. How is EPA responding to comments?

EPA received several comments from organizations with various interests in the fire protection industry on the proposed listing of 2-BTP as acceptable, subject to use conditions, as a total flooding and streaming agent in certain aircraft applications. Comments were in reference to EPA's approach to the end-use categories for fire suppression, an expedited listing for 2-BTP based on international halon replacement deadline for handheld extinguishers on new aircraft, conditions for use including minimum volumes for aircraft compartments for safe handheld extinguisher use and labeling of extinguishers, and broadening the acceptable applications for 2-BTP. All commenters supported the proposed

listing decision, however, several commenters requested that EPA consider a listing date of no later than August 2016 for 2-BTP in order to meet an international target date of the end of 2016 for all aircraft entering service to use handheld extinguishers that do not use halon. Several commenters suggested the reference to aviation-specific guidance rather than UL standard as more comprehensive analysis of safe agent levels for handheld extinguishers used onboard aircraft.

Commenters included the International Coordinating Council of Aerospace Industries Associations (ICCAIA) representing Aerospace Industries Associations of the United States, Europe, Canada, Brazil, Russia, and Japan; the Halon Alternatives Research Corporation, Inc. (HARC), a trade association; NAM; NEDA/CAP; Boeing; Airbus also representing the aircraft manufacturers Bombardier, Dassault Aviation, and Embraer; and P3Group.

We have grouped comments together and responded to the issues raised by the comments in the sections that follow, or in a separate Response to Comments document which is included in the docket for this rule (EPA-HQ-OAR-2015-0663).

i. Substitutes and End-Uses Proposed

Comment: Several commenters expressed support for EPA's proposed acceptability listing of 2-BTP; these included Airbus, Boeing, ICCAIA, NAM, NEDA/CAP, and P3Group. Airbus noted the "complexity of fighting fires in aircraft cabins and cockpits requires fire-fighting agents and equipment which also minimize health impacts on aircraft crews and occupants while ensuring continued safe flight and landing." Airbus also cited the "need for . . . EPA approval of 2-BTP as a prerequisite to allow commercialization in the leading US civil aviation market. Others including Boeing, ICCAIA, NAM, and NEDA/CAP noted the importance of this acceptability listing to meeting the ICAO Annex 6 deadline of December 31, 2016, for halon replacement in handheld extinguishers for all new production aircraft, and requested EPA to consider an expedited listing for 2-BTP. Airbus and HARC both urged EPA to continue review of other potential applications of 2-BTP and broaden its acceptability listings in other uses which would support the long-term availability of the agent on the market. HARC expressed concern that the restriction to only aircraft use impacts the agent's commercial viability as an aircraft halon replacement.

Response: EPA appreciates the interest and support offered by the commenters in the acceptability listing of 2-BTP. EPA is aware of the ICAO requirement to replace halons on handheld extinguishers on newly produced aircraft entering service after the end of this year. EPA has worked expeditiously to issue a final rule as quickly as possible noting that the comment period closed June 16, 2016. Regarding comments urging EPA to consider use of 2-BTP in other fire protection applications, as stated in the proposed rule, EPA is reviewing additional potential fire suppression applications for 2-BTP as identified by the submitter.

ii. Listing Date

Comment: ICCAIA urged a final acceptability listing of 2-BTP by August 2016 in order to meet an international deadline for halon replacement in handheld extinguishers for all aircraft placed into service on or after December 31, 2016. That deadline was incorporated by the International Civil Aviation Organization (ICAO) in 2011 into the revised Chicago Convention Standards and Recommended Practices (SARPs) for Annex 6, Operation of Aircraft, which affects already certified aircraft, and Annex 8, Airworthiness of Aircraft, which affects new aircraft types, to include deadlines for halon replacement in various applications on aircraft including in handheld extinguishers. Considering the additional design, reviews, and certifications required following EPA's acceptability listing for 2-BTP, ICCAIA requested that EPA also consider the option of issuing a separate final rule for 2-BTP to meet this August timeline. Other commenters in support of ICCAIA's request for expedited listing for 2-BTP included Airbus, Boeing, NEDA/CAP, and NAM. Airbus, Boeing, and NAM cited the adoption of halon replacement deadlines for civil aviation into the ICAO SARPs; in 2011, ICAO amended its Annex 6, Operation of Aircraft.

Response: EPA appreciates the significant interest in the acceptability listing of 2-BTP to meet the ICAO requirement to replace halons on handheld extinguishers on aircraft. EPA has worked expeditiously to issue a final rule as quickly as possible noting that the comment period closed June 16, 2016. The commenters did not provide sufficient information to explain how an August 2016 acceptability listing fits into the design, specification, review, and certification process for new production aircraft and how it would have specifically affected this timeline.

It is also worth noting that while the United States strongly supported related actions taken at ICAO on halons including the amendments to Annexes 6 and 8, following the final amendment of Annexes 6 and 8, the United States filed a difference to these new SARPs. As a Contracting State to the Chicago Convention, the United States is required to either comply with or file differences to the Standards contained in the ICAO Annexes; differences filed by member States are not considered permanent, but rather States are meant to continuously review the status of their differences and inform ICAO if and when a difference is no longer necessary.

iii. Use Conditions

Comment: ICCAIA, Airbus, P3Group, and Boeing referred to discussion in the preamble regarding EPA's evaluation of potential exposure risk at end-use, specifically to 2-BTP discharged from handheld extinguishers onboard aircraft. The NPRM made reference to the UL 2129 standard, Halocarbon Clean Agent Fire Extinguishers, which prohibits discharge in a confined space exceeding the cardiotoxic LOAEL for any fire suppressant. EPA stated that "per UL 2129, labels for 2-BTP extinguishers will contain the statement, 'Do not use in confined spaces less than 896 cubic feet per extinguisher.'" P3Group noted that the UL 2129 value of 896 ft³ minimum confined space volume was based on the LOAEL for the extinguishing agent, and the extinguisher containing 3.75 lbs. of 2-BTP. Airbus noted that implementing the 896 cubic feet compartment size limit as a strict requirement would exclude 2-BTP handheld extinguishers from any smaller aircraft or even from use in large transport aircraft cockpits, service or crew rest compartments if considered, in terms of fire-fighting, as individual compartments. All commenters noted that the industry utilizes FAA guidance for determining appropriate minimum volumes relevant to aircraft compartments as this guidance provides more comprehensive analysis of acceptable agent levels under aircraft operating conditions. Airbus suggested text for proposed use conditions for 2-BTP including required labeling per UL 2129, and a listing of the minimum space volume in order to discharge other sizes of extinguishers on aircraft. Boeing commented that they disagreed with the Airbus proposed use conditions for 2-BTP citing that these requirements for aircraft are specified by the FAA guidance which the industry intends to follow.

Response: EPA appreciates the clarification of the UL 2129 standard and the information on the relevant FAA guidance that is intended to be used by the industry to determine appropriate minimum volumes for aircraft handheld extinguishers. EPA is revising the additional information on 2-BTP use as a streaming fire extinguishing agent in handheld extinguishers in aircraft to indicate that use should be in accordance with UL 711, Rating and Testing of Fire Extinguishers, the Federal Aviation Administration (FAA) Minimum Performance Standard for Hand-Held Extinguishers (DOT/FAA/AR-01/37), with regard to the size and number of extinguishers depending on the size of aircraft, and FAA Stratification and Localization of Halon 1211 Discharged in Occupied Aircraft Compartments (DOT/FAA/TC-14/50).

2. Change of Listing Status for Certain Perfluorocarbons for Total Flooding

While EPA proposed and requested comments on listing the PFCs (C_4F_{10} and C_3F_8) as unacceptable in fire suppression total flooding uses, EPA is deferring final action at this time. EPA plans to continue assessing the merits of taking action in this sector more broadly, based on additional information provided during the comment period on the use of alternatives in this end use. EPA requested advance comments on other alternatives, specifically SF₆ and HFC-125 in total flooding and HFC-227ea in both total flooding and streaming applications, to improve our understanding. We received several comments in support of the proposed action on PFCs and several commenters requested that EPA eliminate or limit the use of additional high-GWP HFCs. Other commenters requested that EPA take no action at this time with regard to the other alternatives for which EPA sought advance comments, citing current use in challenging applications such as aviation and the need to ensure their availability for these uses in the future. These comments provided us with additional but limited information on uses of SF₆, HFC-23, HFC-125, HFC-227ea, HFC-134a, and HFC-236fa, confirming the specialized, niche applications for some of these agents.

3. Removal of Use Conditions for Powdered Aerosol D

a. Background

Powdered Aerosol D is a pyrotechnic particulate aerosol and explosion suppressant that also is marketed under the trade names of Aero-K® and Stat-X®.

This fire suppressant is supplied to users as a solid housed in a double-walled hermetically-sealed steel container. When the unit is triggered by heat (300 °C), the product is pyrotechnically activated to produce gases and aerosol particles from a mixture of chemicals. EPA listed Powdered Aerosol D as acceptable subject to use conditions as a total flooding agent (71 FR 56359; September 7, 2006). The use conditions required that Powdered Aerosol D be used only in areas that are not normally occupied, because the Agency did not have sufficient information at that time supporting its safe use in areas that are normally occupied. Based on a review of additional information from the submitter to support the safe use of Powdered Aerosol D in normally occupied spaces, EPA subsequently determined that Powdered Aerosol D is also acceptable for use in total flooding systems for normally occupied spaces (79 FR 62863; October 21, 2014). The listing provides that Powdered Aerosol D is acceptable for total flooding uses, which includes both unoccupied and occupied spaces. In the October 2014 listing action, EPA noted that in a subsequent rulemaking, the Agency would remove the previous listing of acceptable subject to use conditions.

b. What is EPA's final decision?

As proposed, EPA is removing the previous listing in appendix O to subpart G of 40 CFR part 82 for Powdered Aerosol D as acceptable subject to use conditions as a total flooding agent (71 FR 56359; September 7, 2006). This has been superseded by the listing of October 21, 2014 (79 FR 62863) listing Powdered Aerosol D as acceptable for total flooding uses, which includes both unoccupied and occupied spaces.

c. How is EPA responding to comments?

Comment: Chemours stated that it opposed the removal of the use restrictions for Powdered Aerosol D based on the fatalities from the recent incident in a bank vault in Thailand after the inadvertent discharge of a powdered aerosol system. Chemours noted that the industry still needed to learn about the appropriate use of this technology.

Response: EPA is aware of the incident at the Thai bank and understands the investigation continues. We note that the substitute involved was not Powdered Aerosol D. Regarding the listing of Powdered Aerosol D under the SNAP program, a decision to not modify the acceptable subject to use conditions, as advocated by the

commenter, will not achieve the result they are seeking. As noted, Powdered Aerosol D is listed as acceptable for all total flooding uses. If the commenter believes that there is evidence to support that Powdered Aerosol D cannot be used safely in some total flooding uses, they should submit that information to EPA and EPA could consider it to determine whether it should initiate rulemaking to change the acceptable listing.

VII. How is EPA responding to other public comments?

EPA received additional comments on topics not addressed in other sections of this document. These comments address a host of issues, including EPA's CAA authority to change the status of alternatives; perceived inconsistencies with the SNAP program's "guiding principles;" perceived inconsistency with other actions; and interactions with other rules. Additionally, some commenters requested status changes for end-uses or alternatives that were not included in the proposed rule.

We have grouped comments together and responded to the issues raised by the comments in the sections that follow, or in a separate Response to Comments document which is included in the docket for this rule (EPA-HQ-OAR-2015-0663).

A. General Comments

1. Proposed Status Listing Changes

Comment: Several commenters, including the Alliance, Clayton, EIA, NRDC, IGSD, Honeywell, NASA, Dow, and CARB generally supported EPA's actions related to the proposed status changes. While these commenters expressed their support for the SNAP program, the Alliance emphasized the importance of an amendment to the Montreal Protocol for a gradual phase-down approach to HFCs and urged caution when changing listing status of substitutes under the SNAP framework. The Alliance believe that a gradual phasedown approach is important in order to allow for effective technology development and introduction, to allow for the building codes and safety standards process to align with the newly available low-GWP technologies and applications, and to ensure energy efficiency performance is not diminished. Honeywell commented that the proposed listing changes would lead to significant emission reductions, setting an example for other countries around the world to follow. Clayton noted that EPA was extremely thorough in considering challenges posed by the proposal and engaging with

stakeholders. NASA noted that they take regulatory compliance seriously and have committed significant time and resources to implementing environmentally acceptable materials in their facilities and programs. Dow stressed that any new technologies should be built upon success with attainable timelines that allow the industry to innovate, develop, and commercialize alternative technologies for our stakeholders.

Response: EPA thanks these commenters for supporting the proposed listing changes. As noted elsewhere in this document, EPA views this final action as complementary to the United States' support for adopting an amendment to the Montreal Protocol to phase down production and consumption of HFCs.

Comment: Chemours and Honeywell supported EPA's efforts to reduce GHG emissions associated with the use of HFCs in the production of insulating foams and other foam products by listing high-GWP foam blowing agents as unacceptable and approving technically appropriate lower-GWP alternatives as sufficient quantities of those lower GWP solutions become commercially available.

Response: EPA appreciates the commenters' support for changing the status of high-GWP foam blowing agents.

Comment: NEDA/CAP, an organization representing manufacturers of a variety of refrigeration and air conditioning equipment among others, commented that its members have recently made substantial capital investments replacing IPR and commercial building ACs, warehouse chillers, and other equipment that utilized ODS refrigerants that have been phased out because acceptable non-ODS refrigerants were available for these uses. NEDA/CAP's members are concerned that there are almost no acceptable, commercially available alternatives for the refrigerants proposed for a status change and the proposed rule would reduce demand for non-ODS refrigerants for new equipment. NEDA/CAP believe it is "unfair and unreasonable" for EPA to propose to change the status of certain HFCs from acceptable to unacceptable in new equipment without simultaneously listing acceptable, commercially available alternatives. For these reasons, NEDA/CAP recommended that EPA evaluate the actual availability of alternatives, not their theoretical availability, in its examination of alternatives under CAA section 612. Specifically, NEDA/CAP recommended that EPA evaluate the continued

availability of acceptable alternatives for existing equipment (e.g., IPR, and commercial comfort and industrial cooling equipment) that may be affected by the proposed rule.

Response: EPA disagrees with the commenter that there are almost no available alternatives for the substitutes for which EPA proposed a status change. As noted in the NPRM and section VI.A.5–9 of the preamble to the final rule, EPA has listed a number of alternatives as acceptable in new equipment in residential and light commercial AC and heat pumps, cold storage warehouses, and centrifugal and positive displacement chillers for commercial comfort AC. CO₂, propane, isobutane, R-441A, ammonia, HFO-1234ze(E), *trans*-1-chloro-3,3,3-trifluoroprop-1-ene, and not-in-kind technologies such as Stirling cycle, water/lithium bromide absorption, dessicant cooling, or evaporative cooling, are acceptable in new equipment for one or more of the end-uses for which EPA proposed a change in status. The commenter also did not provide information as to why they believe these alternatives would not be viable in new equipment. Moreover, EPA does not agree that the change of status for certain refrigerants in specific uses would result in a corresponding reduction in demand for non-ozone-depleting refrigerants in new equipment. The overall global demand for refrigeration and air conditioning equipment has expanded while ODS are being phased out and EPA anticipates this expansion will continue. There will be continued use of other non-ozone-depleting alternatives not subject to this action in new equipment.

Comment: NEDA/CAP commented that EPA should address in the rulemaking (1) EPA's analysis of the impact of the proposed status changes on the refrigerant supply base for existing affected refrigeration and cooling equipment; (2) whether the supply base for this existing equipment will remain viable for the expected life of recently replaced equipment; (3) what the economic impacts are for businesses related to the inevitable drop in demand for existing refrigerants; (4) whether alternative refrigerants other than propane will be available and what the conditions for their use will be; (5) the impact of the proposal on the production of current acceptable HFCs and propylene and indicate what the alternatives available are for retrofit of existing equipment if existing chemical producers cease manufacturing these compounds as a result of the proposed rule.

Response: EPA has provided information in the docket to this rulemaking and in the preamble to the July 2015 rule concerning changes in the production of both fluorinated and non-fluorinated alternatives to ODS. EPA has no information to suggest there will be a shortage in refrigerant supply for existing equipment.

This action does not require retrofitting existing equipment. EPA is confident there will be adequate supply to service existing equipment either based on continued production or based on recovery and reuse of existing supplies of the refrigerants undergoing a change of status. EPA bases this judgment on our historical experience. For example, CFC chillers can still be serviced even though we have had no production or import of newly produced CFCs since 1996. Similarly, halons continued to be used even though we ceased production and import of newly produced halons in 1994. HCFC-22 was phased out of production for new equipment as of 2010, but is still being produced and used for existing equipment.

EPA's action does not ban production of any HFC and as noted above, some of the HFCs will be blended with HFOs to develop new refrigerants. While there may be a shift between chemical or refrigerant producers, it is not clear that there will be a loss for these companies and demand may increase in other global markets. It is possible that the price of refrigerants undergoing a status change will increase if supplies decrease relative to demand. End users with existing equipment may take steps to reduce the impact of price changes on the open market such as recovering and recycling their refrigerant, as many supermarkets currently do with HCFC-22.

As noted throughout this rule, we anticipate many refrigerants will be available and not just propane. Propane is only acceptable for a limited number of refrigeration and AC end-uses, including household refrigerators and freezers, and is not currently listed as acceptable for chillers, cold storage warehouses, or retail food refrigeration—refrigerated food processing and dispensing equipment. EPA has listed a number of HFO and HFO/HFC refrigerants as acceptable with no use conditions for use in each of the refrigeration and AC end-uses undergoing a change of status in this rule (e.g., R-450A and R-513A for all these end-uses; HFO-1336mzz(Z), HCFO-1233zd(E), HFO-1234ze(E) and R-514A for centrifugal chiller). In addition, CO₂ and ammonia are acceptable refrigerants in retail food

refrigeration—refrigerated food processing and dispensing equipment and ammonia is acceptable in cold storage warehouses.

Chemical producers may continue to produce the HFCs undergoing a change of status for uses that are acceptable including for servicing of existing equipment and for end-uses that are not subject to a change of status. In the case of propylene, that refrigerant has only been listed as acceptable as a refrigerant in IPR, and EPA has not proposed to change that status. Nothing in this action calls for retrofitting. However, we note that EPA has published lists of acceptable refrigerants for new equipment and retrofits, and these are available at <https://www.epa.gov/snap/refrigeration-and-air-conditioning>.

2. Proposed Status Change Dates

Comment: The Alliance appreciated that EPA considered the DOE energy conservation standards for the rulemaking, but urged the Agency to better coordinate the proposed status change dates with the ongoing DOE energy conservation rulemaking schedules.

Response: EPA appreciates this comment. The Agency and DOE have increased our dialogue to better understand the timing that each is taking under our separate authorities.

Comment: Arkema, NAFEM, and UTC requested that EPA delay the change of status dates to provide adequate time for product research and development, product testing, certification, and time for the approved alternatives to become widely available on the marketplace. Arkema noted that the proposed rule seems to acknowledge these difficulties only for uses involving either the federal government or the aeronautics industry, giving extra time for military, space, and aeronautics applications to transition from HFCs in foam blowing and in chillers. Arkema also stated that if the rule is finalized as proposed, EPA should allow all users to claim an exemption based on the unavailability of feasible alternatives or explain the standard (e.g., availability of alternatives, cost, environmental benefits, etc.) it is trying to satisfy in setting the change of status dates. NAFEM requested an extension of at least 10 years for the proposed status changes to allow sufficient time for safe product development and testing, while Arkema suggested specific dates for specific substitutes and end-uses, ranging from 2021 for 407A–F in new chillers, refrigerated food processing and dispensing, and cold storage warehouses to 2025 for most applications of R-134a and R-410A. UTC

stated that EPA should not implement the change of status for HFC-134a before 2025, which would allow time for system redesign, testing, and to change state and local codes in cases where the refrigerants are flammable. UTC believes that any change of status dates earlier than January 1, 2025, would effectively lead to a ban on the sale of air cooled chillers in many states and force customers to use existing units or to switch to lower efficiency packaged products and VRF systems that are still allowed to use R-410A. While EPA and large parts of the industry are committed to a transition away from HFC refrigerants, there is simply no forcing mechanism at the state and local level that would lead to near-immediate adoption of the necessary code changes.

Response: EPA looked at each change of status independently and has provided a rationale for the specific date for each end-use affected by this final rule. EPA does not agree that any specific minimal number of years should be required for a change of status and notes that there may be instances where immediate action is justified. With regards to NAFEM's comments supporting an extension, it is not clear if NAFEM is requesting additional time for an end-use covered in this action or whether the request concerns the July 2015 rule, which is beyond the scope of this action. EPA disagrees with Arkema's comments regarding the availability of alternatives. EPA has listed as acceptable alternatives that pose lower overall risk to human health and the environment than the substitutes we are listing as unacceptable, which supports a transition away from the substitutes that we have concluded provide a greater risk to human health and the environment. The commenter did not provide information as to why these alternatives would not be viable in the end-uses addressed in this action.

Comment: NAFEMF suggested that EPA provide manufacturers an opportunity to qualify for additional status change extensions under SNAP's grandfathering provisions. They noted that EPA has historically allowed manufacturers that transitioned to a substitute deemed acceptable by the Agency to continue using the previously acceptable substitute until the current supply was used up, even if that occurred after the rule's compliance date.

Response: While EPA is not applying "grandfathering" in this rulemaking, we have established status change dates for different sectors and end-uses that reflect the date by which we expect alternatives that pose lower overall risk

to human health and the environment will be available, both for existing and new users of certain substitutes. In considering when alternatives will be available for these other end-uses, we have considered the technical challenges that the end users are facing with the transition. Under both the approach used in this rule and the grandfathering approach, we consider whether there is a basis to establish the change of status later than the effective date of the rulemaking and thus the approaches result in a similar outcome.

Comment: Johnson Controls commented that there is speculation that EPA chose the change of status dates in this rule to meet obligations proposed in the North American amendment proposal to the Montreal Protocol.

Response: The change of status dates in this rule were arrived at after careful consideration of the availability of other substitutes in each end-use. These decisions were informed by extensive consultation with stakeholders throughout the rulemaking process. While the United States is seeking an amendment to the Montreal Protocol, it is not clear what control measures, if any, might be adopted. The changes in status here relate to use in the United States of alternatives that are safer overall for human health and the environment.

Comment: Arkema provided a list of steps needed for "product line development" including "researching options, risk assessment, analyzing existing manufacturing capabilities, working with component suppliers, building test units, testing beta units, updating manufacturing processes (including employee training), building pre-production units, field testing, completing the customer approval process, phasing in production, disposing of trapped inventory, and training installation and maintenance personnel" and ensuring "products conform to local building codes." For new cold storage warehouses and for refrigerated food processing and dispensing equipment, Arkema suggested a 2021 transition date for R-407A, R-407B, R-407C, R-407D, R-407E, and R-407F, claiming that "[t]his decision should mirror previous supermarket decisions for new and retrofit applications." For HFC-134a, they proposed a 2025 status change date and as their "[r]ationale" only stated "[s]upply, suitability of alternatives."

Response: The commenter is mistaken as to EPA's previous action for the supermarket systems end-use category within the retail food refrigeration end-use. In SNAP Rule 20 (80 FR 42870; July

20, 2015), EPA changed the status of only one of the identified refrigerants (R-407B) for this end use and established a January 1, 2017 status change date for new equipment.

For the reasons provided in section VI.A.6 and in our proposal, we have determined that January 1, 2023 is a reasonable but expeditious date for the change of status for new cold storage warehouses. For new refrigerated food processing and dispensing equipment, the recommended 2021 date for the R-407 series refrigerants matched our proposal and for the reasons provided in section VI.A.7 and our proposal we have finalized that change of status date.

The commenter did not otherwise provide any support for why a bifurcated 2021 and 2025 change of status date was sufficient and needed to address the technical challenges for either the cold storage warehouse end-use or the refrigerated food processing and dispensing equipment end-use category. For the 2025 date, the commenter provided no justification for why the supply or suitability of existing alternatives was not sufficient to support the proposed January 1, 2023, status change date for cold storage warehouses but would be to support a January 1, 2025, date. The commenter did not provide any evidence that supply of alternatives was lacking to justify their proposed 2025 status change date for HFC-134a in both end-uses. EPA had already determined that not to be true in a previous rulemaking (80 FR 42904; July 20, 2015). Further, the commenter did not indicate why the supply for HFC-134a alternatives in either end-use would not be available until 2025 yet the supply of alternatives for the R-407 series refrigerants would be available by 2021, or why the set of alternatives would be different.

B. Authority

1. General Authority

Comment: EIA supported EPA's authority to regulate substances within a comparative risk framework. EIA commented that EPA's SNAP program was created to assure the health and environmental safety of alternatives for ODS that were being phased out, which is achieved through EPA's comparative review process. EIA also indicated that the proposed rule is an important step towards implementing the President's CAP.

Response: EPA appreciates the commenter's support of the rule.

Comment: Arkema, AHAM, and Mexichem expressed the opinion that the proposed rule is outside the scope of EPA's regulatory authority. Similar to

their comments submitted in response to the NPRM for the July 2015 rule, the commenters stated that the purpose of the original SNAP program was to evaluate substitutes for ODS, and that now using this same framework to evaluate non-ODS against other non-ODS on the basis of GWP, for example, violates the authority granted under CAA section 612. They argued that these new compounds are not substitutes for ODS, and thus are not real "substitutes" in the context of the original SNAP framework. Arkema emphasized its support for an HFC amendment to the Montreal Protocol, but asserted that EPA is proposing to "replace non-ODS with new non-ODS chemicals based on [GWP]," which goes against the mandate of CAA section 612 to "replace" ODS. AHAM stated that CAA Title VI was not intended to "provide EPA broad, general and roving authority to regulate refrigerants, foams and chemicals in whatever circumstances it deems desirable if they are unrelated to ozone depletion." Likewise, Mexichem asserted that the repeated references to class I and class II substances in Title VI demonstrate that, in enacting CAA section 612, Congress was concerned with phasing out ODS, and that there is "no mention in section 612 (or its legislative history) that Congress ever intended for this law to be used to regulate second-generation substances on the basis of [GWP]."

Response: EPA disagrees with the commenters that it lacks the authority to regulate the continuing replacement of ODS with the substitutes whose listing status is addressed in this action. In this rulemaking, EPA considered whether such replacement should continue to occur given the expanded suite of other alternatives to ODS in the relevant end-uses and our evolving understanding of risks to the environment and public health. There is no question that the substitutes subject to a change in status in this action (e.g., HFC-134a) directly replaced ODS in the relevant sectors. See section VII.A.2 of the preamble to the July 2015 rule for additional discussion of non-ODS alternatives.

Comment: AHAM stated that this proposal violates Executive Orders 12866 (9-30-93), 13563 (1-18-2011), and 13610 (5-10-12) requiring that agencies consider the cumulative effects of regulations, including cumulative burden. AHAM commented that given the new energy efficiency standards placed on the appliance industry, being forced to also comply with the timeline and additional restrictions proposed in this rulemaking would be unnecessarily burdensome on affected entities. They especially emphasized the minimal

difference in emissions saved by prematurely transitioning the industry to these substitutes.

Response: EPA disagrees with the commenter's assertion that the proposed rule violates Executive Order 13563, given that there is currently no DOE standard that results in cumulative regulatory burden with this rule. Further, we expect that with a change of status date of January 1, 2021, for household refrigerators and freezers, companies would be able to coordinate compliance with an energy conservation standard with a compliance date in 2020. Thus, we believe that in fact, the potential cumulative impacts of the two sets of regulations are reasonable. See also the discussion in section VI.A.8.ii on the change of status dates for household refrigerators and freezers.

2. GWP Considerations

Comment: Mexichem commented that EPA focuses the analysis of HFC-134a on comparative GWP instead of conducting a comprehensive analysis that considers all of the agency's criteria—atmospheric effects, exposure assessments, toxicity data, flammability, and other environmental impacts, such as ecotoxicity and local air quality impacts—as well as a full alternatives analysis of performance, availability, hazard, exposure, and cost of the alternatives. Arkema also commented that EPA relies on the differences in GWP to justify the proposed status changes, but fails to explain why those differences result in a larger risk for certain HFCs in each end-use. For example, Arkema stated that EPA does not explain the rationale for proposing to change the status from acceptable to unacceptable for some high-GWP substitutes, such as R-407A with a GWP of 2,107, but not R-407F with a GWP of 1,824, for cold storage warehouses.

Response: EPA disagrees with the commenters that it relies solely on GWP in the evaluation of the alternatives under the SNAP program. In all cases, EPA considers the intersection between the specific alternative and the particular end-use and the availability of substitutes for those particular end-uses. When reviewing a substitute, EPA compares the risk posed by that substitute to the risks posed by other alternatives and determines whether that specific substitute under review poses significantly more risk than other alternatives for the same use. In our analysis of overall risk, we evaluate the criteria at 40 CFR 82.180(a)(7). For particular substances, EPA found significant potential differences in risk with respect to one or more specific criteria, such as flammability, toxicity,

or local air quality concerns, while otherwise posing comparable levels of risk to those of other alternatives in specific end-uses. Regarding GWP, that is one of several criteria EPA considers in the overall evaluation of the alternatives under the SNAP program. There are a number of examples in this rulemaking where we determined not to change the status of HFC-134a, for example, because the GWP of other alternatives is a concern for a specific use. For particular substances, such as R-407A, EPA found significant potential differences in risk with respect to one or more specific criteria, such as GWP, while otherwise posing comparable levels of risk to those of other alternatives in specific end-uses. EPA also notes that several decisions included in this action are based on significant potential differences with respect to other factors including flammability, and local air quality. For example, we are listing propylene and R-443A as unacceptable in centrifugal chillers, positive displacement chillers, cold storage warehouses, and residential and light commercial AC and heat pumps in particular because of concerns about local air quality. We are listing all refrigerants identified as flammability Class 3 in ANSI/ASHRAE Standard 34–2013 and all refrigerants meeting the criteria for flammability Class 3 in ANSI/ASHRAE Standard 34–2013 as unacceptable for use in retrofit unitary split AC systems and heat pumps in the residential and light commercial air conditioning and heat pumps end-use.

Concerning differences in GWP values and how EPA decided to change the status of certain alternatives while other alternatives remained acceptable, EPA did not establish bright-line cutoffs but rather considered which substitutes are available on an end-use by end-use basis. For the example of refrigerants in the cold storage warehouse end-use that Arkema cites, we considered that R-407F has the lowest GWP of the refrigerant blends that are both widely commercially available and can be used for those situations and types of equipment where HCFC-22 is used. R-407A has a higher GWP and otherwise is comparable to R-407F, and thus results in higher overall risk to human health and the environment.

See also section VII.A.3 of the preamble to the July 2015 rule and section 6.3.3 of the Response to Comments for the NPRM for that rule for additional information on GWP considerations under the SNAP program.

Comment: Arkema commented that EPA makes GWP the sole criterion for decisions about atmospheric effects,

instead of basing it on the “total [GWP] of the substitute and the indirect contributions to global warming caused by the production or use of the substitute (e.g., changes in energy efficiency), and environmental release data, including available information on any pollution controls used or that could be used in association with the substitute.”

Response: EPA disagrees that GWP was the only criterion considered in determining whether to change the status of a substitute. Further information and explanation on use of GWP as a metric is provided in section VII.A.3 of the preamble to the July 2015 rule and in the following response. Considerations of atmospheric effects and related health and environmental impacts have always been a part of SNAP’s comparative review process, and the provision of GWP-related information is required by the SNAP regulations (see 40 CFR 82.178 and 82.180). The issue of EPA’s authority to consider GWP in its SNAP listing decisions was raised in the initial rule establishing the SNAP program. In the preamble to the final 1994 SNAP rule, EPA stated: “The Agency believes that the Congressional mandate to evaluate substitutes based on reducing overall risk to human health and the environment authorizes use of global warming as one of the SNAP evaluation criteria. Public comment failed to identify any definition of overall risk that warranted excluding global warming” (59 FR 13044, March 18, 1994). Consistent with that understanding, the 1994 SNAP rule specifically included “atmospheric effects and related health and environmental impacts” as evaluation criteria the Agency uses in undertaking comparative risk assessments (59 FR 13044, March 18, 1994; 40 CFR 82.180(a)(7)(i)). That rule also established the requirement that anyone submitting a notice of intent to introduce a substitute into interstate commerce provide the substitute’s GWP (see 40 CFR 82.178(a)(6)). Accordingly, we have considered the relative GWP of alternatives in many SNAP listing decisions. EPA did not propose to revise its regulations to abandon consideration of GWP in this rule.

In response to comments that EPA failed to assess and account for indirect climate impacts, we note that we do not have a practice in the SNAP program of including indirect climate impacts in the overall risk analysis. EPA initially contemplated such considerations in the initial SNAP rule, but our experience has been that it is impractical to perform a detailed analysis of indirect global

warming impacts associated with a particular substitute. For example, the inherent energy efficiency of the substitute is not the same as the energy efficiency of equipment using that substitute. To analyze energy efficiency and other indirect climate impacts would require EPA to identify not only every type of equipment but also each model, identify or predict the amount of each available substitute that might be used in each type of equipment, make assumptions about how the equipment would be operated, assess what type of electricity was used to both manufacture the substance and power the equipment or manufacturing process, and so on. See the July 2015 rule, 80 FR at 42921 and section 6.4.2 of the response to comments document for that rule. We do, however, consider issues such as technical needs for energy efficiency (e.g., to meet DOE standards) in determining whether alternatives are “available,” and have followed that practice in this rulemaking. We believe that there is a sufficient range of acceptable alternatives that end users will be able to maintain energy efficiency levels. We also note that federal energy conservation standards will continue to ensure that equipment regulated by this rule will not increase its indirect climate impacts.

Comment: Honeywell commented that even greater emissions reductions could be projected by using more up-to-date GWP values. Honeywell commented that the use of out-of-date GWP values in such an important rule can cause confusion, especially among those trying to evaluate and compare low-GWP technologies. Instead of GWP values from the IPCC Fourth Assessment Report (AR4), Honeywell suggested that EPA consider adopting the IPCC AR5 GWP values in the future.

Response: EPA used the GWP values in the IPCC AR4 in the NPRM and continues to use these in this final rulemaking to maintain consistency with other rules and facets of the SNAP program and with other U.S. domestic programs (e.g., EPA’s Greenhouse Gas Reporting program, codified at 40 CFR part 98). Using consistent GWPs allows for more efficient operation of U.S. climate programs and facilitates integration with other public and private sector programs on international, national, state, and local levels. It also reduces the burden on stakeholders of keeping track of separate GWPs when interacting with these programs. Use of the AR4 GWPs will also ensure compatibility with the Climate Action Report and other reporting requirements under the United Nations Framework Convention

on Climate Change (UNFCCC). Countries, including the United States, that submit GHG inventories under the UNFCCC have decided to use AR4 GWPs for the GHGs that have AR4 GWPs, beginning with the inventories submitted in 2015.²¹⁶ Adoption of AR5 GWPs while other EPA and international programs are using AR4 GWPs likely would cause stakeholder confusion, create an ongoing need to explain the distinction in GWPs in subsequent actions, and complicate decision-making. Also, use of AR4 GWPs ensures that the SNAP program uses widely relied on, published, peer-reviewed GWP data. EPA may consider adoption of AR5 GWPs or other GWP values in the future. In any event, use of AR5 GWPs would not result in a change in EPA's conclusions about the comparative risk posed by the substitutes addressed in this rule.

Comment: CARB recommended establishing specific numerical limits for GWP of acceptable substitutes in certain end-uses. They recommended prohibiting all refrigerants with a GWP greater than 150 in cold storage warehouses, refrigerated food processing and dispensing equipment and household refrigerators and freezers. For chillers, CARB recommended prohibiting all refrigerants with a GWP greater than 750.

Response: EPA has not set "bright line" cut offs based on GWP or the other SNAP criteria, for reasons explained in numerous actions, including section IV.B of the SNAP Proposed Rule 20 (79 FR 46135; August 6, 2014), sections IV.B and V.C.6.(a) of the corresponding final Rule 20 (80 FR 42920; July 20, 2015), section I.A of the proposed rule (81 FR 22812–22813; April 18, 2016), and section I.A of this final rule. As noted in those actions, the structure of the SNAP program, which is based on a comparative framework of available substitutes for a specific end-use at the time a decision is being made, does not support the use of such bright lines.

3. SNAP Review Criteria and Guiding Principles

Comment: Arkema commented that the proposed rule fails to follow EPA's policies in the guiding principles, fails to consider all relevant information as defined by regulation, and fails to apply

the regulatory criteria for SNAP evaluation when determining if a substitute poses more risk than other alternatives for the same end-use. Arkema stated that EPA's policy has been to restrict a SNAP substitute only if it is significantly worse than the alternatives; however, the proposed rule "relies on differences in [GWP] to justify reclassification." Arkema further commented that, according to 40 CFR 82.178(a)(6), EPA is to consider information concerning GWP, including both the total GWP of the substitute and the indirect contributions to global warming caused by the production or use of the substitute, and environmental release data, including available information on any pollution controls used or that could be used in association with the substitute. Arkema believes EPA fails to follow these principles and instead, makes GWP the sole criterion for decisions about atmospheric effects. Finally, Arkema commented that the proposed rule states "EPA is not setting a risk threshold for any specific SNAP criterion, such that the only acceptable substitutes pose risk below a specified level of risk." Arkema believes this statement violates EPA's policy to regulate only significant risk in a specific end-use because it asserts that the Agency "can ban a substance to reduce any risk, regardless of the magnitude of the risk."

Response: EPA disagrees with the commenter that the proposed rule violates the Agency's regulations or guiding principles. See the preamble to the July 2015 rule at 80 FR 42940–42. We consider the proposed and final rules to be consistent with the SNAP guiding principles:

1. First guiding principle: *Evaluate substitutes within a comparative risk framework.* As suggested by the first guiding principle, in all of the actions that EPA proposed and is today finalizing, EPA evaluated the risk of substitutes compared to available or potentially available alternatives. In that effort, a range of risk factors are well described in this action. The factors that EPA considers are stated at 40 CFR 82.180(a)(7).

2. Second guiding principle: *Do not require that substitutes be risk free to be found acceptable.* EPA has not required substitutes to be risk free. We acknowledge in the proposed and final rules that both the substitutes changing status and the other available alternatives have risks. In this rule, as in past SNAP rules, we have considered whether there are alternatives that are available or potentially available that pose a lower overall risk to human

health and the environment in specific end-uses and end-use categories.

3. Third guiding principle: *Restrict those substitutes that are significantly worse.* EPA has based our decisions on whether substitutes have significantly greater risk than other available substitutes for the same uses. For example, we did not propose and are not finalizing today changes in status where there is only a marginal difference in risk between two alternatives available or potentially available in the same end-use. As described in the preambles to the proposed and final rules, the Agency carefully considered the substances addressed in this action on the basis of the SNAP criteria, and concluded that other alternatives presented a degree of reduced overall risk sufficient to warrant the actions being taken in this rulemaking. In response to the comment that the NPRM compares GWPs without explaining the significance of the differences for any effect on climate, EPA did not estimate differences in temperature change or other physical climate metrics due to the impacts of the rule. EPA has not used these metrics in the past as measures of climate impact for other SNAP decisions. See section II.G and III on the use of GWP as a metric for climate impact and the significance of the rule for climate.

4. Fourth guiding principle: *Evaluate risks by use.* EPA evaluated substitutes for specific uses and reached different conclusions for the same substitute in different uses, depending on the specific risks and other available or potentially available alternatives in the relevant uses. For example, we are listing propane as acceptable, subject to use conditions in new self-contained commercial ice machines, new water coolers, and new very low temperature refrigeration equipment, while listing propane and all other ASHRAE flammability Class 3 refrigerants as unacceptable for retrofitting existing unitary split systems within residential and light commercial AC and heat pumps. No action was taken to ban any one HFC or other alternative across all end-uses. Additionally, as noted by the commenter, we considered the potential risks of alternatives used for servicing of MVAC or commercial refrigeration apart from new equipment or from retrofits of existing equipment. See section 6.3.6 of the Response to Comments for the NPRM for the July 2015 rule.

5. Fifth guiding principle: *Provide the regulated community with information as soon as possible.* EPA provided the regulated community with information as soon as possible by holding a series of workshops and public meetings

²¹⁶ The IPCC publishes Scientific Assessment Reports, including updated and expanded sets of GWPs, approximately every six years. The countries that submit annual GHG inventories under the UNFCCC update the GWPs that they use for those inventories less frequently. For example, the GWPs from the IPCC Second Assessment Report have been used for UNFCCC reporting for over a decade.

concerning this action and other regulatory issues relevant to various industrial sectors over the course of more than a year before we issued our proposal. See section 6.3.6 of the Response to Comments for the NPRM for the July 2015 rule.

6. Sixth guiding principle: *Do not endorse products manufactured by specific companies.* Our change of status decisions reflect the availability of multiple alternatives for each end-use. Regarding endorsements, see section V.B.6.a of the preamble to the July 2015 rule at 80 FR 42896.

7. Seventh guiding principle: *Defer to other environmental regulations when warranted.* We note that this reads “Defer to other environmental regulations when warranted” (emphasis added). Other regulations may not ensure that substitutes that pose significantly greater risk are prohibited where safer alternatives are available because those regulations do not address all or address sufficiently the risk posed. EPA has considered the potential impacts of other environmental, health, and safety regulations. EPA carefully considered these and other existing regulations under other programs when reviewing substitutes. For example, we considered the presence of OSHA regulations in addressing flammability risk in factories where foam is blown. EPA did not propose and is not finalizing a change in how this principle is applied. EPA continues to consider other environmental, health and safety regulations and notes these regulations where appropriate in our decisions. We also considered the existing MACT standard that prohibits the use of methylene chloride in flexible PU foam production for major sources, including relying on the risk analysis performed for EPA’s recent risk review of the MACT. See sections VI.A.2 and VI.C.4 regarding EPA’s consideration of other stratospheric ozone regulations.

Concerning consideration of all relevant information as defined by regulation, we note that it is within the discretion of the Agency to determine which information is relevant out of the total set of information in EPA’s possession. The specific information that must be provided to EPA for review under the SNAP regulations at 40 CFR 82.178 informs, but does not govern, EPA’s decisional criteria for review of substitutes under 40 CFR 82.180(a)(7).

Concerning Arkema’s quotation from the proposed rule, it states that we do not use the same “bright line” risk threshold for all substances. This is consistent with EPA’s guiding principles, where we consider

comparative risk of the available substitutes within an end-use. From a scientific point of view, it would be inappropriate, and potentially not protective, for EPA to use the same concentration in ppm to determine flammability risks or toxic concentrations for different substitutes, rather than considering the LFL or exposure limit for the specific substitute.

Comment: Arkema commented that the military, NASA, and the aeronautics industry would have special exceptions for certain chiller and spray-foam applications for which there appears to be little supporting technical detail in the record, but that at least for chillers are based on the relative significance of the associated emissions. Arkema asked what the effect on the atmosphere would be if the entire private sector had the benefits of the proposed narrowed use limits for military marine vessels, human-rated spacecraft, and related support equipment.

Response: We expect that the rest of the private sector would not meet the requirements for a narrowed use limit because substitutes that are acceptable, subject to narrowed use limits, may only be used where reasonable efforts have been made to ascertain that other alternatives are not technically feasible due to performance or safety requirements. Multiple alternatives with lower GWP are available for chillers and equipment manufacturers are already implementing them;^{217 218} thus, other alternatives are technically feasible. See also sections VI.A.5.i and VI.A.6.i of this rule for a discussion of available alternatives. This is different from the situation for military marine vessels and human-rated spacecraft and related support equipment which have many unique characteristics that make it more difficult and time-consuming to evaluate and implement alternatives; see the preamble to the NPRM at 81 FR 22844, 22848 (April 18, 2016). In addition, the time periods for qualification of products to meet specifications for the military or for space flight and aeronautics-related applications are significant. For example, in the case of foams, one aerospace company stated that it would take more than two years to develop, test and qualify a new alternative, and it will take at least another five years “to manufacture flight-representative foam samples, followed by ground and flight

testing,” and then additional time to retool their facilities to manufacture the foam with an alternative blowing agent.²¹⁹ NASA began development of spray polyurethane foams using HFC-245fa in 2007 and only now in 2016 expects to complete qualification.²²⁰

EPA did not base the narrowed use limits for centrifugal and positive displacement compressor chillers for military marine vessels or for human-rated spacecraft and related support equipment applications on the relative significance of the associated emissions; rather, for informational purposes, we indicated that emissions were not expected to be significant. EPA’s decisions are based on the comparative risk of various alternatives considering the SNAP criteria, not based on achieving a specific climate benefit. EPA provided information concerning the estimated climate benefits associated with the proposed and final rule. EPA did not calculate the benefits or atmospheric impacts from every possible scenario.

Comment: AHRI, the Alliance, HARC and NEDA/CAP all urged consistency in EPA’s stance on and implementation of the SNAP program. AHRI and HARC encouraged EPA to adhere closely to the principles of the Agency’s position at the Montreal Protocol and the initial 1994 SNAP framework. The Alliance requested (1) that EPA clarify how the proposal is consistent with a global phase-down approach to HFCs, (2) that EPA articulate how the SNAP program would be used in the context of implementing an HFC amendment to the Montreal Protocol, and (3) that for any future rulemakings for a change of SNAP listing status, EPA publish a clear and predictable evaluation process by which risk factors are compared in the comparative risk framework to make SNAP change of status decisions with transparency on how the factors will be weighted. NEDA/CAP expressed concern about the greater frequency of new rules and listings and the “rolling and complex schedule” of change of status dates, which could complicate industry’s ability to operate the installed base of existing equipment using refrigerants proposed to undergo a change of status in new equipment. NEDA/CAP suggested that EPA provide a “master schedule” for the review and

²¹⁹ The Boeing Company. Comments on Proposed Rule to Change the Status of Certain Substitutes under the Significant New Alternatives Policy Program. October, 2014.

²²⁰ Spray Foam Magazine, 2016. “SPF and SLS Help NASA Explore Deep Space” September/October issue, 2016. This document is accessible at: <http://sprayfoammagazine.com/spf-sls-help-nasa-explore-deep-space/>.

²¹⁷ Press release, “Ingersoll Rand Innovates HVAC Portfolio Using Next Generation, Low Global Warming Refrigerant, R-452B”, June 16, 2016.

²¹⁸ Press release, “Trane Announces Significant Centrifugal Chiller Line Expansion and Services for the United States and Canada.” July 13, 2016.

listing of substitutes, given the fact that “EPA’s increasingly ‘piecemeal’ new approach to SNAP revisions creates other business planning problems and potentially significant equipment compatibility issues for existing refrigerant, chiller and cooling equipment.”

Response: EPA considers this final rule to be consistent with the framework in the initial SNAP rule, as explained in section II of the NPRM at 81 FR 22816–9 and in section II of this preamble. This rule concerns specific uses of certain alternatives to ODS, including some HFCs, while the North American Proposal to amend the Montreal Protocol to add a global phase-down of HFCs concerns HFC production and consumption generally without reference to specific uses. Reductions in use of certain HFCs in specific end uses due to changes of status under the SNAP program are expected to result in decreased production of those HFCs, which would contribute to the United States’ ability to implement reductions in production and consumption of HFCs under a global phase-down of HFCs along the lines of the North American Proposal.

With regard to specific quantification of reductions in overall risk to human health and the environment, in the 1994 rulemaking, we considered and rejected comments suggesting that we develop an index to rank all substitutes based on risk. In the preamble to the rule, we specifically noted that “a strict quantitative index would not allow for sufficient flexibility in making appropriate risk management decisions” (59 FR 13044, March 18, 1994). See July 2015 SNAP rule at 80 FR 42940. Concerning NEDA/CAP’s comment about the frequency of recent rulemakings and listings, EPA notes that we have the authority to change the status of a previously listed alternative and mentioned this as a possibility in the initial SNAP rulemaking. See the preamble to the July 2015 rule at 80 FR 42939–40. Further, the CAP has guided EPA in our decision to issue more frequent listings as well as rulemakings including changes of status. We also note that some of our recent decisions mentioned by NEDA/CAP have provided additional alternatives for both new and retrofits of existing equipment, which would have no impact on the production of other alternatives or on existing equipment manufactured with other alternatives. Concerning NEDA/CAP’s comment about the potential impact of the rule on existing equipment, see the discussion in section VII.A.1.

Comment: AHAM commented that EPA has no justification for changing the listing status of compounds of which the toxicity, GWP, efficiency and other criteria of evaluation remain unchanged.

Response: EPA disagrees. The suite of available or potentially available alternatives changes over time and the availability of those alternatives enables a broader review of comparative risk under section 612(c). Further, our understanding of the impact that HFCs have on climate has evolved and become much deeper over the years. See the preamble to the July 2015 rule at 80 FR 42935–6.

Comment: Arguing that we should not change the status of R-407A and R-407B for cold storage warehouse, and should find R-448A and R-449A acceptable for that end-use as well as for refrigerated food processing and dispensing equipment, AHRI stated that the “direct refrigerant emissions in these end uses represent a small percentage of the overall life cycle climate performance” and that overall greenhouse gas emissions will increase if a less efficient product were used.

Response: EPA interprets this comment to be based on the SNAP review criteria of “atmospheric effects,” which is discussed above in section II.E.1. We have noted that part of our review of the overall risk to human health and the environment that substitutes pose includes the GWP of a particular substitute, and the GWPs of R-407A and R-407B are higher than those of other alternatives in the cold storage warehouse end-use. Our conclusion as discussed in section VI.A.6.b.i above was that these refrigerants pose overall greater risk than other alternatives. With respect to R-448A and R-449A in both end-uses, we noted in sections VI.A.6.c.i and VI.A.7.b.ii above that EPA is currently evaluating those refrigerants for these end-uses but has not yet issued either a proposed decision or a Notice of Acceptability for these refrigerants in these end-uses.

The reader is referred to sections VII.B.2 above and VII.D.3. As discussed in response to other comments in section VII.D.3 below, energy efficiency is not a specific criterion under SNAP, and indirect GHG emissions may vary based on energy efficiency of the appliance. As discussed in response to comment in section VII.B.2 above, EPA initially contemplated considering indirect climate impacts as part of our overall risk analysis in the initial SNAP rule, but our experience has been that it is impractical to perform a detailed analysis of indirect global warming

impacts associated with a particular substitute.

C. Cost and Economic Impacts

EPA received comments from Arkema, NAFEM, Structural Composites and Compsys, AHAM, and UTC in which commenters provided data on the cost and economic impacts of the proposed rule. These comments are summarized in the response to comments sections for the end-uses addressed in this final rule. We summarize and respond to the more general cost comments in this section.

1. Costs of Rule

Comment: EPA received comments suggesting that EPA provide more time for the changes in status in order to avoid undue burden on the U.S. economy. UTC commented that if this rule is finalized as proposed, industries and companies utilizing many of the refrigerants and propellants affected by this rule will need to invest substantial resources in order to promote compliance with the intended transition over the next decade. AHAM stated that under EPA’s proposed change of status dates, the costs would be significantly higher during the transition to an alternative refrigerant as compared to a date three years later, which would allow companies adequate time to structure costs and decrease risk over multiple years and at almost half the cost. AHRI noted that accelerating the process for changing multiple product platforms by even a single year can significantly impact manufacturers’ costs and resources burden. Arkema commented that no SNAP rule should impose unreasonable burdens on the U.S. economy. Arkema recommended that EPA allow more time for transitions to avoid that outcome.

Response: EPA understands that there are challenges associated with transitioning substitutes, including costs to manufacturers in redesigning equipment and making changes to manufacturing facilities. As an initial matter, and as discussed more fully in section VII.A.3, under the SNAP criteria for review in 40 CFR 82.180(a)(7), consideration of cost is limited to cost of the substitute under review, and that consideration does not include the cost of transition when a substitute is found unacceptable.

The transition timelines in this final rule are based on information concerning the availability of alternatives. While EPA does not consider the cost of transition in its analysis, EPA recognizes that later dates allow industry time to plan and to spread out capital costs over longer time

periods. We have selected the change of status dates, both as proposed and as finalized, considering technical factors, such as time required for research and development, time required for testing to meet industry and regulatory standards, time to adjust their manufacturing processes to safely accommodate the use of other substitutes, and supply of alternatives.

Comment: NAFEM commented that if the proposed changes are finalized, the rule will limit manufacturer productivity, threaten less profitable but important niche product lines that currently meet marketplace needs, and shift significant costs to end users of commercial refrigeration equipment. NAFEM further commented that costs and impacts for niche product lines, safety concerns, and evaluation, research, redesign, testing, implementation and training should be included in EPA's revised analyses. Structural Composites and Compsys comments that costs will dramatically increase if alternatives fail and several rounds of trials are required.

Response: Although EPA did not consider the costs of transitioning to other alternatives in making the listing decisions in this rulemaking, for informational purposes, we did prepare a cost analysis and a small business impacts analysis for this rule for businesses that are directly regulated. EPA recognizes that transitioning to other alternatives is likely to require capital costs and investments in research, updated equipment, and their related financial impacts. However, EPA's cost analysis did not evaluate the share of costs likely to be borne by consumers, since it is not clear what proportion of cost impacts may be passed on to consumers, and further, such economic analyses typically look at costs to the regulated community rather than indirect impacts on consumers. NAFEM did not provide specific cost or cost impact information for niche users or specific information for profit losses that would have allowed us to analyze the impacts for niche product lines. In the cases where commenters provided specific, detailed cost information, we used that information to revise the cost assumptions in our updated cost analysis for this final rule. For additional information on economic analysis conducted for this rule, see the supporting document "Cost Analysis for Regulatory Changes to the Listing Status of High-GWP Alternatives used in

Refrigeration and Air Conditioning, Foams, and Fire Suppression."²²¹

2. EPA's Cost Analysis and Small Business Impacts Screening Analysis

Comment: EPA received comments indicating that small businesses bear a disproportionate share of the regulatory burden. NAFEM and Structural Composites and Compsys stated that the proposed rule was overly burdensome to small businesses. NAFEM comments that if this rule is finalized as proposed, the available supply of equipment models will decrease because manufacturers will not be able to sell existing supply, will not have a portfolio of products ready to sell that comply with the new rule, and will have to pause the current development process for new projects already in the planning stage, further burdening small businesses. AHAM commented that the EPA's estimates for one time investments and annualized costs for facility conversion were "grossly" understated and EPA does not capture the "full financial impact to manufacturers."

Response: EPA disagrees with this comment. We prepared a preliminary small business screening analysis during the development of the proposed rule. We have updated our small business screening analysis using the change of status decisions and dates in the final rule and using detailed cost information provided by commenters.²²² In the analyses, EPA recognized that some small businesses may experience significant costs, but concluded that the number of small businesses that would experience significant costs was not substantial. A Small Business Advocacy Panel is convened when a proposed rulemaking is expected to have a significant impact on a substantial number of small entities, or "SISNOSE." EPA's preliminary and final screening analyses concluded that this rulemaking would not pose a SISNOSE. Accordingly, we did not convene a Small Business Advocacy Panel.

More broadly, for purposes of E.O. 12866, we performed an analysis of the costs of the proposed rule on all-sized businesses and estimated the total annualized upfront compliance costs to range from \$59.2–\$71.3 million, using a

7% discount rate, and \$58.8–\$70.6 million, using a 3% discount rate.²²³ Total annualized compliance costs across affected small businesses are estimated at approximately \$11.8–\$14.4 million at a 7% discount rate, or \$11.5–\$14.0 million at a 3% discount rate.²²⁴ We updated both analyses based upon the regulatory options and change of status dates in the final rule. The changes in the final rule—especially with respect to compliance dates—do not change the cost impacts on businesses. The commenters did not point to any specific aspects of that analysis that they believe are deficient.

Both the screening analysis for purposes of determining whether there was a SISNOSE and the analysis for purposes of E.O. 12866 were conducted based on the best market and cost information available to the Agency.

EPA also disagrees with the comment regarding the inability to sell existing supply as the status changes in the rule relate to new manufacturing and do not limit the sale of existing supply.

Comment: Arkema commented that EPA underestimated the costs of the NPRM. Arkema believes EPA's cost estimates are unduly optimistic given all that must be done to redesign equipment. Arkema further commented on three areas of economic analysis that they state need to be addressed. First, Arkema stated that EPA does not include the "wasted costs" incurred by those manufacturers that have actually changed designs of their equipment to meet DOE standards, based on the continued availability of existing SNAP substitutes, but that now may need to change their designs again. Second, Arkema suggested that EPA should account for "economic effects" on U.S. plants that produce HFC-134a and the other HFCs and HFC blends whose listing the Agency proposed to change. Third, Arkema suggested that the economic analyses should disclose how EPA expects prices and availability to change once it eliminates competing products, including stimulation of short-term demand for the HFCs and HFC blends whose listing the Agency proposed to change, longer term increases in prices for the HFCs and HFC blends, and increased demand for next-generation fluorinated products.

²²¹ ICF, 2016a. Cost Analysis for Regulatory Changes to the Listing Status of High-GWP Alternatives used in Refrigeration and Air Conditioning, Foams, and Fire Suppression. September, 2016.

²²² ICF, 2016b. Economic Impact Screening Analysis for Regulatory Changes to the Listing Status of High-GWP Alternatives used in Refrigeration and Air Conditioning, Foams, and Fire Suppression. ICF International. September, 2016.

²²³ ICF, 2016a. Cost Analysis for Regulatory Changes to the Listing Status of High-GWP Alternatives used in Refrigeration and Air Conditioning, Foams, and Fire Suppression. ICF International. September, 2016.

²²⁴ ICF, 2016b. Economic Impact Screening Analysis for Regulatory Changes to the Listing Status of High-GWP

Alternatives used in Refrigeration and Air Conditioning, Foams, and Fire Suppression. ICF International. September, 2016.

Response: See response above and see also section VII.B.1 of the preamble to the July 2015 rule.

Comment: Structural Composites and Comsys generally agreed with the economic impact of transitioning to an alternative, as outlined in EPA's "Economic Impact Screening Analysis for Regulatory Changes to the Listing Status of High-GWP Alternatives used in Refrigeration and Air Conditioning, Foams, and Fire Suppression."

Response: EPA appreciates this comment.

Comment: AHAM noted the anticipated development costs fluctuate depending on the transition deadline. According to data collected by AHAM, EPA's proposed date of 2021 for new household refrigerants has the highest transition cost per company, while the 2024 deadline proposed by industry allows companies adequate time to structure costs over multiple years at nearly half the cost.

Response: The cost of transition to other alternatives is not a consideration under the SNAP review criteria. See sections VI and VII.C for additional information on considerations of cost under the SNAP program. With regard to AHAM's analysis, it is not clear what years AHAM considered. For example, we could not determine if AHAM considered dates earlier than 2021 or limited their evaluation to 2021 and later dates.

D. Environmental Impacts of Status Changes

1. General Comments

Comment: UTC commented that EPA should avoid utilizing specific GWP limits in this or subsequent rulemakings.

Response: EPA agrees with this commenter, and notes that no SNAP action has established a maximum GWP above which a substitute would be unacceptable. EPA recognizes that different end-uses have different technical demands and available alternatives, and so has always sought to determine which substitutes are safer overall in the intersection of each substitute and end-use.

Comment: NRDC and EIA expressed their support for the rule, encouraged similar actions be taken in other sectors and end-uses, and stated that promotion of alternatives with lower GWPs than those that are still acceptable is necessary.

Response: We appreciate the support of these commenters and their concurrence in the importance of the benefits of this rule. Regarding requests for finding unacceptable substitutes

with GWPs in the range of 600 to 1,400, the agency must consider the availability of other alternatives that are safer overall in each end use. We encourage the development of such alternatives, and as technologies continue to evolve, the agency intends to continue to evaluate present and new alternatives.

Comment: Hudson encouraged EPA not to approve substitutes for retrofit purposes unless they have a lower GWP and are more energy efficient than the current chemical in that equipment.

Response: This action does not approve substitutes for retrofit purposes.

2. EPA's Climate Benefits Analysis

Comment: AHAM, FPA, Johnson Controls, NEDA/CAP, Flexible Packaging Association, and Sub Zero Group stated that the environmental benefits of this action are small when compared with the total of the United States' GHG emissions or in comparison with the benefits of other EPA rules.

Response: EPA disagrees with the notion that the environmental benefits of this rule are "miniscule," as one commenter said, or that the benefits to human health and the environment are too small to make this action worthwhile. While the Agency agrees that some other sectors, such as electricity generation, currently emit more GHGs than the sectors affected by this rule, the estimated benefits of this rule are significant. To place the benefits in perspective, the 10–11 MMTCO₂eq of prevented emissions in 2030 are equivalent to the total energy use of over one million homes, or equivalent to taking well over two million cars off the road.²²⁵ Further, the problem of climate change is of the type that is the result of many small acts of pollution rather than one giant spill or other polluting event. It is the sum of all the small releases of gases that leads to the problem, and to claim that individual sources of emissions should not be reduced because their contributions, taken alone, are not as large as those of others would make control of the problem impossible. In fact, due to the high GWPs of many of the gases affected by this rule, reducing emission of HFCs is widely considered low-hanging fruit in terms of the efficiency of approaches to reduce GHG emissions.²²⁶

²²⁵ EPA's Greenhouse Gas Equivalencies Calculator. Accessible at www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.

²²⁶ UNEP, 2011. HFCs: A Critical Link in Protecting Climate and the Ozone Layer, A UNEP Synthesis Report. November, 2011. This document is accessible at: www.unep.org/dewa/portals/67/pdf/HFC_report.pdf.

Comment: UTC commented that the environmental analysis underlying this rule is flawed, and that benefits should be calculated based on a projection of state-by-state code adoption.

Response: EPA disagrees with this commenter. In our consultation with stakeholders, we have frequently heard that patchworks of local regulations often make matters more difficult for businesses. This action will change the status of certain substitutes in certain end-uses uniformly across the country. Hence our approach of calculating benefits assuming similar adoption rates nationally is appropriate. It is true that some localities may implement regulations that nudge or force businesses to transition faster than the transition dates in this rule, just as some businesses may make the decision to transition more quickly, but that simply means that the cumulative benefits estimated are conservative in this respect. Benefits in given years after the transition dates would not be affected by such early transitions.

Comment: NAFEM requested that EPA conduct a study to determine the effect on the environment of this action using refrigerant escape estimates rather than overall use of refrigerants in various end-uses.

Response: EPA does consider the rates at which substitutes leak or are otherwise emitted in its estimation of environmental benefits. The Agency's Vintaging Model accounts for emissions from use, servicing, and disposal of equipment and materials as each year's worth, or "vintage," of that equipment goes through its life cycle. This model, and the estimates of leak rates within it, is peer-reviewed and regularly updated.

3. Energy Efficiency

Comment: Hudson and UTC both claim that the energy efficiency implications of changes in refrigerant should be considered, and Hudson specifically suggests that finding alternatives acceptable for retrofit uses can lead to losses in efficiency.

Response: The SNAP regulations for review of substitutes include both a list of "information required to be submitted" (section 82.178) and "criteria for review" of SNAP submissions (section 82.180). The list of required information includes global warming impacts and mentions changes in energy efficiency as an example of indirect contributions to global warming. The criteria for review do not mention energy efficiency. While EPA uses all information submitted to inform its general understanding of the substitute, the end-use, and the sector, the Agency does not use all the

information as part of its comparative assessment to support listing decisions. As EPA previously stated, “[w]e note that we do not have a practice in the SNAP program of including energy efficiency in the overall risk analysis. We do, however, consider issues such as technical needs for energy efficiency (e.g., to meet DOE standards) in determining whether alternatives are ‘available’” (80 FR 42921; July 20, 2015).

The Agency agrees with the commenters that energy efficiency can have significant impacts on the GHG emissions. However, we disagree that this action will have unintended detrimental effects on energy efficiency. As described in the July 2015 rule (80 FR 42902), the energy efficiency actually achieved will depend on both the refrigerant used and the design and settings of the equipment. It is impractical for EPA to evaluate all possible equipment design and refrigerant combinations. As part of its consideration of whether available alternatives exist in particular end-uses, SNAP considers as part of its evaluation whether use of potential alternatives is feasible. For example, if use of a particular alternative made it impossible for end users to comply with DOE energy conservation standards, that chemical would not be considered a truly available substitute, and this would be considered in decisions on the status of other alternatives in that end-use. In fact, many substitutes that remain acceptable can lead to better energy efficiency in that end-use than the alternatives that are having their status changed in this rule.

Comment: For new cold storage warehouses, Daikin recommended that R-410A remain acceptable in direct expansion systems “in order to maintain the energy efficiency and safety of Cold Storage Warehouses.” They provided an explanation of why R-410A is more energy efficient than R-404A. Arguing that we should not change the status of R-407A and R-407B, and should find R-448A and R-449A acceptable, for both cold storage warehouses and for refrigerated food processing and dispensing equipment, AHRI stated without identifying any specific substitutes that “[s]ome of the SNAP listed low-GWP refrigerants in this application will result in less efficient products.”

Response: See responses above. For new cold storage warehouses, we noted that some equipment could be subject to DOE energy conservation standards, and have considered this in determining a reasonable yet expeditious change of status date. For new refrigerated food

processing and dispensing equipment, as an equipment manufacturer indicated, there are not applicable DOE energy conservation standards.

E. Interactions With Other Rules

Comment: CPI and BASF stated that there needs to be an alignment between EPA and the Canadian regulatory framework for HFC emissions. Both organizations encouraged EPA to work with Environment and Climate Change Canada (ECCC) to align regulatory controls under development to limit HFC emissions from foam products that impact similar end-uses. The commenters stated that a consistent approach would reduce confusion in the marketplace and facilitate compliance with any use restrictions.

Response: The regulatory frameworks and decisions of the U.S. and other countries may vary due to differences in the statutes on which the regulations are based as well as public input and other factors. While EPA agrees that certain countries, such as Canada, look to the work already done in the United States and some similarities may result, each country’s regulations are based on its domestic statutes and regulatory processes. ECCC proposals to date have considered EPA’s rules,²²⁷ and EPA appreciates the value of consistency where practicable.

F. Other Suggestions or Requests

Comment: Zero Zone recommended that EPA add R-448A and R-449A to the list of acceptable alternatives for stand-alone equipment. NAFEM commented that there are no acceptable alternatives for R-404A, other than propane, and recommended that EPA add R-448A and R-449A to the list of acceptable alternatives for medium temperature stand-alone equipment. NAFEM stated that “R-448A and 449A have lower GWPs and deliver fewer emissions than 404A, and in most cases, these refrigerants can be used as a drop in replacement for 404A.” NAFEM commented that the same public health arguments that the EPA cited in deeming R-450A and similar refrigerants as acceptable for medium temperature stand-alone (retail food refrigeration) equipment should also apply to R-448A and R-449A. NAFEM noted that EPA performed assessments to examine the health and environmental risks of R-450A in docket EPA-HQ-OAR-2003-

0118. NAFEM indicated that it would be burdensome for manufacturers using R-404A for medium temperature applications to transition to R-450A, for example, given that R-450A “was designed to replace R-134A and has significantly different performance characteristics when compared to R-404A.” NAFEM stated that R-450A is a low pressure gas compared to the R-404A, which is a medium-pressure gas, and cited technical challenges with transitioning to R-450A would require redesign of current systems and regulatory testing. These factors, NAFEM stated, would reduce productivity of the equipment, increase manufacturing costs, and threaten market supply of medium temperature equipment. Conversely, NAFEM believe the use of R-448A and R-449A would only require valve adjustments in current system design, reduce GWP by $\frac{2}{3}$, and would require about 10 percent effort for manufacturers to implement when compared to R-450A. In support of their argument for the acceptable listing of R-448A and R-449A for medium temperature equipment, NAFEM also stated that stand-alone equipment has lower leak rates and refrigerant charge than remote systems.

Response: These comments go beyond the scope of the current rulemaking as they concern end-uses and/or substitutes not addressed in this action. EPA appreciates receiving this information and will consider the comments as it evaluates possible future actions.

Comment: While CARB supported EPA’s efforts to change the status of certain high-GWP alternatives for use in several end-uses, the agency encouraged EPA to list additional high-GWP refrigerants as unacceptable in the refrigeration and AC sector and work with refrigerant safety standards committees, such as ASHRAE and UL, to accelerate the transition to lower-GWP refrigerants. CARB also stated that the proposed rule is a valuable early action item that will assist in developing additional HFC reduction measures in their SLCP Reduction Strategy that they plan to finalize in the fall of 2016.

Response: EPA appreciates receiving this information and will consider the comments as it evaluates possible future actions. EPA is committed to its engagement with stakeholders in the refrigerants industry, including ASHRAE and UL. For example, EPA staff are currently members of ASHRAE, and participate in relevant subcommittees, such as ASHRAE Standing Standard Project Committees 15 and 15.2, some of the leading safety

²²⁷ See the ECCC’s permitting and reporting requirements for HFCs, which take effect in February 2017. Canada Gazette, June 2016. Ozone-depleting Substances and Halocarbon Alternatives Regulations. Available at: <http://www.gazette.gc.ca/rp-pr/p2/2016/2016-06-29/html/sor-dors137-eng.php>.

standards for refrigerants in the United States, and EPA staff regularly attend industry conferences intended for the refrigerants industry.

Comment: The Alliance requested that EPA disclose the timeline for finalizing the Agency's proposal to amend the section 608 refrigerant management regulations (80 FR 69458; November 9, 2015). The Alliance indicated that its members are supportive of the proposal, but are concerned that the Agency has not finalized the rule, given that the public comment period closed on December 9, 2015. They also noted that they submitted a petition on January 31, 2015, requesting the proposed rule. The Alliance believe that "promoting effective refrigerant management practices, including recovery, reclamation and reuse, is an important immediate element of reducing the GHG footprint associated with the use of HFCs and will allow production to be focused primarily for use in new equipment."

Response: EPA agrees with the Alliance that the 608 rule will strengthen refrigerant management practices and reduce emissions of ODS and gases with high GWPs. For information on the final 608 rule, see the docket for the rulemaking (EPA-HQ-OAR-2015-0453).

Comment: HSI encouraged EPA to postpone the publication of the rule until relevant cases still pending, which challenged the July 2015 rule, have been settled.

Response: EPA disagrees. We are finalizing this rule in a timely fashion in response to public comments to provide information to the regulated community, some of whom have requested expedited finalization.

VIII. Statutory and Executive Order Reviews

Additional information about these statutes and Executive Orders can be found at <http://www2.epa.gov/laws-regulations/laws-and-executive-orders>.

A. Executive Order 12866: Regulatory Planning and Review and Executive Order 13563: Improving Regulation and Regulatory Review

This action is a significant regulatory action that was submitted to the Office of Management and Budget (OMB) for review. It raises novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in the Executive Order. Any changes made in response to OMB recommendations have been documented in the docket. EPA prepared analyses of the potential costs

and benefits associated with this action. These are available in docket EPA-HQ-OAR-2015-0663 under the titles, "Climate Benefits of the SNAP Program Status Change Rule" and "Cost Analysis for Regulatory Changes to the Listing Status of High-GWP Alternatives used in Refrigeration and Air Conditioning, Foams, and Fire Suppression."

B. Paperwork Reduction Act (PRA)

This action does not impose any new information collection burden under the PRA. OMB has previously approved the information collection requirements contained in the existing regulations and has assigned OMB control number 2060-0226. This rule contains no new requirements for reporting or recordkeeping.

C. Regulatory Flexibility Act

I certify that this action will not have a significant economic impact on a substantial number of small entities under the RFA. The small entities subject to the requirements of this action are small businesses. For purposes of assessing the impacts of this rule on small entities, EPA evaluated small businesses as defined by the Small Business Administration's (SBA) regulations at 13 CFR 121.201. The Agency has determined that about 90 small businesses could be subject to the rulemaking, and roughly 76 percent of the small businesses subject to this rulemaking would be expected to experience compliance costs of less than one percent of annual sales revenue. Details of this analysis are presented in the document entitled, "Economic Impact Screening Analysis for Regulatory Changes to the Listing Status of High-GWP Alternatives used in Refrigeration and Air Conditioning, Motor Vehicle Air Conditioners, Foams, and Fire Suppression."²²⁸ EPA evaluated the potential costs to small businesses associated with the rule. EPA estimates that the total annualized compliance costs for all small businesses would be approximately \$11.8 to \$14.4 million at a seven percent discount rate, or \$11.5 to \$14.0 million at a three percent discount rate.²²⁹ This action allows equipment manufacturers the additional options of using propane, HFO-1234yf, and 2-BTP in the specified end-uses but does not mandate such use. Because these substitutes are not yet being used in the United States for the end-uses (with the exception of

limited test-marketing), no change in business practice would be required to meet the use conditions, resulting in no adverse impact compared to the absence of this rule. Provisions that allow venting of HC refrigerants in the uses of propane addressed by this rule would reduce regulatory burden. We have therefore concluded that this action would relieve regulatory burden for all small entities that choose to use propane as a refrigerant in the end-uses in this listing. The use conditions of this rule apply to manufacturers of commercial ice machines, water coolers, and very low temperature refrigeration equipment that choose to use propane.

The requirements of this rule with respect to HFCs would impact small businesses that manufacture food processing and dispensing equipment, household refrigerators and freezers, cold storage refrigeration systems, and polyurethane foams; operators of cold storage refrigeration systems, including refrigerated warehouses, wholesalers, and food manufacturers; and manufacture and use cold storage warehouses, and small businesses that import products containing closed cell phenolic, polyisocyanurate, polyolefin, PU, and polystyrene foams manufactured with HFC or HCFC foam blowing agents. The prohibition of methylene chloride as a foam blowing agent is not anticipated to impact small businesses because this substance is not expected to be used currently as a blowing agent. This rule's provisions do not create enforceable requirements for refrigeration and AC technicians, but they would indirectly affect technicians servicing motor vehicle AC systems, certain types of retail food refrigeration equipment, cold storage warehouses, and commercial AC equipment where the technician, rather than the refrigeration or AC equipment owner, purchases servicing equipment for different refrigerants. EPA expects these indirect impacts on technicians are minimal, because the transitions to different refrigerants required by this rule are already occurring due to corporate social responsibility initiatives (e.g., Consumer Goods Forum pledge concerning HFC refrigerants), and because many of the still-acceptable alternatives are already used for these refrigeration or AC equipment types. Further, most acceptable HFC refrigerant blends can be recovered and serviced using equipment that service technicians already own. In some uses, there is no significant impact of the rule because the substitutes prohibited are not widely used (e.g., use of perfluorocarbons for fire suppression,

²²⁸ ICF, 2016b. Economic Impact Screening Analysis for Regulatory Changes to the Listing Status of High-GWP Alternatives used in Refrigeration and Air Conditioning, Foams, and Fire Suppression. September, 2016.

²²⁹ Ibid.

use of methylene chloride as a foam blowing agent in various types of foam). A significant portion of the businesses regulated under this rule are not small businesses (e.g., commercial AC manufacturers). We have therefore concluded that this action will not have a significant impact on a significant number of small entities.

D. Unfunded Mandates Reform Act (UMRA)

This action does not contain any unfunded mandate as described in UMRA, 2 U.S.C. 1531–1538, and does not significantly or uniquely affect small governments. The action imposes no enforceable duty on any state, local or tribal governments or the private sector.

E. Executive Order 13132: Federalism

This action does not have federalism implications. It will not have substantial direct effects on the states, on the relationship between the national government and the states, or on the distribution of power and responsibilities among the various levels of government. EPA is aware that the California Air Resources Board has proposed regulation of a number of the substitutes and end-uses in this rule.

F. Executive Order 13175: Consultation and Coordination With Indian Tribal Governments

This action does not have tribal implications as specified in Executive Order 13175. It will not have substantial direct effects on tribal governments, on the relationship between the Federal government and Indian tribes, or on the distribution of power and responsibilities between the Federal government and Indian tribes, as specified in Executive Order 13175. Thus, Executive Order 13175 does not apply to this action.

G. Executive Order 13045: Protection of Children From Environmental Health and Safety Risks

This action is not subject to Executive Order 13045 because it is not economically significant as defined in Executive Order 12866, and because EPA does not believe the environmental health or safety risks addressed by this action present a disproportionate risk to children. This rule restricts the use of certain substitutes that have greater overall risks for human health and the environment, primarily due to their high GWP. The reduction in GHG emissions would provide climate benefits for all people, including benefits for children and future generations. The risk screens are in the

docket for this rulemaking.^{230 231 232 233 234}

H. Executive Order 13211: Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use

This action is not a “significant energy action” because it is not likely to have a significant adverse effect on the supply, distribution or use of energy. For the end-uses that are related to energy effects such as refrigeration and AC, a number of alternatives are available to replace those refrigerants that are listed as unacceptable in this action; many of the alternatives are as energy efficient or more energy efficient than the substitutes being listed as unacceptable. Thus, we have concluded that this rule is not likely to have any adverse energy effects.

I. National Technology Transfer and Advancement Act (NTTAA) and 1 CFR Part 51

This action involves technical standards. EPA is using standards from UL in the use conditions for propane and standards from SAE for HFO-1234yf. Additionally, EPA is incorporating by reference a standard from SAE that EPA already requires in a use condition for HFC-152a in MVAC. These use conditions will ensure that these new substitutes for very low temperature refrigeration equipment, commercial ice machines, and water coolers, do not present significantly greater risk to human health or the environment than other alternatives.

EPA is incorporating by reference portions of current editions of the UL Standard 399, “Standard for Drinking-Water Coolers”; UL Standard 471, “Standard for Commercial Refrigerators and Freezers”; and UL Standard 563, “Standard for Ice Makers”, which includes requirements for the safe use of

refrigerants. Specifically, these standards are:

1. *Supplement SB to UL Standard 399: Requirements for Drinking Water Coolers Employing A Flammable Refrigerant in the Refrigerating System* (7th Edition, August 22, 2008). This document establishes requirements for self-contained drinking water coolers, including those supplying cold and/or hot water and those employing flammable refrigerants. The standard is available at <http://ulstandards.ul.com/standard/?id=399>, and may be purchased by mail at: COMM 2000, 151 Eastern Avenue, Bensenville, IL 60106; Email: orders@comm-2000.com; Telephone: 1–888–853–3503 in the U.S. or Canada (other countries dial +1–415–352–2168); Internet address: <http://ulstandards.ul.com/> or www.comm-2000.com. The cost of UL 399 is \$798 for an electronic copy and \$998 for hardcopy. UL also offers a subscription service to the Standards Certification Customer Library (SCCL) that allows unlimited access to their standards and related documents. The cost of obtaining this standard is not a significant financial burden for equipment manufacturers and purchase is not required for those selling, installing and servicing the equipment. Therefore, EPA concludes that the UL standard being incorporated by reference is reasonably available.

2. *Supplement SB to UL Standard 471: Requirements for Refrigerators and Freezers Employing A Flammable Refrigerant in the Refrigerating System* (10th Edition, November 24, 2010). This document establishes requirements for commercial refrigerators and freezers that employ a refrigerant that has been identified as having flammable characteristics. The standard is available at <http://ulstandards.ul.com/standard/?id=471&edition=10&doctype=ulstd>, and may be purchased by mail at: COMM 2000, 151 Eastern Avenue, Bensenville, IL 60106; Email: orders@comm-2000.com; Telephone: 1–888–853–3503 in the U.S. or Canada (other countries dial +1–415–352–2168); Internet address: <http://ulstandards.ul.com/> or www.comm-2000.com. The cost of UL 471 is \$716 for an electronic copy and \$897 for hardcopy. UL also offers a subscription service to the SCCL that allows unlimited access to their standards and related documents. The cost of obtaining this standard is not a significant financial burden for equipment manufacturers and purchase is not required for those selling, installing and servicing the equipment. Therefore, EPA concludes that the UL

²³⁰ ICF, 2016c. Significant New Alternatives Policy Program: Refrigeration and Air Conditioning Sector Risk Screen on Substitutes in Water Coolers Substitute: Propane (R-290).

²³¹ ICF, 2016d. Significant New Alternatives Policy Program: Refrigeration and Air Conditioning Sector Risk Screen on Substitutes in Very Low Temperature Refrigeration Substitute: Propane (R-290) and Ethane (R-170).

²³² ICF, 2016e. Significant New Alternatives Policy Program: Refrigeration and Air Conditioning Sector Risk Screen on Substitutes in Commercial Ice Machines Substitute: Propane (R-290).

²³³ ICF, 2016f. Significant New Alternatives Policy Program: Refrigeration and Air Conditioning Sector Risk Screen on Substitutes in Residential and Light Commercial Air Conditioning and Heat Pumps. Substitute: R-443A.

²³⁴ ICF, 2016g. Significant New Alternatives Policy Program: Refrigeration and Air Conditioning Sector Risk Screen on Substitutes in Chillers and Cold Storage Warehouses. Substitute: Propylene (R-1270).

standard being incorporated by reference is reasonably available.

3. *Supplement SA to UL Standard 563: Requirements for Ice Makers Employing a Flammable Refrigerant in the Refrigeration System* (8th Edition, July 31, 2009). This document establishes requirements for automatic ice makers, including unitary and remote ice makers. The standard is available at <http://ulstandards.ul.com/standard/?id=563&edition=8&doctype=ulstd>, and may be purchased by mail at: COMM 2000, 151 Eastern Avenue, Bensenville, IL 60106; Email: orders@comm-2000.com; Telephone: 1-888-853-3503 in the U.S. or Canada (other countries dial +1-415-352-2168); Internet address: <http://ulstandards.ul.com/> or www.comm-2000.com. The cost of UL 563 is \$716 for an electronic copy and \$897 for hardcopy. UL also offers a subscription service to the SCCL that allows unlimited access to their standards and related documents. The cost of obtaining this standard is not a significant financial burden for equipment manufacturers and purchase is not required for those selling, installing and servicing the equipment. Therefore, EPA concludes that the UL standard being incorporated by reference is reasonably available.

EPA is also incorporating by reference the list of refrigerants that ASHRAE designates as flammability Class 3 according to ASHRAE Standard 34-2013, *Designation and Safety Classification of Refrigerants*, in the unacceptability listing for certain highly flammable refrigerants for use in existing residential and light commercial split AC systems. This standard is available at <https://www.ashrae.org/resources-publications/bookstore/standards-15-34> and may be purchased by mail at: 6300 Interfirst Drive, Ann Arbor, MI 48108; by telephone: 1-800-527-4723 in the U.S. or Canada; Internet address: http://www.techstreet.com/ashrae/ashrae_standards.html?ashrae_auth_token=. The cost of ASHRAE Standard 34-2013 is \$107 for an electronic or hardcopy. The cost of obtaining this standard is not a significant financial burden for equipment manufacturers and purchase is not required for those selling, installing and servicing the equipment. Therefore, EPA concludes that the ASHRAE standard being incorporated by reference is reasonably available.

In addition, EPA is using standards from SAE in the use conditions for HFO-1234yf. These standards are:

1. *SAE J639: Safety Standards for Motor Vehicle Refrigerant Vapor*

Compression Systems (revised December 19, 2011). This document establishes safety standards for HFO-1234yf MVAC systems that include unique fittings; a warning label indicating the refrigerant's identity and that it is a flammable refrigerant; and requirements for engineering design strategies that include a high-pressure compressor cutoff switch and pressure relief devices. This standard is available at http://standards.sae.org/j639_201112/.

2. *SAE J1739 (adopted 2009): Potential Failure Mode and Effects Analysis in Design (Design FMEA) and Potential Failure Mode and Effects Analysis in Manufacturing and Assembly Processes (Process FMEA) and Effects Analysis for Machinery (Machinery FMEA)* (revised January 1, 2009). This standard describes potential FMEA in design and potential FMEA in manufacturing and assembly processes. It requires manufacturers of MVAC systems and vehicles to conduct a FMEA and assists users in the identification and mitigation of risk by providing appropriate terms, requirements, ranking charts, and worksheets. This standard is available at http://standards.sae.org/j1739_200901/.

3. *SAE J2844 (Revised October 2011): R-1234yf (HFO-1234yf) New Refrigerant Purity and Container Requirements For Use in Mobile Air-Conditioning Systems* (revised October 2011). This standard sets purity standards and describes container requirements, including fittings for refrigerant cylinders. For connections with refrigerant containers for use in professional servicing, use fittings must be consistent with SAE J2844 (revised October 2011). This standard is available at http://standards.sae.org/j2844_201110/.

These standards may be purchased by mail at: SAE Customer Service, 400 Commonwealth Drive, Warrendale, PA 15096-0001; by telephone: 1-877-606-7323 in the United States or 724-776-4970 outside the United States or in Canada. The cost of SAE J639, SAE J1739, and SAE 2844 is \$74 each for an electronic or hardcopy. The cost of obtaining these standards is not a significant financial burden for manufacturers of MVAC systems and purchase is not required for those selling, installing and servicing the systems. Therefore, EPA concludes that the use of SAE J639, SAE J1739, and SAE J2844 are reasonably available.

In addition, in today's rule, we are incorporating by reference a standard that EPA already requires in a use condition for HFC-152a in MVAC:

4. *SAE J2773: Standard for Refrigerant Risk Analysis for Mobile Air*

Conditioning Systems (revised February 4, 2011). This standard describes methods to understand the risks associated with MVAC systems in all aspects of a vehicle's lifecycle including design, production, assembly, operation and end of life. This standard is available at http://standards.sae.org/j2773_201102/ and may be purchased by mail at: SAE Customer Service, 400 Commonwealth Drive, Warrendale, PA 15096-0001; by telephone: 1-877-606-7323 in the United States or 724-776-4970 outside the United States or in Canada. The cost of SAE J2773 is \$74 for an electronic or hardcopy. The cost of obtaining this standard is not a significant financial burden for manufacturers of MVAC systems and purchase is not required for those selling, installing and servicing the systems. Therefore, EPA concludes that the use of SAE J2773 is reasonably available.

J. Executive Order 12898: Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations

The human health or environmental risk addressed by this action will not have potential disproportionately high and adverse human health or environmental effects on minority, low-income or indigenous populations. This action's health and risk assessments are contained in the comparisons of toxicity for the various substitutes, as well as risk screens for the substitutes that are listed as acceptable, subject to use conditions, or are newly listed as unacceptable.^{235 236 237 238 239} The risk screens are in the docket for this rulemaking.

K. Congressional Review Act (CRA)

This action is subject to the CRA, and EPA will submit a rule report to each House of the Congress and to the

²³⁵ ICF, 2016c. Significant New Alternatives Policy Program: Refrigeration and Air Conditioning Sector Risk Screen on Substitutes in Water Coolers Substitute: Propane (R-290).

²³⁶ ICF, 2016d. Significant New Alternatives Policy Program: Refrigeration and Air Conditioning Sector Risk Screen on Substitutes in Very Low Temperature Refrigeration Substitute: Propane (R-290) and Ethane (R-170).

²³⁷ ICF, 2016e. Significant New Alternatives Policy Program: Refrigeration and Air Conditioning Sector Risk Screen on Substitutes in Commercial Ice Machines Substitute: Propane (R-290).

²³⁸ ICF, 2016f. Significant New Alternatives Policy Program: Refrigeration and Air Conditioning Sector Risk Screen on Substitutes in Residential and Light Commercial Air Conditioning and Heat Pumps. Substitute: R-443A.

²³⁹ ICF, 2016g. Significant New Alternatives Policy Program: Refrigeration and Air Conditioning Sector Risk Screen on Substitutes in Chillers and Cold Storage Warehouses. Substitute: Propylene (R-1270).

Comptroller General of the United States. This action is not a “major rule” as defined by 5 U.S.C. 804(2).

IX. References

- Abt Associates, 2016. Review of propylene acute toxicity for R-443A risk screen. Prepared for EPA. July 6, 2016.
- A.S. Trust & Holdings, 2014. Response to Incompleteness Letter from A.S. Trust & Holdings to EPA—Sent March 7, 2014
- AHRI, 2012. “Test Report #1: System Drop-in Test of R-410A Alternative Fluid (ARM-32a, ARM-70a, DR-5, HPR1D, L-41a, L-41b, and R-32) in a 5-RT Air Cooled Water Chiller (Cooling Mode).” November 26, 2012. This document is accessible at http://www.ahrinet.org/App_Content/ahri/files/RESEARCH/AREP_Final_Reports/AHRI%20Low-GWP%20AREP-Rpt-001.pdf.
- AHRI, 2014. Guideline N-2014 for Assignment of Refrigerant Container Colors. This document is accessible online at http://www.ahrinet.org/App_Content/ahri/files/Guidelines/AHRI_Guideline_N_2014.pdf.
- AHRI, 2016. “AHRI, ASHRAE, DOE Partner to Fund Flammable Refrigerant Research.” June 2, 2016. This document is accessible at <http://www.ahrinet.org/News-Events/News-and-Shipping-Releases.aspx?A=1170>.
- AIRAH, 2013. Australian Institute of Refrigeration, Air Conditioning and Heating. Safety Guide: Flammable Refrigerants. 2013. This document is accessible at: <http://www.unep.fr/ozonaction/information/mmcfiles/7681-e-FlammableRefrigerantsGuideAIRAH.pdf>.
- Airgas, 2015. Safety Data Sheet for Propylene.
- Akerman, 2013. Hydrofluorocarbons and Climate Change: Summaries of Recent Scientific and Papers. 2013.
- ANSI/International Institute of Ammonia Refrigeration (IIR) Standard 2-2008 (Addendum B)—American National Standard for Equipment, Design, & Installation of Closed Circuit Ammonia Mechanical Refrigerating Systems
- ASHRAE, 2013a. ANSI/ASHRAE Standard 34-2013: Designation and Safety Classification of Refrigerants.
- ASHRAE, 2013b. ANSI/ASHRAE Standard 15-2013: Safety Standard for Refrigeration Systems.
- ASHRAE, 2014. 2014 Handbook—Refrigeration. The American Society of Heating, Refrigerating, and Air-conditioning Engineers, Inc. Atlanta, Georgia, USA. ISBN 978-1-936504-71-8; ISSN 1930-7195.
- Berg, M., S.R. Muller, J. Muhlemann, A. Wiedmer, and R.P. Schwarzenbach: Concentrations and mass fluxes of chloroacetic acids and trifluoroacetic acid in rain and natural waters in Switzerland. Environ. Sci. Technol. 34, 2675-2683, 2000.
- Blupura, 2015. SNAP Information Notice for R-290 in Water Coolers. October, 2015.
- Carrier, 2016. “Carrier China Showcases latest Innovations at China Refrigeration Expo.” April 7, 2016. This document is accessible at http://www.carrier.com/carrier/en/us/news/news-article/carrier_china_showcases_latest_innovations_at_china_refrigeration_expo.aspx.
- Clayton Corporation, 2014. Re: Proposed SNAP Program Status Change Rule Docket ID No. EPA-HQ-OAR-2014-0198, comment submitted by Clayton Corporation. October 20, 2014. Docket number EPA-HQ-OAR-2014-0198-0133.
- Clayton Corporation, 2015. Clayton Corporation Meeting with EPA Stratospheric Protection Division, December 8, 2015.
- Climaveneta, 2015. “Against Global Warming with the NEW TECS2 HFO Chillers.” January 12, 2015. This document is accessible at <http://www.climaveneta.com/EN/Media/Press-Releases/112.html>.
- Cooling Post, 2014. Trane first with 1233zd chiller, June 30, 2014. This document is accessible at www.coolingpost.com/world-news/trane-first-with-1233zd-chiller/.
- Cooling Post, 2015. “Blue Box offers R1234ze chiller option.” April 29, 2015. This document is accessible at www.coolingpost.com/world-news/blue-box-offers-r1234ze-chiller-option/.
- Cooling Post, 2015. “Chemours to build HFO-1336mzz plant,” November 17, 2015. This document is accessible online at: <http://www.coolingpost.com/world-news/chemours-to-build-hfo-1336mzz-plant/>.
- DOE, 2014. Building Energy Codes Program. Energy Efficiency Standards for Federal Buildings. Available at: <https://www.energycodes.gov/regulations/federal-building-standards>. Last updated February 13, 2014.
- Doniger and Yurek, 2016. Doniger, David (NRDC) and Stephen Yurek (AHRI), February 1, 2016. AHRI/NRDC Letter Regarding Chiller Actions Under SNAP. Docket number EPA-HQ-OAR-2015-0663-0013.
- DuPont, 2014. Re: Protection of Stratospheric Ozone: Change of Listing Status for Certain Substitutes under the Significant New Alternatives Policy Program. Submitted by Michael Parr and Mack McFarland, DuPont. October 17, 2014. Docket number EPA-HQ-OAR-2014-0198-0077.
- Ecomall, 2015. Greenfreeze: A Revolution in Domestic Refrigeration. Accessible at: <http://www.ecomall.com/greeshopping/greenfreeze.htm>.
- Engie Refrigeration, 2016. “Quantum: Series and features of the energy-efficient chiller series.” This document is accessible at https://www.engie-refrigeration.de/export/sites/cofelyrefrigeration/content/documents/ENG/Produkte/Quantum/ENG_Quantum_Folder.pdf.
- EIA, 2015. Petition requesting EPA to modify the status under the Significant New Alternatives Policy Program, of certain high-GWP chemicals in various end-uses. Submitted October 6, 2015.
- EPA, 2009a. Technical Support Document for Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act. December, 2009. This document is accessible at: http://www3.epa.gov/climatechange/Downloads/Endangerment/Endangerment_TSD.pdf.
- EPA, 2009b. Risk Assessment: PMN 07-0601. Available at: <http://www.regulations.gov/#/documentDetail;D=EPA-HQ-OAR-2008-0664-0036>.
- EPA, 2013. Finding of Violation, issued to Enviro-Safe Refrigerants, Inc. June, 2013. This document is accessible at: http://www2.epa.gov/sites/production/files/2015-07/documents/mailfov_envirosafe_06112013.pdf.
- EPA, 2015. Draft Regulatory Impact Analysis: Proposed Rulemaking for Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles—Phase 2. EPA-420-D-15-900. June 2015. Available at <http://www3.epa.gov/otaq/climate/documents/420d15900.pdf>.
- EPA, 2016a. Climate Benefits of the SNAP Program Status Change Rule. March, 2016.
- EPA, 2016b. Tables of Alternatives for End-Uses Considered in the Final Rule, Protection of Stratospheric Ozone: Listing Modifications for Certain Substitutes under the Significant New Alternatives Policy Program. September, 2016.
- EPA, 2016c. A “Cool” Way to Combat Climate Change under the Montreal Protocol. July 20, 2016. Available online at <https://blog.epa.gov/blog/2016/07/a-cool-way-to-combat-climate-change/>.
- Eppendorf, 2015. SNAP Information Notice for R-170 and R-290 in Very Low Temperature Refrigeration. May, 2015.
- EU, 2014. Regulation (EU) No 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006. Available online at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2014.150.01.0195.01.ENG.
- FAA, 2002. Federal Aviation Administration (FAA) Minimum Performance Standard for Hand-Held Extinguishers. This document is accessible at: <http://www.fire.tc.faa.gov/pdf/01-37.pdf>.
- FAA, 2016. FAA Stratification and Localization of Halon 1211 Discharged in Occupied Aircraft Compartments (DOT/FAA/TC-14/50). This document is accessible at: <https://www.fire.tc.faa.gov/pdf/TC-14-50.pdf>.
- Fomo, 2014. Comment Re: Proposed SNAP Program Status Change Rule Docket ID No. EPA-HQ-OAR-2014-0198, submitted by Dr. Thomas Fishback, Vice President, Research and Development, Fomo Products, Inc. October 16, 2014. Docket number EPA-HQ-OAR-2014-0198-0139.
- Fomo, 2015. “The Use of Solstice® Gas Blowing Agent (GBA) in Low-Pressure Spray Polyurethane Foam Applications,” Cline, Mojee and Bogdan, Mary, October, 2015. Polyurethane Industry Conference 2015.
- FOTC, 2011. 2010 Report of the Rigid and Flexible Foams Technical Options

- Committee. This document is accessible at: http://ozone.unep.org/Assessment_Panels/TEAP/Reports/FTOC/FTOC-2010-Assessment-Report.pdf.
- Geoclima, 2014. Geoclima Brochure. This document is accessible at http://www.benndorf-hildebrand.eu/sites/default/files/fabrikate/pdf/geoclima_broschure.pdf.
- Gradient, 2013. Additional Risk Assessment of Alternative Refrigerant R-1234yf. Prepared by Gradient for SAE International Cooperative Research Program 1234-4. July 24, 2013. The Executive Summary of this document is accessible at: <http://www.sae.org/standardsdev/tsb/cooperative/executivesummary.pdf>.
- Honeywell, 2014. Comments on Proposed Rule: Protection of Stratospheric Ozone: Change of Listing Status for Certain Substitutes under the Significant New Alternatives Policy Program (Docket no. EPA-HQ-OAR-2014-0198). October 20, 2014. Docket number EPA-HQ-OAR-2014-0198-0170.
- Honeywell, 2016. Comments on Proposed Rule: Protection of Stratospheric Ozone: Change of Listing Status for Certain Substitutes under the Significant New Alternatives Policy Program (Docket no. EPA-HQ-OAR-2015-0663). Docket number EPA-HQ-OAR-2015-0663-0086.
- Hossaini, et al., 2015. R. Hossaini, M. P. Chipperfield, S. A. Montzka, A. Rap, S. Dhomse, W. Feng. Efficiency of short-lived halogens at influencing climate through depletion of stratospheric ozone. *Nature Geoscience*, February 16, 2015. This document is accessible online at <http://DOI:10.1038/ngeo2363>.
- HVACNews, 2016. "Opteon Refrigerants Increasingly Selected by Leading Global OEMs." January 25, 2016. <http://hvacnews.com/2016/01/25/opteon-refrigerants-increasingly-selected-by-leading-global-oems/>.
- ICCT, 2015. International Council on Clean Transportation: Regulatory Considerations for Advancing Commercial Pickup and Van Efficiency Technology in the United States. Available online at: <http://www.theicct.org/us-commercial-pickups-vans-efficiency-technology>.
- ICF, 2008. Air-Conditioning Refrigerant Charge Size to Passenger Compartment Volume Ratio Analysis. Confidential Memorandum Prepared for the U.S. Environmental Protection Agency. 2008.
- ICF, 2009a. Revised Final Draft Assessment of the Potential Impacts of HFO-1234yf and the Associated Production of TFA on Aquatic Communities and Local Air Quality.
- ICF, 2009b. Risk Screen on Substitutes for CFC-12 in Motor Vehicle Air Conditioning: Substitute: HFO-1234yf. This document is accessible at: <http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2008-0664-0038>.
- ICF, 2010a. Summary of HFO-1234yf Emissions Assumptions.
- ICF, 2010b. Summary of Updates to the Vintaging Model that Impacted HFO-1234yf Emissions Estimates.
- ICF, 2010c. Revised Assessment of the Potential Impacts of HFO-1234yf and the Associated Production of TFA on Aquatic Communities, Soil and Plants, and Local Air Quality.
- ICF, 2010d. Sensitivity Analysis CMAQ results on projected maximum TFA rainwater concentrations and maximum 8-hr ozone concentrations.
- ICF, 2014a. Assessment of the Potential Impact of Hydrocarbon Refrigerants on Ground Level Ozone Concentrations. February, 2014.
- ICF, 2014b. Risk Screen on Substitutes for HCFC-22 in Residential and Light Commercial Air Conditioning and Heat Pumps; Substitute: Propane (R-290).
- ICF, 2014c. Risk Screen on Substitutes for HCFC-22 in Residential and Light Commercial Air Conditioning and Heat Pumps; Substitute: R-441A.
- ICF, 2015. Market Characterization of the U.S. Motor Vehicle Air Conditioning Industry, U.S. Foams Industry, U.S. Aerosols Industry, and U.S. Commercial Refrigeration Industry. July, 2015.
- ICF, 2016a. Cost Analysis for Regulatory Changes to the Listing Status of High-GWP Alternatives used in Refrigeration and Air Conditioning, Foams, and Fire Suppression. September, 2016.
- ICF, 2016b. Economic Impact Screening Analysis for Regulatory Changes to the Listing Status of High-GWP Alternatives used in Refrigeration and Air Conditioning, Foams, and Fire Suppression. September, 2016.
- ICF, 2016c. Significant New Alternatives Policy Program: Refrigeration and Air Conditioning Sector Risk Screen on Substitutes in Water Coolers Substitute: Propane (R-290).
- ICF, 2016d. Significant New Alternatives Policy Program: Refrigeration and Air Conditioning Sector Risk Screen on Substitutes in Very Low Temperature Refrigeration Substitute: Propane (R-290) and Ethane (R-170).
- ICF, 2016e. Significant New Alternatives Policy Program: Refrigeration and Air Conditioning Sector Risk Screen on Substitutes in Commercial Ice Machines Substitute: Propane (R-290).
- ICF, 2016f. Significant New Alternatives Policy Program. Refrigeration and Air Conditioning Sector Risk Screen on Substitutes in Residential and Light Commercial Air Conditioning and Heat Pumps. Substitute: R-443A.
- ICF, 2016g. Significant New Alternatives Policy Program. Refrigeration and Air Conditioning Sector Risk Screen on Substitutes in Chillers and Cold Storage Warehouses. Substitute: Propylene (R-1270).
- ICF, 2016h. Market Characterization for Fire Suppression, Comfort Cooling, Cold Storage, Refrigerated Food Processing and Dispensing Equipment, and Household Refrigeration Industries in the United States. Prepared for the U.S. Environmental Protection Agency. February, 2016.
- ICF, 2016i. Technical Support Document for Acceptability Listing of HFO-1234yf for Motor Vehicle Air Conditioning in Limited Heavy-Duty Applications.
- ICF, 2016j. Significant New Alternatives Policy Program. Fire Extinguishing and Explosion Prevention Sector. Risk Screen on Substitutes as a Streaming Agent in Civil Aviation Applications. Substitute: 2-bromo-3,3,3-trifluoropropene (2-BTP).
- ICF, 2016k. Significant New Alternatives Policy Program. Fire Extinguishing and Explosion Prevention Sector. Risk Screen on Substitutes for Total Flooding Systems in Unoccupied Spaces. Substitute: 2-bromo-3,3,3-trifluoropropene (2-BTP).
- ICF, 2016l. Additional Follow-on Assessment of the Potential Impact of Hydrocarbon Refrigerants on Ground Level Ozone Concentrations. September, 2016.
- ICF, 2016m. Risk Screen on Substitutes in Chillers Substitute: HFO-1336mzz(Z)/trans-1,2-dichloroethylene blend (74.7/25.3) (Opteon™ XP30).
- INCHEM, 1996. International Programme on Chemical Safety. Environmental Health Criteria 164. Methylene chloride, second edition. World Health Organization, 1996. This document is accessible online at: <http://www.inchem.org/documents/ehc/ehc/ehc164.htm>.
- IPCC, 2007. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. This document is accessible at: www.ipcc.ch/publications_and_data/ar4/wg1/en/contents.html.
- IPCC, 2013. Annex II: Climate System Scenario Tables [Prather, M., G. Flato, P. Friedlingstein, C. Jones, J.-F. Lamarque, H. Liao and P. Rasch (eds.)]. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. This document is accessible at: <http://www.ipcc.ch/report/ar5/wg1/>.
- IPCC/TEAP, 2005. Special Report: Safeguarding the Ozone Layer and the Global Climate System: Issues Related to Hydrofluorocarbons and Perfluorocarbons. Cambridge Univ Press, New York. This document is accessible at: https://www.ipcc.ch/pdf/special-reports/sroc/sroc_full.pdf.
- JARN, 2015a. First Carrier AquaForce Chillers using HFO-1234ze, July 30, 2015. This document is accessible at: <http://www.ejarn.com/news.aspx?ID=35619>.
- JARN, 2015b. Trane Exhibits First Air-cooled Chiller with Climate-friendly Refrigerant

- DR-55, September 21, 2015. This document is accessible at: www.ejarn.com/news.aspx?ID=36282.
- Johnson Controls, 2016. "Johnson Controls Advances Environmental Sustainability with Chiller Platforms Compatible with Low GWP Refrigerants." January 20, 2016. <http://www.johnsoncontrols.com/media-center/news/press-releases/2016/01/20/advanced-environmental-sustainability-with-chiller-platforms-compatible-with-low-gwp-refrigerants>.
- Kazil et al., 2014. Deposition and rainwater concentrations of trifluoroacetic acid in the United States from the use of HFO-1234yf. JGR-Atmospheres, 2014.
- Luecken et al., 2009. Ozone and TFA impacts in North America from degradation of 2, 3, 3, 3-tetrafluoropropene (HFO-1234yf), a potential greenhouse gas replacement. Environmental Science & Technology 2009. The document is accessible at: [http://www.researchgate.net/profile/Robert_Waterland/publication/40481734_Ozone_and_TFA_impacts_in_North_America_from_degradation_of_2333-Tetrafluoropropene_\(HFO-1234yf\)_a_potential_greenhouse_gas_replacement/links/00b7d514ca9595bf5e000000.pdf](http://www.researchgate.net/profile/Robert_Waterland/publication/40481734_Ozone_and_TFA_impacts_in_North_America_from_degradation_of_2333-Tetrafluoropropene_(HFO-1234yf)_a_potential_greenhouse_gas_replacement/links/00b7d514ca9595bf5e000000.pdf).
- Kontomaris et al., 2010. "A Non-Flammable, Reduced GWP, HFC-134a Replacement in Centrifugal Chillers: DR-11." This document is accessible at <http://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=2021&context=iracc>.
- Manitowoc, 2015. SNAP Information Notice, September, 2013. EPA SNAP Submittal—Revision to Extend R-290 Use to Commercial Ice Machines, Manitowoc Ice, Inc. October, 2015.
- Manitowoc, 2016. "Icecore Remote Refrigeration Units." This document is accessible at <http://www.manitowocbeverage.com/asset/?id=bkbf®ions=us&prefLang=en>.
- McDonald's 2004. "Cool: The world's first HFC-free McDonald's restaurant." This document is accessible at <http://www.unep.fr/ozonaction/information/mmcfiles/4256-e-mcdonalds.pdf>.
- MHI, 2015. "MHI Develops 'ETI-Z Series' of Next-generation Centrifugal Chiller—Adopt New Non-ozone-depleting Refrigeration to Minimize Greenhouse Gas Emissions." June 10, 2015. This document is accessible at www.mhi-global.com/news/story/1506101900.html.
- Mitsubishi, 2012. "Deployment to New Series of 'eco Turbo chiller ETI series.'" This document is accessible at <http://www.mhi.co.jp/technology/review/pdf/491/491058.pdf>.
- Montzka, 2012. HFCs in the Atmosphere: Concentrations, Emissions and Impacts. ASHRAE/NIST Conference 2012. This document is accessible at: ftp://ftp.cmdl.noaa.gov/hats/papers/montzka/2012_pubs/Montzka_ASHRAE_2012.pdf.
- NRDC/IGSD, 2015. Petition for Change of Status of HFCs under Clean Air Act Section 612 (Significant New Alternatives Policy). Submitted October 6, 2015.
- ORNL, 2015. ORNL's JUMP Challenge: JUMP in to Advance Tech Innovation!
- Presented by Brian Fricke, Oak Ridge National Laboratory. November 17, 2015.
- Pandian et al., 1998. "Correcting Errors in the Nationwide Data Base of Residential Air Exchange Rates." Journal of Exposure Analysis and Environmental Epidemiology, Vol. 8, No. 4, 577–585, 1998.
- Patten and Wuebbles, 2010. "Atmospheric Lifetimes and Ozone Depletion Potentials of trans-1-chloro-3,3,3-trichloropropylene and trans-1,2-dichloroethylene in a three-dimensional model." Atmos. Chem. Phys., 10, 10867–10874, 2010.
- Patten et al., 2012. Correction to "OH reaction rate constant, IR absorption spectrum, ozone depletion potentials and global warming potentials of 2-bromo-3,3,3-trifluoropropene." J. Geophys. Res., 117, D22301, doi:10.1029/2012JD19051.
- RAC, 2012. "Klima-Therm discusses world's first HFO chiller for Waitrose." January 10, 2012. This document is accessible online at <http://www.racplus.com/features/klima-therm-discusses-worlds-first-hfo-chiller-for-waitrose/8624689.article>.
- RAC, 2016. "Carrier opts for HFO 1234ze refrigerants for global chiller range." February 26, 2016. This document is accessible at <http://www.racplus.com/news/carrier-opts-for-hfo-1234ze-refrigerants-for-global-chiller-range/10003440.article?blocktitle=News&contentID=15773>.
- Ravishankara, A. R., A. A. Turnipseed, N. R. Jensen, S. Barone, M. Mills, C. J. Howard, and S. Solomon. 1994. Do hydrofluorocarbons destroy stratospheric ozone? *Science* 263: 71–75. Available online at <http://www.ciesin.org/docs/011-552/011-552.html>.
- RC Group, 2016. "Unico Turbo Air Cooled Liquid Chiller." This document is accessible at <http://www.rcgroup.it/EN/Prodotti/?idP=1563>.
- RTOC, 2015. 2014 Report of the Refrigeration, Air-Conditioning and Heat Pumps Technical Options Committee. This document is accessible at: <http://ozone.unep.org/sites/ozone/files/documents/RTOC-Assessment-Report-2014.pdf>.
- SAE, 2013. SAE International Cooperative Research Project CRP1234–4 on R-1234yf Safety, Finishes Work and Presents Conclusions. This document is accessible at: http://www.sae.org/servlets/pressRoom?OBJECT_TYPE=PressReleases&PAGE=showRelease&RELEASE_ID=2146.
- Sleasman, K. and Biggs, M., 2015. Lessons learned from the Federal Partners Workgroup on Spray Polyurethane Foam (SPF), presented at the Center for the Polyurethanes Industry Technical Conference, October, 2015.
- SMARTD, 2016. "Revolutionary Energy Savings for the Built Environment", "Trendsetting Technologies for Centrifugal Chillers." These documents are available at <http://climatecontrolme.com/2013/12/trendsetting-technologies-for-centrifugal-chillers/> and <http://www.smartd.com/docs/SMARTD%20BROCHURE%20ENGLISH%20JAN%202016.pdf>.
- Star Refrigeration, 2012. "Star's Three-Way Development Test for R-1234ze(E)." July 2012. This document is accessible at <http://www.star-ref.co.uk/star/images/stories/pdf/Case%20Study%20No%2082%20-%20Refrigerant%20R-1234ze.pdf>.
- TEAP, 2013. Report of the Technology and Economic Assessment Panel, Volume 2: Decision XXIV/7 Task Force Report, Additional Information on Alternatives to ODS. September, 2013. This document is accessible at: http://ozone.unep.org/Assessment_Panels/TEAP/Reports/TEAP_Reports/TEAP_TaskForce%20XXIV-7-September2013.pdf.
- TEAP, 2015. 2014 Assessment Report of the Technology and Economic Assessment Panel. This document is accessible at: http://conf.montreal-protocol.org/meeting/oewg/oewg-36/presession/Background%20Documents%20are%20available%20in%20English%20only/TEAP_Assessment_report_2014.pdf.
- TEAP/HTOC, 2015. 2014 Report of the Halons Technical Options Committee (Vol. 1). This document is accessible at: http://ozone.unep.org/en/Assessment_Panels/TEAP/Reports/HTOC/HTOC%202014%20Assessment%20Report.pdf.
- The NEWS, 2014. "Airedale Chiller with Low-GWP HFO Refrigerant to Cool New John Lewis Store." June 9, 2014. This document is accessible at <http://www.achrnews.com/articles/126828-airedale-chiller-with-low-gwp-hfo-refrigerant-to-cool-new-john-lewis-store>.
- Trane, 2016. "Trane Announces Significant Centrifugal Chiller Line Expansion and Services for the United States and Canada." June 15, 2016. This document is accessible at <http://www.trane.com/commercial/north-america/us/en/about-us/newsroom/press-releases/centrifugal-chiller-line-expansion.html>.
- The White House, 2013. President's Climate Action Plan. This document is accessible at: <https://www.whitehouse.gov/sites/default/files/image/president27climateactionplan.pdf>.
- The White House, 2015. Fact Sheet: Obama Administration and Private-Sector Leaders Announce Ambitious Commitments and Robust Progress to Address Potent Greenhouse Gases, October 15, 2015. Accessible at <https://www.whitehouse.gov/the-press-office/2015/10/15/fact-sheet-obama-administration-and-private-sector-leaders-announce>.
- Trane, 2015. Trane® Sintesis™ Air-cooled Chillers. This document is accessible at: http://www.trane.com/content/dam/Trane/Commercial/global/products-systems/equipment/chillers/air-cooled/TRANE_Sintesis_Brochure.pdf.
- UL, 2004. Standard 711—Rating and Testing of Fire Extinguishers. This document is accessible at: http://ulstandards.ul.com/standard/?id=711_7.
- UL, 2005. Standard 2129—Halocarbon Clean Agent Fire Extinguishers. This document

- is accessible at: http://ulstandards.ul.com/standard/?id=2129_2.
- UL, 2008. Standard 399—Standard for Drinking-Water Coolers. 7th edition. Supplement SB: Requirements for Room Air Conditioners Employing a Flammable Refrigerant in the Refrigerating System. Underwriters Laboratories, Inc. August 22, 2008. A summary of this document is accessible at: http://ulstandards.ul.com/standard/?id=399_7.
- UL, 2009. Standard 563—Standard for Ice Makers. 8th edition. Supplement SA: Requirements for Refrigerators and Freezers Employing a Flammable Refrigerant in the Refrigerating System. Underwriters Laboratories, Inc. July 31, 2009. A summary of this document is accessible at: <http://ulstandards.ul.com/standard/?id=563>.
- UL, 2010. Standard 471—Standard for Commercial Refrigerators and Freezers. 10th edition. Supplement SB: Requirements for Refrigerators and Freezers Employing a Flammable Refrigerant in the Refrigerating System. Underwriters Laboratories, Inc. November 24, 2010. A summary of this document is accessible at: http://ulstandards.ul.com/standard/?id=471_10.
- UNEP, 2011. HFCs: A Critical Link in Protecting Climate and the Ozone Layer, A UNEP Synthesis Report. November, 2011. This document is accessible at: www.unep.org/dewa/portals/67/pdf/HFC_report.pdf.
- UNEP, 2013. Report of the Technology and Economic Assessment Panel, Volume 2: Decision XXIV/7 Task Force Report, Additional Information on Alternatives to ODS. September, 2013.
- UTC, 2016. Comments on Proposed Rule: Protection of Stratospheric Ozone: Change of Listing Status for Certain Substitutes under the Significant New Alternatives Policy Program (Docket no. EPA-HQ-OAR-2015-0663). Docket number EPA-HQ-OAR-2015-0663-0069.
- Velders, G. J. M., D. W. Fahey, J. S. Daniel, M. McFarland, S. O. Andersen (2015). "Future atmospheric abundances and climate forcings from scenarios of global and regional hydrofluorocarbon (HFC) emissions." *Atmospheric Environment* 123: 200–209.

- Velders, G. J. M., D. W. Fahey, J. S. Daniel, M. McFarland, S. O. Andersen (2009). "The large contribution of projected HFC emissions to future climate forcing." *Proceedings of the National Academy of Sciences USA* 106: 10949–10954.
- Wallington, T. J., J. J. Orlando and G. S. Tyndall, O. J. Nielsen: Comment on "Airborne Trifluoroacetic Acid and Its Fraction from the Degradation of HFC-134a in Beijing, China", *Environ. Sci. Technol.*, 48, 9948–9948, DOI: 10.1021/es502485w, 2014.
- Wang D., Olsen S., Wuebbles D. 2011. "Preliminary Report: Analyses of tCFP's Potential Impact on Atmospheric Ozone." Department of Atmospheric Sciences. University of Illinois, Urbana, IL. September 26, 2011.
- Wickham, 2002. Status of Industry Efforts to Replace Halon Fire Extinguishing Agents. March, 2002.
- Wu, J., J. Martin, Z. Zhai, K. Lu, L. Li, X. Fang, H. Jin, J. Hu, and J. Zhang. Airborne trifluoroacetic acid and its fraction from the degradation of HFC-134a in Beijing, China. *Environ. Sci. Technol.*, 10.1021/es4050264, 2014.
- Zhai Z., J. Wu, X. Hu, L. Li, L. Guo, B. Zhang, J. Hu, and J. Zhang: A 17-fold increase of trifluoroacetic acid in landscape waters of Beijing, China during the last decade, *Chemosphere*, 129, 110–117, 2015.

List of Subjects in 40 CFR Part 82

Environmental protection, Administrative practice and procedure, Air pollution control, Incorporation by reference, Recycling, Reporting and recordkeeping requirements, Stratospheric ozone layer.

Dated: September 26, 2016.

Gina McCarthy,
Administrator.

For the reasons set forth in the preamble, EPA amends 40 CFR part 82 as follows:

PART 82—PROTECTION OF STRATOSPHERIC OZONE

■ 1. The authority citation for part 82 continues to read as follows:

Authority: 42 U.S.C. 7414, 7601, 7671–7671q.

Subpart F—Recycling and Emissions Reduction

■ 2. Amend § 82.154 by revising the introductory text to paragraph (a)(1) and paragraph (a)(1)(viii) to read as follows:

§ 82.154 Prohibitions.

(a) * * * (1) No person maintaining, servicing, repairing, or disposing of an appliance or industrial process refrigeration may knowingly vent or otherwise release into the environment any refrigerant from such appliances. Notwithstanding any other provision of this subpart, the following substitutes in the following end-uses are exempt from this prohibition and from the requirements of this subpart:

* * * * *

(viii) Propane (R-290) in retail food refrigerators and freezers (stand-alone units only); household refrigerators, freezers, and combination refrigerators and freezers; self-contained room air conditioners for residential and light commercial air-conditioning and heat pumps; vending machines; and effective January 3, 2017, self-contained commercial ice machines, very low temperature refrigeration equipment, and water coolers;

* * * * *

Subpart G—Significant New Alternatives Policy Program

■ 3. In appendix B to subpart G of part 82, the table titled "Refrigerants—Acceptable Subject to Use Conditions" is amended by:

- a. Revising the fifth entry;
- b. Adding three entries at the end; and
- c. Revising the NOTE following footnote 3.

The revisions and additions to read as follows:

Appendix B to Subpart G of Part 82—Substitutes Subject to Use Restrictions and Unacceptable Substitutes

REFRIGERANTS—ACCEPTABLE SUBJECT TO USE CONDITIONS

Application	Substitute	Decision	Conditions	Comments
CFC-12 Automobile Motor Vehicle Air Conditioning (New equipment only).	R-152a as a substitute for CFC-12.	Acceptable subject to use conditions.	Engineering strategies and/or devices shall be incorporated into the system such that foreseeable leaks into the passenger compartment do not result in R-152a concentrations of 3.7% v/v or above in any part of the free space inside the passenger compartment for more than 15 seconds when the car ignition is on. Manufacturers must adhere to all the safety requirements listed in the Society of Automotive Engineers (SAE) Standard J639 (adopted 2011), including unique fittings and a flammable refrigerant warning label as well as SAE Standard J2773 (adopted February 2011).	Additional training for service technicians recommended. Manufacturers should conduct and keep on file failure mode and Effect Analysis (FMEA) on the MVAC as stated in SAE J1739.
Motor vehicle air conditioning (newly manufactured medium-duty passenger vehicles).	HFO-1234yf	Acceptable subject to use conditions.	As of January 3, 2017: (1) HFO-1234yf MVAC systems must adhere to all of the safety requirements of SAE J639 (adopted 2011), including requirements for a flammable refrigerant warning label, high-pressure compressor cutoff switch and pressure relief devices, and unique fittings. For connections with refrigerant containers for use in professional servicing, use fittings must be consistent with SAE J2844 (revised October 2011). (2) Manufacturers must conduct Failure Mode and Effect Analysis (FMEA) as provided in SAE J1739 (adopted 2009). Manufacturers must keep the FMEA on file for at least three years from the date of creation.	Additional training for service technicians recommended. HFO-1234yf is also known as 2,3,3,3-tetrafluoro-prop-1-ene (CAS. Reg. No. 754-12-1).
Motor vehicle air conditioning (newly manufactured heavy-duty pickup trucks).	HFO-1234yf	Acceptable subject to use conditions.	As of January 3, 2017: (1) HFO-1234yf MVAC systems must adhere to all of the safety requirements of SAE J639 (adopted 2011), including requirements for a flammable refrigerant warning label, high-pressure compressor cutoff switch and pressure relief devices, and unique fittings. For connections with refrigerant containers for use in professional servicing, use fittings must be consistent with SAE J2844 (revised October 2011). (2) Manufacturers must conduct Failure Mode and Effect Analysis (FMEA) as provided in SAE J1739 (adopted 2009). Manufacturers must keep the FMEA on file for at least three years from the date of creation.	Additional training for service technicians recommended. HFO-1234yf is also known as 2,3,3,3-tetrafluoro-prop-1-ene (CAS No 754-12-1).
Motor vehicle air conditioning (newly manufactured complete heavy-duty vans only).	HFO-1234yf	Acceptable subject to use conditions.	As of January 3, 2017: (1) HFO-1234yf MVAC systems must adhere to all of the safety requirements of SAE J639 (adopted 2011), including requirements for a flammable refrigerant warning label, high-pressure compressor cutoff switch and pressure relief devices, and unique fittings. For connections with refrigerant containers for use in professional servicing, use fittings must be consistent with SAE J2844 (revised October 2011). (2) Manufacturers must conduct Failure Mode and Effect Analysis (FMEA) as provided in SAE J1739 (adopted 2009). Manufacturers must keep the FMEA on file for at least three years from the date of creation.	Additional training for service technicians recommended. HFO-1234yf is also known as 2,3,3,3-tetrafluoro-prop-1-ene (CAS No 754-12-1). HFO-1234yf is acceptable for complete heavy-duty vans. Complete heavy-duty vans are not altered by a secondary or tertiary manufacturer.

* * * * *

Note 1: The Director of the Federal Register approves the incorporation by reference of the material under “Conditions” in the table “REFRIGERANTS—ACCEPTABLE SUBJECT TO USE CONDITIONS” (5 U.S.C. 552(a) and 1 CFR part 51). You may obtain a copy from SAE Customer Service, 400 Commonwealth Drive, Warrendale, PA 15096-0001 USA; email: CustomerService@sae.org; Telephone: 1-877-606-7323 (U.S. and Canada only) or 1-724-776-4970 (outside the U.S. and

Canada); Internet address: <http://store.sae.org/dlabout.htm>. You may inspect a copy at U.S. EPA’s Air Docket; EPA West Building, Room 3334; 1301 Constitution Ave. NW., Washington, DC, or at the National Archives and Records Administration (NARA). For questions regarding access to these standards, the telephone number of EPA’s Air Docket is 202-566-1742. For information on the availability of this material at NARA, call 202-741-6030, or go to: http://www.archives.gov/federal_register/

code_of_federal_regulations/ibr_locations.html.

* * * * *

■ 4. Appendix K to subpart G of part 82 is revised to read as follows:

Appendix K to Subpart G of Part 82—Substitutes Subject to Use Restrictions and Unacceptable Substitutes Listed in the July 22, 2002, Final Rule Effective August 21, 2002

FOAM BLOWING—UNACCEPTABLE SUBSTITUTES

End-use	Substitute	Decision	Comments
Replacements for HCFC-141b in the following rigid polyurethane/polyisocyanurate applications: <ul style="list-style-type: none"> —Boardstock —Appliance —Spray 	HCFC-22, HCFC-142b and blends thereof.	Unacceptable Closed cell foam products and products containing closed cell foams manufactured with these substitutes on or before December 1, 2017 may be used after that date.	Alternatives exist with lower or zero-ODP.
All foam end-uses	HCFC-124	Unacceptable Closed cell foam products and products containing closed cell foams manufactured with this substitute on or before December 1, 2017 may be used after that date.	Alternatives exist with lower or zero-ODP.

■ 5. Appendix M to subpart G of part 82 is revised to read as follows:

Appendix M to Subpart G—Unacceptable Substitutes Listed in the September 30, 2004 Final Rule, Effective November 29, 2004

FOAM BLOWING—UNACCEPTABLE SUBSTITUTES

End-use	Substitute	Decision	Comments
All foam end-uses: <ul style="list-style-type: none"> —rigid polyurethane and polyisocyanurate laminated boardstock —rigid polyurethane appliance —rigid polyurethane spray and commercial refrigeration, and sandwich panels —rigid polyurethane slabstock and other foams —polystyrene extruded insulation boardstock and billet —phenolic insulation board and bunstock —flexible polyurethane —polystyrene extruded sheet —Except for:¹ <ul style="list-style-type: none"> —space vehicle —nuclear —defense —research and development for foreign customers 	HCFC-141b	Unacceptable Closed cell foam products and products containing closed cell foams manufactured with this substitute on or before December 1, 2017 may be used after that date.	Alternatives exist with lower or zero-ODP.

¹ Exemptions for specific applications are identified in the list of acceptable substitutes, which is available on the SNAP Web site at: <https://www.epa.gov/snap/foam-blowing-agents>.

■ 6. Appendix O to subpart G of part 82 is amended by revising the table titled “Fire Suppression and Explosion Protection Sector-Total Flooding Substitutes-Acceptable Subject to Use Conditions” to read as follows:

Appendix O to Subpart G of Part 82—Substitutes Listed in the September 27, 2006 Final Rule, Effective November 27, 2006

FIRE SUPPRESSION AND EXPLOSION PROTECTION SECTOR—TOTAL FLOODING SUBSTITUTES—ACCEPTABLE SUBJECT TO USE CONDITIONS

End-use	Substitute	Decision	Conditions	Further information
Total flooding	Gelled Halocarbon/ Dry Chemical Suspension (Envirogel) with sodium bicarbonate additive.	Acceptable subject to use conditions.	Use of whichever hydrofluorocarbon gas (HFC-125, HFC-227ea, or HFC-236fa) is employed in the formulation must be in accordance with all requirements for acceptability (<i>i.e.</i> , narrowed use limits) of that HFC under EPA's SNAP program.	Use of this agent should be in accordance with the safety guidelines in the latest edition of the NFPA 2001 Standard for Clean Agent Fire Extinguishing Systems, for whichever hydrofluorocarbon gas is employed, and the latest edition of the NFPA 2010 standard for Aerosol Extinguishing Systems. Sodium bicarbonate release in all settings should be targeted so that increased blood pH level would not adversely affect exposed individuals. Users should provide special training, including the potential hazards associated with the use of the HFC agent and sodium bicarbonate, to individuals required to be in environments protected by Envirogel with sodium bicarbonate additive extinguishing systems. Each extinguisher should be clearly labeled with the potential hazards from use and safe handling procedures. See additional comments 1, 2, 3, 4, 5.
Total flooding	Powdered Aerosol E (FirePro®).	Acceptable subject to use conditions.	For use only in normally unoccupied areas ..	Use of this agent should be in accordance with the safety guidelines in the latest edition of the NFPA 2010 standard for Aerosol Extinguishing Systems. For establishments manufacturing the agent or filling, installing, or servicing containers or systems to be used in total flooding applications, EPA recommends the following: —adequate ventilation should be in place to reduce airborne exposure to constituents of agent; —an eye wash fountain and quick drench facility should be close to the production area; —training for safe handling procedures should be provided to all employees that would be likely to handle containers of the agent or extinguishing units filled with the agent; —workers responsible for clean up should allow for maximum settling of all particulates before reentering area and wear appropriate protective equipment; and —all spills should be cleaned up immediately in accordance with good industrial hygiene practices. See additional comments 1, 2, 3, 4, 5.
Total flooding	Phosphorous Tribromide (PBr ₃).	Acceptable subject to use conditions.	For use only in aircraft engine nacelles	For establishments manufacturing the agent or filling, installing, or servicing containers or systems, EPA recommends the following: —adequate ventilation should be in place and/or positive pressure, self-contained breathing apparatus (SCBA) should be worn; —training for safe handling procedures should be provided to all employees that would be likely to handle containers of the agent or extinguishing units filled with the agent; and —all spills should be cleaned up immediately in accordance with good industrial hygiene practices. See additional comments 1, 2, 3, 4, 5.

Additional comments:

- 1—Should conform to relevant OSHA requirements, including 29 CFR 1910, Subpart L, Sections 1910.160 and 1910.162.
- 2—Per OSHA requirements, protective gear (SCBA) should be available in the event personnel should reenter the area.
- 3—Discharge testing should be strictly limited to that which is essential to meet safety or performance requirements.
- 4—The agent should be recovered from the fire protection system in conjunction with testing or servicing, and recycled for later use or destroyed.
- 5—EPA has no intention of duplicating or displacing OSHA coverage related to the use of personal protective equipment (*e.g.*, respiratory protection), fire protection, hazard communication, worker training or any other occupational safety and health standard with respect to halon substitutes.

■ 7. Appendix Q to subpart G of part 82 is revised to read as follows:

**Appendix Q to Subpart G of Part 82—
Unacceptable Substitutes Listed in the
March 28, 2007 Final Rule, Effective
May 29, 2007**

FOAM BLOWING UNACCEPTABLE SUBSTITUTES

End-use	Substitute	Decision	Further information
—Rigid polyurethane commercial refrigeration —Rigid polyurethane sandwich panels —Rigid polyurethane slabstock and other foams.	HCFC-22, HCFC-142b as substitutes for HCFC-141b.	Unacceptable ¹ Closed cell foam products and products containing closed cell foams manufactured with these substitutes on or before December 1, 2017 may be used after that date.	Alternatives exist with lower or zero-ODP.
—Rigid polyurethane and polyisocyanurate laminated boardstock. —Rigid polyurethane appliance —Rigid polyurethane spray and commercial refrigeration, and sandwich panels. —Rigid polyurethane slabstock and other foams. —Polystyrene extruded insulation boardstock and billet. —Phenolic insulation board and bunstock —Flexible polyurethane —Polystyrene extruded sheet	HCFC-22, HCFC-142b as substitutes for CFCs.	Unacceptable ² Closed cell foam products and products containing closed cell foams manufactured with these substitutes on or before December 1, 2017 may be used after that date.	Alternatives exist with lower or zero-ODP.

¹ For existing users of HCFC-22 and HCFC-142b as of November 4, 2005 other than in marine applications, the unacceptability determination is effective on March 1, 2008; for existing users of HCFC-22 and HCFC-142b as of November 4, 2005 in marine applications, including marine flotation foam, the unacceptability determination is effective on September 1, 2009. For an existing user of HCFC-22 or HCFC-142b that currently operates in only one facility that it does not own, and is scheduled to transition to a non-ODS, flammable alternative to coincide with a move to a new facility and installation of new process equipment that cannot be completed by March 1, 2008, the unacceptability determination is effective January 1, 2010.

² For existing users of HCFC-22 and HCFC-142b in polystyrene extruded insulation boardstock and billet and the other foam end-uses, as of November 4, 2005, the unacceptability determination is effective on January 1, 2010.

■ 8. Appendix U to subpart G of part 82 is amended by revising the tables titled “Foam Blowing Agents—Substitutes Acceptable Subject to Narrowed Use Limits” and “Unacceptable Substitutes” to read as follows:

**Appendix U to Subpart G of Part 82—
Unacceptable Substitutes and
Substitutes Subject to Use Restrictions
Listed in the July 20, 2015 Final Rule,
Effective August 19, 2015**

* * * * *

FOAM BLOWING AGENTS—SUBSTITUTES ACCEPTABLE SUBJECT TO NARROWED USE LIMITS

End-use	Substitute	Decision	Narrowed use limits	Further information
Rigid Polyurethane: Appliance.	HFC-134a, HFC-245fa, HFC-365mfc and blends thereof; Formacel T1, and Formacel Z-6.	Acceptable Subject to Narrowed Use Limits.	Acceptable from January 1, 2020, until January 1, 2022, in military applications and until January 1, 2025, in space- and aeronautics-related applications where reasonable efforts have been made to ascertain that other alternatives are not technically feasible due to performance or safety requirements. Closed cell foam products and products containing closed cell foams manufactured with these substitutes on or before January 1, 2022, for military applications or on and before January 1, 2025, in space- and aeronautics-related applications, may be used after those dates.	Users are required to document and retain the results of their technical investigation of alternatives for the purpose of demonstrating compliance. Information should include descriptions of: <ul style="list-style-type: none"> • Process or product in which the substitute is needed; • Substitutes examined and rejected; • Reason for rejection of other alternatives, e.g., performance, technical or safety standards; and/or • Anticipated date other substitutes will be available and projected time for switching.
Rigid Polyurethane: Commercial Refrigeration and Sandwich Panels.	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; Formacel T1, and Formacel Z-6.	Acceptable Subject to Narrowed Use Limits.	Acceptable from January 1, 2020, until January 1, 2022, in military applications and until January 1, 2025, in space- and aeronautics-related applications where reasonable efforts have been made to ascertain that other alternatives are not technically feasible due to performance or safety requirements. Closed cell foam products and products containing closed cell foams manufactured with these substitutes on or before January 1, 2022, for military applications or on and before January 1, 2025, in space- and aeronautics-related applications, may be used after those dates.	Users are required to document and retain the results of their technical investigation of alternatives for the purpose of demonstrating compliance. Information should include descriptions of: <ul style="list-style-type: none"> • Process or product in which the substitute is needed; • Substitutes examined and rejected; • Reason for rejection of other alternatives, e.g., performance, technical or safety standards; and/or • Anticipated date other substitutes will be available and projected time for switching.

FOAM BLOWING AGENTS—SUBSTITUTES ACCEPTABLE SUBJECT TO NARROWED USE LIMITS—Continued

End-use	Substitute	Decision	Narrowed use limits	Further information
Flexible Polyurethane	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof.	Acceptable Subject to Narrowed Use Limits.	Acceptable from January 1, 2017, until January 1, 2022, in military applications and until January 1, 2025, in space- and aeronautics-related applications where reasonable efforts have been made to ascertain that other alternatives are not technically feasible due to performance or safety requirements.	Users are required to document and retain the results of their technical investigation of alternatives for the purpose of demonstrating compliance. Information should include descriptions of: <ul style="list-style-type: none"> • Process or product in which the substitute is needed; • Substitutes examined and rejected; • Reason for rejection of other alternatives, <i>e.g.</i>, performance, technical or safety standards; and/or • Anticipated date other substitutes will be available and projected time for switching.
Rigid Polyurethane: Slabstock and Other.	HFC-134a, HFC-245fa, HFC-365mfc and blends thereof; Formacel TI, and Formacel Z-6.	Acceptable Subject to Narrowed Use Limits.	Acceptable from January 1, 2019, until January 1, 2022, in military applications and until January 1, 2025, in space- and aeronautics-related applications where reasonable efforts have been made to ascertain that other alternatives are not technically feasible due to performance or safety requirements. Closed cell foam products and products containing closed cell foams manufactured with these substitutes on or before January 1, 2022, for military applications or on and before January 1, 2025, in space- and aeronautics-related applications, may be used after those dates.	Users are required to document and retain the results of their technical investigation of alternatives for the purpose of demonstrating compliance. Information should include descriptions of: <ul style="list-style-type: none"> • Process or product in which the substitute is needed; • Substitutes examined and rejected; • Reason for rejection of other alternatives, <i>e.g.</i>, performance, technical or safety standards; and/or • Anticipated date other substitutes will be available and projected time for switching.
Rigid Polyurethane and Polyisocyanurate Laminated Boardstock.	HFC-134a, HFC-245fa, HFC-365mfc and blends thereof.	Acceptable Subject to Narrowed Use Limits.	Acceptable from January 1, 2017, until January 1, 2022, in military applications and until January 1, 2025, in space- and aeronautics-related applications where reasonable efforts have been made to ascertain that other alternatives are not technically feasible due to performance or safety requirements. Closed cell foam products and products containing closed cell foams manufactured with these substitutes on or before January 1, 2022, for military applications or on and before January 1, 2025, in space- and aeronautics-related applications, may be used after those dates.	Users are required to document and retain the results of their technical investigation of alternatives for the purpose of demonstrating compliance. Information should include descriptions of: <ul style="list-style-type: none"> • Process or product in which the substitute is needed; • Substitutes examined and rejected; • Reason for rejection of other alternatives, <i>e.g.</i>, performance, technical or safety standards; and/or • Anticipated date other substitutes will be available and projected time for switching.
Rigid Polyurethane: Marine Flotation Foam.	HFC-134a, HFC-245fa, HFC-365mfc and blends thereof; Formacel TI, and Formacel Z-6.	Acceptable Subject to Narrowed Use Limits.	Acceptable from January 1, 2020, until January 1, 2022, in military applications and until January 1, 2025, in space- and aeronautics-related applications where reasonable efforts have been made to ascertain that other alternatives are not technically feasible due to performance or safety requirements. Closed cell foam products and products containing closed cell foams manufactured with these substitutes on or before January 1, 2022, for military applications or on and before January 1, 2025, in space- and aeronautics-related applications, may be used after those dates.	Users are required to document and retain the results of their technical investigation of alternatives for the purpose of demonstrating compliance. Information should include descriptions of: <ul style="list-style-type: none"> • Process or product in which the substitute is needed; • Substitutes examined and rejected; • Reason for rejection of other alternatives, <i>e.g.</i>, performance, technical or safety standards; and/or • Anticipated date other substitutes will be available and projected time for switching.
Polystyrene: Extruded Sheet.	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; Formacel TI, and Formacel Z-6.	Acceptable Subject to Narrowed Use Limits.	Acceptable from January 1, 2017, until January 1, 2022, in military applications and until January 1, 2025, in space- and aeronautics-related applications where reasonable efforts have been made to ascertain that other alternatives are not technically feasible due to performance or safety requirements. Closed cell foam products and products containing closed cell foams manufactured with these substitutes on or before January 1, 2022, for military applications or on and before January 1, 2025, in space- and aeronautics-related applications, may be used after those dates.	Users are required to document and retain the results of their technical investigation of alternatives for the purpose of demonstrating compliance. Information should include descriptions of: <ul style="list-style-type: none"> • Process or product in which the substitute is needed; • Substitutes examined and rejected; • Reason for rejection of other alternatives, <i>e.g.</i>, performance, technical or safety standards; and/or • Anticipated date other substitutes will be available and projected time for switching.

FOAM BLOWING AGENTS—SUBSTITUTES ACCEPTABLE SUBJECT TO NARROWED USE LIMITS—Continued

End-use	Substitute	Decision	Narrowed use limits	Further information
Polystyrene: Extruded Boardstock and Billet.	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; Formacel TI, Formacel B, and Formacel Z-6.	Acceptable Subject to Narrowed Use Limits.	Acceptable from January 1, 2021, until January 1, 2022, in military applications and until January 1, 2025, in space- and aeronautics-related applications where reasonable efforts have been made to ascertain that other alternatives are not technically feasible due to performance or safety requirements. Closed cell foam products and products containing closed cell foams manufactured with these substitutes on or before January 1, 2022, for military applications or on and before January 1, 2025, in space- and aeronautics-related applications, may be used after those dates.	Users are required to document and retain the results of their technical investigation of alternatives for the purpose of demonstrating compliance. Information should include descriptions of: <ul style="list-style-type: none"> • Process or product in which the substitute is needed; • Substitutes examined and rejected; • Reason for rejection of other alternatives, <i>e.g.</i>, performance, technical or safety standards; and/or • Anticipated date other substitutes will be available and projected time for switching.
Integral Skin Polyurethane.	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; Formacel TI, and Formacel Z-6.	Acceptable Subject to Narrowed Use Limits.	Acceptable from January 1, 2017, until January 1, 2022, in military applications and until January 1, 2025, in space- and aeronautics-related applications where reasonable efforts have been made to ascertain that other alternatives are not technically feasible due to performance or safety requirements.	Users are required to document and retain the results of their technical investigation of alternatives for the purpose of demonstrating compliance. Information should include descriptions of: <ul style="list-style-type: none"> • Process or product in which the substitute is needed; • Substitutes examined and rejected; • Reason for rejection of other alternatives, <i>e.g.</i>, performance, technical or safety standards; and/or • Anticipated date other substitutes will be available and projected time for switching.
Polyolefin	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; Formacel TI, and Formacel Z-6.	Acceptable Subject to Narrowed Use Limits.	Acceptable from January 1, 2020, until January 1, 2022, in military applications and until January 1, 2025, in space- and aeronautics-related applications where reasonable efforts have been made to ascertain that other alternatives are not technically feasible due to performance or safety requirements. Closed cell foam products and products containing closed cell foams manufactured with these substitutes on or before January 1, 2022, for military applications or on and before January 1, 2025, in space- and aeronautics-related applications, may be used after those dates.	Users are required to document and retain the results of their technical investigation of alternatives for the purpose of demonstrating compliance. Information should include descriptions of: <ul style="list-style-type: none"> • Process or product in which the substitute is needed; • Substitutes examined and rejected; • Reason for rejection of other alternatives, <i>e.g.</i>, performance, technical or safety standards; and/or • Anticipated date other substitutes will be available and projected time for switching.
Phenolic Insulation Board and Bunstock.	HFC-143a, HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof.	Acceptable Subject to Narrowed Use Limits.	Acceptable from January 1, 2017, until January 1, 2022, in military applications and until January 1, 2025, in space- and aeronautics-related applications where reasonable efforts have been made to ascertain that other alternatives are not technically feasible due to performance or safety requirements. Closed cell foam products and products containing closed cell foams manufactured with these substitutes on or before January 1, 2022, for military applications or on and before January 1, 2025, in space- and aeronautics-related applications, may be used after those dates.	Users are required to document and retain the results of their technical investigation of alternatives for the purpose of demonstrating compliance. Information should include descriptions of: <ul style="list-style-type: none"> • Process or product in which the substitute is needed; • Substitutes examined and rejected; • Reason for rejection of other alternatives, <i>e.g.</i>, performance, technical or safety standards; and/or • Anticipated date other substitutes will be available and projected time for switching.

UNACCEPTABLE SUBSTITUTES

End-use	Substitute	Decision	Further information
All Foam Blowing End-uses ..	HCFC-141b and blends thereof	Unacceptable effective September 18, 2015. Closed cell foam products and products containing closed cell foams manufactured with these substitutes on or before December 1, 2017 may be used after that date.	HCFC-141b has an ozone depletion potential of 0.11 under the Montreal Protocol. EPA previously found HCFC-141b unacceptable in all foam blowing end-uses (appendix M to subpart G of 40 CFR part 82). HCFC-141b has an ozone depletion potential (ODP) of 0.11.
All Foam Blowing end-uses ..	HCFC-22, HCFC-142b, and blends thereof	Unacceptable effective September 18, 2015. Closed cell foam products and products containing closed cell foams manufactured with these substitutes on or before December 1, 2017 may be used after that date.	Use or introduction into interstate commerce of virgin HCFC-22 and HCFC-142b for foam blowing is prohibited after January 1, 2010 under EPA's regulations at 40 CFR part 82 subpart A unless used, recovered, and recycled. These compounds have ODPs of 0.055 and 0.065, respectively.

UNACCEPTABLE SUBSTITUTES—Continued

End-use	Substitute	Decision	Further information
Flexible Polyurethane	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof.	Unacceptable as of January 1, 2017, except where allowed under a narrowed use limit.	These foam blowing agents have global warming potentials (GWPs) ranging from 725 to 1,430. Other substitutes will be available for this end-use with lower overall risk to human health and the environment by the status change date.
Polystyrene: Extruded Sheet	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; Formacel TI, and Formacel Z-6.	Unacceptable as of January 1, 2017, except where allowed under a narrowed use limit. Closed cell foam products and products containing closed cell foams manufactured with these substitutes on or before December 1, 2017 may be used after that date.	These foam blowing agents have GWPs ranging from higher than 370 to approximately 1,500. Other substitutes will be available for this end-use with lower overall risk to human health and the environment by the status change date.
Phenolic Insulation Board and Bunstock.	HFC-143a, HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof.	Unacceptable as of January 1, 2017, except where allowed under a narrowed use limit. Closed cell foam products and products containing closed cell foams manufactured with these substitutes on or before December 1, 2017 may be used after that date.	These foam blowing agents have GWPs ranging from 725 to 4,470. Other substitutes will be available for this end-use with lower overall risk to human health and the environment by the status change date.
Integral Skin Polyurethane	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; Formacel TI, and Formacel Z-6.	Unacceptable as of January 1, 2017, except where allowed under a narrowed use limit.	These foam blowing agents have GWPs ranging from higher than 370 to approximately 1,500. Other substitutes will be available for this end-use with lower overall risk to human health and the environment by the status change date.
Rigid Polyurethane: Slabstock and Other.	HFC-134a, HFC-245fa, HFC-365mfc and blends thereof; Formacel TI, and Formacel Z-6.	Unacceptable as of January 1, 2019, except where allowed under a narrowed use limit. Closed cell foam products and products containing closed cell foams manufactured with these substitutes on or before January 1, 2019, may be used after that date.	These foam blowing agents have GWPs ranging from higher than 370 to approximately 1,500. Other substitutes will be available for this end-use with lower overall risk to human health and the environment by the status change date.
Rigid Polyurethane and Polyisocyanurate Laminated Boardstock.	HFC-134a, HFC-245fa, HFC-365mfc and blends thereof.	Unacceptable as of January 1, 2017, except where allowed under a narrowed use limit. Closed cell foam products and products containing closed cell foams manufactured with these substitutes on or before December 1, 2017 may be used after that date.	These foam blowing agents have GWPs ranging from 725 to 1,430. Other substitutes will be available for this end-use with lower overall risk to human health and the environment by the status change date.
Rigid Polyurethane: Marine Flotation Foam.	HFC-134a, HFC-245fa, HFC-365mfc and blends thereof; Formacel TI, and Formacel Z-6.	Unacceptable as of January 1, 2020 except where allowed under a narrowed use limit. Closed cell foam products and products containing closed cell foams manufactured with these substitutes on or before January 1, 2020, may be used after that date.	These foam blowing agents have GWPs ranging from higher than 370 to approximately 1,500. Other substitutes will be available for this end-use with lower overall risk to human health and the environment by the status change date.
Rigid Polyurethane: Commercial Refrigeration and Sandwich Panels.	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; Formacel TI, and Formacel Z-6.	Unacceptable as of January 1, 2020 except where allowed under a narrowed use limit. Closed cell foam products and products containing closed cell foams manufactured with these substitutes on or before January 1, 2020, may be used after that date.	These foam blowing agents have GWPs ranging from higher than 370 to approximately 1,500. Other substitutes will be available for this end-use with lower overall risk to human health and the environment by the status change date.
Rigid Polyurethane: Appliance.	HFC-134a, HFC-245fa, HFC-365mfc and blends thereof; Formacel TI, and Formacel Z-6.	Unacceptable as of January 1, 2020, except where allowed under a narrowed use limit. Closed cell foam products and products containing closed cell foams manufactured with these substitutes on or before January 1, 2020, may be used after that date.	These foam blowing agents have GWPs ranging from higher than 370 to approximately 1,500. Other substitutes will be available for this end-use with lower overall risk to human health and the environment by the status change date.
Polystyrene: Extruded Boardstock and Billet.	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; Formacel TI, Formacel B, and Formacel Z-6.	Unacceptable as of January 1, 2021, except where allowed under a narrowed use limit. Closed cell foam products and products containing closed cell foams manufactured with these substitutes on or before January 1, 2021, may be used after that date.	These foam blowing agents have GWPs ranging from higher than 140 to approximately 1,500. Other substitutes will be available for this end-use with lower overall risk to human health and the environment by the status change date.

UNACCEPTABLE SUBSTITUTES—Continued

End-use	Substitute	Decision	Further information
Polyolefin	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; Formacel TI, and Formacel Z-6.	Unacceptable as of January 1, 2020, except where allowed under a narrowed use limit. Closed cell foam products and products containing closed cell foams manufactured with these substitutes on or before January 1, 2020, may be used after that date.	These foam blowing agents have GWPs ranging from higher than 370 to approximately 1,500. Other substitutes will be available for this end-use with lower overall risk to human health and the environment by the status change date.

* * * * *

■ 9. Add appendix V to subpart G of part 82 to read as follows:

**Appendix V to Subpart G of Part 82—
Substitutes Subject to Use Restrictions
and Unacceptable Substitutes Listed in
the December 1, 2016 Final Rule**

REFRIGERANTS—ACCEPTABLE SUBJECT TO USE CONDITIONS

End-use	Substitute	Decision	Use conditions	Further information
Commercial ice machines (self-contained) (new only).	Propane (R-290)	Acceptable, subject to use conditions.	<p>As of January 3, 2017:</p> <p>This refrigerant may be used only in new equipment designed specifically and clearly identified for the refrigerant—<i>i.e.</i>, this refrigerant may not be used as a conversion or “retrofit” refrigerant for existing equipment.</p> <p>This refrigerant may be used only in self-contained commercial ice machines that meet all requirements listed in Supplement SA to UL 563.^{1,2,5} In cases where this rule includes requirements more stringent than those in UL 563, the equipment must meet the requirements of the final rule in place of the requirements in the UL Standard.</p> <p>The charge size must not exceed 150g (5.29 oz) in each refrigerant circuit of a commercial ice machine.</p> <p>As provided in clauses SA6.1.1 and SA6.1.2 of UL 563, the following markings must be attached at the locations provided and must be permanent:</p> <p>(a) “DANGER—Risk of Fire or Explosion. Flammable Refrigerant Used. Do Not Use Mechanical Devices To Defrost Refrigerator. Do Not Puncture Refrigerant Tubing.” This marking must be provided on or near any evaporators that can be contacted by the consumer.</p> <p>(b) “DANGER—Risk of Fire or Explosion. Flammable Refrigerant Used. To Be Repaired Only By Trained Service Personnel. Do Not Puncture Refrigerant Tubing.” This marking must be located near the machine compartment.</p> <p>(c) “CAUTION—Risk of Fire or Explosion. Flammable Refrigerant Used. Consult Repair Manual/Owner’s Guide Before Attempting To Service This Product. All Safety Precautions Must be Followed.” This marking must be located near the machine compartment.</p> <p>(d) “CAUTION—Risk of Fire or Explosion. Dispose of Properly In Accordance With Federal Or Local Regulations. Flammable Refrigerant Used.” This marking must be provided on the exterior of the refrigeration equipment.</p> <p>(e) “CAUTION—Risk of Fire or Explosion Due To Puncture Of Refrigerant Tubing; Follow Handling Instructions Carefully. Flammable Refrigerant Used.” This marking must be provided near all exposed refrigerant tubing.</p> <p>All of these markings must be in letters no less than 6.4 mm (¼ inch) high.</p> <p>The equipment must have red Pantone Matching System (PMS) #185 marked pipes, hoses, or other devices through which the refrigerant passes, to indicate the use of a flammable refrigerant. This color must be applied at all service ports and other parts of the system where service puncturing or other actions creating an opening from the refrigerant circuit to the atmosphere might be expected and must extend a minimum of one (1) inch in both directions from such locations.</p>	<p>Applicable OSHA requirements at 29 CFR part 1910 must be followed, including those at 29 CFR 1910.106 (flammable and combustible liquids), 1910.110 (storage and handling of liquefied petroleum gases), 1910.157 (portable fire extinguishers), and 1910.1000 (toxic and hazardous substances).</p> <p>Proper ventilation should be maintained at all times during the manufacture and storage of equipment containing hydrocarbon refrigerants through adherence to good manufacturing practices as per 29 CFR 1910.106. If refrigerant levels in the air surrounding the equipment rise above one-fourth of the lower flammability limit, the space should be evacuated and re-entry should occur only after the space has been properly ventilated.</p> <p>Technicians and equipment manufacturers should wear appropriate personal protective equipment, including chemical goggles and protective gloves, when handling propane. Special care should be taken to avoid contact with the skin since propane, like many refrigerants, can cause freeze burns on the skin.</p> <p>A Class B dry powder type fire extinguisher should be kept nearby.</p> <p>Technicians should only use spark-proof tools when working on equipment with propane.</p> <p>Any recovery equipment used should be designed for flammable refrigerants.</p> <p>Any refrigerant releases should be in a well-ventilated area, such as outside of a building.</p> <p>Only technicians specifically trained in handling flammable refrigerants should service equipment containing propane. Technicians should gain an understanding of minimizing the risk of fire and the steps to use flammable refrigerants safely.</p> <p>Room occupants should evacuate the space immediately following the accidental release of this refrigerant.</p> <p>If a service port is added then, commercial ice machines or equipment using propane should have service aperture fittings that differ from fittings used in equipment or containers using non-flammable refrigerant. “Differ” means that either the diameter differs by at least ¼ inch or the thread direction is reversed (<i>i.e.</i>, right-handed vs. left-handed). These different fittings should be permanently affixed to the unit at the point of service and maintained until the end-of-life of the unit, and should not be accessed with an adaptor.</p>

REFRIGERANTS—ACCEPTABLE SUBJECT TO USE CONDITIONS—Continued

End-use	Substitute	Decision	Use conditions	Further information
Very low temperature refrigeration equipment (new only).	Propane (R-290)	Acceptable, subject to use conditions.	<p>As of January 3, 2017:</p> <p>This refrigerant may be used only in new equipment designed specifically and clearly identified for the refrigerant—<i>i.e.</i>, this refrigerant may not be used as a conversion or “retrofit” refrigerant for existing equipment.</p> <p>This refrigerant may only be used in equipment that meets all requirements in Supplement SB to UL 471.^{1,2,4} In cases where the final rule includes requirements more stringent than those of UL 471, the appliance must meet the requirements of the final rule in place of the requirements in the UL Standard.</p> <p>The charge size for the equipment must not exceed 150 grams (5.29 ounces) in each refrigerant circuit of the very low temperature refrigeration equipment.</p> <p>As provided in clauses SB6.1.2 to SB6.1.5 of UL 471, the following markings must be attached at the locations provided and must be permanent:</p> <p>(a) “DANGER—Risk of Fire or Explosion. Flammable Refrigerant Used. Do Not Use Mechanical Devices To Defrost Refrigerator. Do Not Puncture Refrigerant Tubing.” This marking must be provided on or near any evaporators that can be contacted by the consumer.</p> <p>(b) “DANGER—Risk of Fire or Explosion. Flammable Refrigerant Used. To Be Repaired Only By Trained Service Personnel. Do Not Puncture Refrigerant Tubing.” This marking must be located near the machine compartment.</p> <p>(c) “CAUTION—Risk of Fire or Explosion. Flammable Refrigerant Used. Consult Repair Manual/Owner’s Guide Before Attempting To Service This Product. All Safety Precautions Must be Followed.” This marking must be located near the machine compartment.</p> <p>(d) “CAUTION—Risk of Fire or Explosion. Dispose of Properly In Accordance With Federal Or Local Regulations. Flammable Refrigerant Used.” This marking must be provided on the exterior of the refrigeration equipment.</p> <p>(e) “CAUTION—Risk of Fire or Explosion Due To Puncture Of Refrigerant Tubing; Follow Handling Instructions Carefully. Flammable Refrigerant Used.” This marking must be provided near all exposed refrigerant tubing.</p> <p>All of these markings must be in letters no less than 6.4 mm (1/4 inch) high.</p> <p>The equipment must have red PMS #185 marked pipes, hoses, or other devices through which the refrigerant passes, to indicate the use of a flammable refrigerant. This color must be applied at all service ports and other parts of the system where service puncturing or other actions creating an opening from the refrigerant circuit to the atmosphere might be expected and must extend a minimum of one (1) inch in both directions from such locations.</p>	<p>Applicable OSHA requirements at 29 CFR part 1910 must be followed, including those at 29 CFR 1910.94 (ventilation) and 1910.106 (flammable and combustible liquids), 1910.110 (storage and handling of liquefied petroleum gases), 1910.157 (portable fire extinguishers), and 1910.1000 (toxic and hazardous substances).</p> <p>Proper ventilation should be maintained at all times during the manufacture and storage of equipment containing hydrocarbon refrigerants through adherence to good manufacturing practices as per 29 CFR 1910.106. If refrigerant levels in the air surrounding the equipment rise above one-fourth of the lower flammability limit, the space should be evacuated and re-entry should occur only after the space has been properly ventilated.</p> <p>Technicians and equipment manufacturers should wear appropriate personal protective equipment, including chemical goggles and protective gloves, when handling propane. Special care should be taken to avoid contact with the skin since propane, like many refrigerants, can cause freeze burns on the skin.</p> <p>A Class B dry powder type fire extinguisher should be kept nearby.</p> <p>Technicians should only use spark-proof tools when working on equipment with flammable refrigerants.</p> <p>Any recovery equipment used should be designed for flammable refrigerants.</p> <p>Any refrigerant releases should be in a well-ventilated area, such as outside of a building.</p> <p>Only technicians specifically trained in handling flammable refrigerants should service equipment containing propane. Technicians should gain an understanding of minimizing the risk of fire and the steps to use flammable refrigerants safely.</p> <p>Room occupants should evacuate the space immediately following the accidental release of this refrigerant.</p> <p>If a service port is added, then very low temperature equipment using propane should have service aperture fittings that differ from fittings used in equipment or containers using non-flammable refrigerant. “Differ” means that either the diameter differs by at least 1/16 inch or the thread direction is reversed (<i>i.e.</i>, right-handed vs. left-handed). These different fittings should be permanently affixed to the unit at the point of service and maintained until the end-of-life of the unit, and should not be accessed with an adaptor.</p> <p>Very low temperature equipment using propane may also use another acceptable refrigerant substitute in a separate refrigerant circuit or stage (<i>e.g.</i>, one temperature stage with propane and a second stage with ethane).</p>

REFRIGERANTS—ACCEPTABLE SUBJECT TO USE CONDITIONS—Continued

End-use	Substitute	Decision	Use conditions	Further information
Water coolers (new only).	Propane (R-290)	Acceptable, subject to use conditions.	<p>As of January 3, 2017:</p> <p>This refrigerant may be used only in new equipment designed specifically and clearly identified for the refrigerant—i.e., this refrigerant may not be used as a conversion or “retrofit” refrigerant for existing equipment.</p> <p>This refrigerant may be used only in water coolers that meet all requirements listed in Supplement SB to UL 399^{1 2 3}. In cases where the rule includes requirements more stringent than those of the UL 399, the appliance must meet the requirements of the final rule in place of the requirements in the UL Standard.</p> <p>The charge size must not exceed 60 grams (2.12 ounces) per refrigerant circuit in the water cooler.</p> <p>The equipment must have red PMS #185 marked pipes, hoses, or other devices through which the refrigerant passes, to indicate the use of a flammable refrigerant. This color must be applied at all service ports and other parts of the system where service puncturing or other actions creating an opening from the refrigerant circuit to the atmosphere might be expected and must extend a minimum of one (1) inch in both directions from such locations.</p> <p>As provided in clauses SB6.1.2 to SB6.1.5 of UL 399, the following markings must be attached at the locations provided and must be permanent:</p> <p>(a) “DANGER—Risk of Fire or Explosion. Flammable Refrigerant Used. Do Not Use Mechanical Devices To Defrost Refrigerator. Do Not Puncture Refrigerant Tubing.” This marking must be provided on or near any evaporators that can be contacted by the consumer.</p> <p>(b) “DANGER—Risk of Fire or Explosion. Flammable Refrigerant Used. To Be Repaired Only By Trained Service Personnel. Do Not Puncture Refrigerant Tubing.” This marking must be located near the machine compartment.</p> <p>(c) “CAUTION—Risk of Fire or Explosion. Flammable Refrigerant Used. Consult Repair Manual/Owner’s Guide Before Attempting To Service This Product. All Safety Precautions Must be Followed.” This marking must be located near the machine compartment.</p> <p>(d) “CAUTION—Risk of Fire or Explosion. Dispose of Properly In Accordance With Federal Or Local Regulations. Flammable Refrigerant Used.” This marking must be provided on the exterior of the refrigeration equipment.</p> <p>(e) “CAUTION—Risk of Fire or Explosion Due To Puncture Of Refrigerant Tubing; Follow Handling Instructions Carefully. Flammable Refrigerant Used.” This marking must be provided near all exposed refrigerant tubing.</p>	<p>Applicable OSHA requirements at 29 CFR part 1910 must be followed, including those at 29 CFR 1910.94 (ventilation) and 1910.106 (flammable and combustible liquids), 1910.110 (storage and handling of liquefied petroleum gases), 1910.157 (portable fire extinguishers), and 1910.1000 (toxic and hazardous substances).</p> <p>Proper ventilation should be maintained at all times during the manufacture and storage of equipment containing hydrocarbon refrigerants through adherence to good manufacturing practices as per 29 CFR 1910.106. If refrigerant levels in the air surrounding the equipment rise above one-fourth of the lower flammability limit, the space should be evacuated and re-entry should occur only after the space has been properly ventilated.</p> <p>Technicians and equipment manufacturers should wear appropriate personal protective equipment, including chemical goggles and protective gloves, when handling propane. Special care should be taken to avoid contact with the skin since propane, like many refrigerants, can cause freeze burns on the skin.</p> <p>A Class B dry powder type fire extinguisher should be kept nearby.</p> <p>Technicians should only use spark-proof tools when working on equipment with flammable refrigerants.</p> <p>Any recovery equipment used should be designed for flammable refrigerants.</p> <p>Any refrigerant releases should be in a well-ventilated area, such as outside of a building.</p> <p>Only technicians specifically trained in handling flammable refrigerants should service equipment containing propane. Technicians should gain an understanding of minimizing the risk of fire and the steps to use flammable refrigerants safely.</p> <p>Room occupants should evacuate the space immediately following the accidental release of this refrigerant.</p> <p>If a service port is added, then water coolers or equipment using propane should have service aperture fittings that differ from fittings used in equipment or containers using non-flammable refrigerant. “Differ” means that either the diameter differs by at least 1/16 inch or the thread direction is reversed (i.e., right-handed vs. left-handed). These different fittings should be permanently affixed to the unit at the point of service and maintained until the end-of-life of the unit, and should not be accessed with an adaptor.</p>

¹ The Director of the Federal Register approves this incorporation by reference (5 U.S.C. 552(a) and 1 CFR part 51). You may inspect a copy at U.S. EPA’s Air and Radiation Docket; EPA West Building, Room 3334, 1301 Constitution Ave. NW., Washington, DC or at the National Archives and Records Administration (NARA). For questions regarding access to these standards, the telephone number of EPA’s Air and Radiation Docket is 202-566-1742. For information on the availability of this material at NARA, call 202-741-6030, or go to: http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html.

² You may obtain the material from: Underwriters Laboratories Inc. (UL) COMM 2000; 151 Eastern Avenue, Bensenville, IL 60106; orders@comm-2000.com; 1-888-853-3503 in the U.S. or Canada (other countries dial +1-415-352-2168); <http://ulstandards.ul.com/> or www.comm-2000.com.

³ UL 399, Standard for Safety: Drinking Water Coolers.—Supplement SB: Requirements for Drinking Water Coolers Employing a Flammable Refrigerant in the Refrigerating System, 7th edition, Dated August 22, 2008, including revisions through October 17, 2013.

⁴ UL 471, Standard for Safety: Commercial Refrigerators and Freezers.—Supplement SB: Requirements for Refrigerators and Freezers Employing a Flammable Refrigerant in the Refrigerating System, 10th edition, Dated November 24, 2010.

⁵ UL 563, Standard for Safety: Ice Makers.—Supplement SA: Requirements for Ice Makers Employing a Flammable Refrigerant in the Refrigerating System, 8th edition, Dated July 31, 2009, including revisions through November 29, 2013.

REFRIGERANTS—SUBSTITUTES ACCEPTABLE SUBJECT TO NARROWED USE LIMITS

End-use	Substitutes	Decision	Narrowed use limits	Further information
Centrifugal chillers (new only).	HFC-134a	Acceptable subject to narrowed use limits.	Acceptable after January 1, 2024, only in military marine vessels where reasonable efforts have been made to ascertain that other alternatives are not technically feasible due to performance or safety requirements.	Users are required to document and retain the results of their technical investigation of alternatives for the purpose of demonstrating compliance. Information should include descriptions of: <ul style="list-style-type: none"> • Application in which the substitute is needed; • Substitutes examined and rejected; • Reason for rejection of other alternatives, <i>e.g.</i>, performance, technical or safety standards; and/or • Anticipated date other substitutes will be available and qualified and projected time for switching.
Centrifugal chillers (new only).	HFC-134a and R-404A.	Acceptable subject to narrowed use limits.	Acceptable after January 1, 2024, only in human-rated spacecraft and related support equipment where reasonable efforts have been made to ascertain that other alternatives are not technically feasible due to performance or safety requirements.	Users are required to document and retain the results of their technical investigation of alternatives for the purpose of demonstrating compliance. Information should include descriptions of: <ul style="list-style-type: none"> • Application in which the substitute is needed; • Substitutes examined and rejected; • Reason for rejection of other alternatives, <i>e.g.</i>, performance, technical or safety standards; and/or • Anticipated date other substitutes will be available and qualified and projected time for switching.
Positive displacement chillers (new only).	HFC-134a	Acceptable subject to narrowed use limits.	Acceptable after January 1, 2024, only in military marine vessels where reasonable efforts have been made to ascertain that other alternatives are not technically feasible due to performance or safety requirements.	Users are required to document and retain the results of their technical investigation of alternatives for the purpose of demonstrating compliance. Information should include descriptions of: <ul style="list-style-type: none"> • Application in which the substitute is needed; • Substitutes examined and rejected; • Reason for rejection of other alternatives, <i>e.g.</i>, performance, technical or safety standards; and/or • Anticipated date other substitutes will be available and qualified and projected time for switching.
Positive displacement chillers (new only).	HFC-134a and R-404A.	Acceptable subject to narrowed use limits.	Acceptable after January 1, 2024, only in human-rated spacecraft and related support equipment where reasonable efforts have been made to ascertain that other alternatives are not technically feasible due to performance or safety requirements.	Users are required to document and retain the results of their technical investigation of alternatives for the purpose of demonstrating compliance. Information should include descriptions of: <ul style="list-style-type: none"> • Application in which the substitute is needed; • Substitutes examined and rejected; • Reason for rejection of other alternatives, <i>e.g.</i>, performance, technical or safety standards; and/or • Anticipated date other substitutes will be available and qualified and projected time for switching.

REFRIGERANTS—UNACCEPTABLE SUBSTITUTES

End-use	Substitutes	Decision	Further information
Centrifugal chillers (new only)	FOR12A, FOR12B, HFC-134a, HFC-227ea, HFC-236fa, HFC-245fa, R-125/134a/600a (28.1/70/1.9), R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407C, R-410A, R-410B, R-417A, R-421A, R-422B, R-422C, R-422D, R-423A, R-424A, R-434A, R-438A, R-507A, RS-44 (2003 composition), and THR-03.	Unacceptable as of January 1, 2024 except where allowed under a narrowed use limit.	These refrigerants have GWPs ranging from approximately 900 to 9,810. Other alternatives will be available for this end-use with lower overall risk to human health and the environment by the status change date.
Centrifugal chillers (new only)	Propylene (R-1270) and R-443A	Unacceptable as of January 3, 2017	These refrigerants are highly photochemically reactive in the lower atmosphere and may deteriorate local air quality (that is, may increase ground level ozone). Other alternatives are available for this end-use with lower overall risk to human health and the environment.

REFRIGERANTS—UNACCEPTABLE SUBSTITUTES—Continued

End-use	Substitutes	Decision	Further information
Cold storage warehouses (new only).	HFC-227ea, R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407A, R-407B, R-410A, R-410B, R-417A, R-421A, R-421B, R-422A, R-422B, R-422C, R-422D, R-423A, R-424A, R-428A, R-434A, R-438A, R-507A, and RS-44 (2003 composition).	Unacceptable as of January 1, 2023	These refrigerants have GWPs ranging from approximately 2,090 to 3,990. Other alternatives will be available for this end-use with lower overall risk to human health and the environment by the status change date.
Cold storage warehouses (new only).	Propylene (R-1270) and R-443A	Unacceptable as of January 3, 2017	These refrigerants are highly photochemically reactive in the lower atmosphere and may deteriorate local air quality (that is, may increase ground level ozone). Other alternatives are available for this end-use with lower overall risk to human health and the environment.
Household refrigerators and freezers (new only).	FOR12A, FOR12B, HFC-134a, KDD6, R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407C, R-407F, R-410A, R-410B, R-417A, R-421A, R-421B, R-422A, R-422B, R-422C, R-422D, R-424A, R-426A, R-428A, R-434A, R-437A, R-438A, R-507A, RS-24 (2002 formulation), RS-44 (2003 formulation), SP34E, and THR-03.	Unacceptable as of January 1, 2021	These refrigerants have GWPs ranging from approximately 900 to 3,985. Other alternatives will be available for this end-use with lower overall risk to human health and the environment by the status change date.
Positive displacement chillers (new only).	FOR12A, FOR12B, HFC-134a, HFC-227ea, KDD6, R-125/134a/600a (28.1/70/1.9), R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407C, R-410A, R-410B, R-417A, R-421A, R-422B, R-422C, R-422D, R-424A, R-434A, R-437A, R-438A, R-507A, RS-44 (2003 composition), SP34E, and THR-03.	Unacceptable as of January 1, 2024 except where allowed under a narrowed use limit.	These refrigerants have GWPs ranging from approximately 900 to 3,985. Other alternatives will be available for this end-use with lower overall risk to human health and the environment by the status change date.
Positive displacement chillers (new only).	Propylene (R-1270) and R-443A	Unacceptable as of January 3, 2017	These refrigerants are highly photochemically reactive in the lower atmosphere and may deteriorate local air quality (that is, may increase ground level ozone). Other alternatives are available for this end-use with lower overall risk to human health and the environment.
Residential and light commercial air conditioning and heat pumps (new only).	Propylene (R-1270) and R-443A	Unacceptable as of January 3, 2017	These refrigerants are highly photochemically reactive in the lower atmosphere and may deteriorate local air quality (that is, may increase ground level ozone). Other alternatives are available for this end-use with lower overall risk to human health and the environment.
Residential and light commercial air conditioning—unitary split AC systems and heat pumps (retrofit only).	All refrigerants identified as flammability Class 3 in ANSI/ASHRAE Standard 34–2013 ^{1,2,3} . All refrigerants meeting the criteria for flammability Class 3 in ANSI/ASHRAE Standard 34–2013. This includes, but is not limited to, refrigerant products sold under the names R-22a, 22a, Blue Sky 22a refrigerant, Coolant Express 22a, DURACOOOL-22a, EC-22, Ecofreeez EF-22a, Envirosafe 22a, ES-22a, Frost 22a, HC-22a, Maxi-Fridge, MX-22a, Oz-Chill 22a, Priority Cool, and RED TEK 22a.	Unacceptable as of January 3, 2017	These refrigerants are highly flammable and present a flammability risk when used in equipment designed for non-flammable refrigerants. Other alternatives are available for this end-use with lower overall risk to human health and the environment.
Retail food refrigeration (refrigerated food processing and dispensing equipment) (new only).	HFC-227ea, KDD6, R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407A, R-407B, R-407C, R-407F, R-410A, R-410B, R-417A, R-421A, R-421B, R-422A, R-422B, R-422C, R-422D, R-424A, R-428A, R-434A, R-437A, R-438A, R-507A, RS-44 (2003 formulation).	Unacceptable as of January 1, 2021	These refrigerants have GWPs ranging from approximately 1,770 to 3,990. Other alternatives will be available for this end-use with lower overall risk to human health and the environment by the status change date.

¹ The Director of the Federal Register approves this incorporation by reference (5 U.S.C. 552(a) and 1 CFR part 51). You may inspect a copy at U.S. EPA's Air and Radiation Docket; EPA West Building, Room 3334, 1301 Constitution Ave. NW., Washington, DC or at the National Archives and Records Administration (NARA). For questions regarding access to this standard, the telephone number of EPA's Air and Radiation Docket is 202–566–1742. For information on the availability of this material at NARA, call 202–741–6030, or go to: http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html.

² You may obtain this material from: American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 6300 Interfirst Drive, Ann Arbor, MI 48108; 1–800–527–4723 in the U.S. or Canada; http://www.techstreet.com/ashrae/ashrae_standards.html?ashrae_auth_token=.

³ ANSI/ASHRAE Standard 34–2013, Designation and Safety Classification of Refrigerants, 2013.

FOAM BLOWING AGENTS—SUBSTITUTES ACCEPTABLE SUBJECT TO NARROWED USE LIMITS

End-use	Substitutes	Decision	Narrowed use limits	Further information
Rigid PU: Spray foam—high-pressure two-component.	HFC-134a, HFC-245fa, and blends thereof; blends of HFC-365mfc with at least four percent HFC-245fa, and commercial blends of HFC-365mfc with seven to 13 percent HFC-227ea and the remainder HFC-365mfc; and Formacel TI.	Acceptable subject to narrowed use limits.	Acceptable from January 1, 2020, until January 1, 2025, only in military or space- and aeronautics-related applications where reasonable efforts have been made to ascertain that other alternatives are not technically feasible due to performance or safety requirements. Closed cell foam products and products containing closed cell foams manufactured with these substitutes on or before January 1, 2025, may be used after that date.	Users are required to document and retain the results of their technical investigation of alternatives for the purpose of demonstrating compliance. Information should include descriptions of: <ul style="list-style-type: none"> • Process or product in which the substitute is needed; • Substitutes examined and rejected; • Reason for rejection of other alternatives, e.g., performance, technical or safety standards; and/or • Anticipated date other substitutes will be available and projected time for switching.
Rigid PU: Spray foam—low-pressure two-component.	HFC-134a, HFC-245fa, and blends thereof; blends of HFC-365mfc with at least four percent HFC-245fa, and commercial blends of HFC-365mfc with seven to 13 percent HFC-227ea and the remainder HFC-365mfc; and Formacel TI.	Acceptable subject to narrowed use limits.	Acceptable from January 1, 2021, until January 1, 2025, only in military or space- and aeronautics-related applications where reasonable efforts have been made to ascertain that other alternatives are not technically feasible due to performance or safety requirements. Low pressure two-component spray foam kits manufactured with these substitutes on or before January 1, 2025, for military or space- and aeronautics-related applications may be used after that date.	Users are required to document and retain the results of their technical investigation of alternatives for the purpose of demonstrating compliance. Information should include descriptions of: <ul style="list-style-type: none"> • Process or product in which the substitute is needed; • Substitutes examined and rejected; • Reason for rejection of other alternatives, e.g., performance, technical or safety standards; and/or • Anticipated date other substitutes will be available and projected time for switching.

FOAM BLOWING AGENTS—UNACCEPTABLE SUBSTITUTES

End-use	Substitutes	Decision	Further information
Flexible PU	Methylene chloride	Unacceptable as of January 3, 2017	Methylene chloride is a carcinogen and may present a toxicity risk. Other alternatives are available for this end-use with lower overall risk to human health and the environment.
Rigid PU: Spray foam—one component foam sealants.	HFC-134a, HFC-245fa, and blends thereof; blends of HFC-365mfc with at least four percent HFC-245fa, and commercial blends of HFC-365mfc with seven to 13 percent HFC-227ea and the remainder HFC-365mfc; and Formacel TI.	Unacceptable as of January 1, 2020 One-component foam sealant cans manufactured with these substitutes on or before January 1, 2020, may be used after that date.	These foam blowing agents have GWPs ranging from higher than 730 to approximately 1,500. Other alternatives will be available for this end-use with lower overall risk to human health and the environment by the status change date.
Rigid PU: Spray foam—high-pressure two-component.	HFC-134a, HFC-245fa, and blends thereof; blends of HFC-365mfc with at least four percent HFC-245fa, and commercial blends of HFC-365mfc with seven to 13 percent HFC-227ea and the remainder HFC-365mfc; and Formacel TI.	Unacceptable as of January 1, 2020, except where allowed under a narrowed use limit. Closed cell foam products and products containing closed cell foams manufactured with these substitutes on or before January 1, 2020, may be used after that date.	These foam blowing agents have GWPs ranging from higher than 730 to approximately 1,500. Other alternatives will be available for this end-use with lower overall risk to human health and the environment by the status change date.
Rigid PU: Spray foam—low-pressure two-component.	HFC-134a, HFC-245fa, and blends thereof; blends of HFC-365mfc with at least four percent HFC-245fa, and commercial blends of HFC-365mfc with seven to 13 percent HFC-227ea and the remainder HFC-365mfc; and Formacel TI.	Unacceptable as of January 1, 2021, except where allowed under a narrowed use limit. Low pressure two-component spray foam kits manufactured with these substitutes on or before January 1, 2025, may be used after that date.	These foam blowing agents have GWPs ranging from higher than 730 to approximately 1,500. Other alternatives will be available for this end-use with lower overall risk to human health and the environment by the status change date.

FIRE SUPPRESSION AND EXPLOSION PROTECTION AGENTS—ACCEPTABLE SUBJECT TO USE CONDITIONS

End-use	Substitute	Decision	Use conditions	Further information
Streaming	2-BTP	Acceptable, subject to use conditions.	As of January 3, 2017, acceptable only for use in handheld extinguishers in aircraft.	<p>This fire suppressant has a relatively low GWP of 0.23–0.26 and a short atmospheric lifetime of approximately seven days.</p> <p>This agent is subject to requirements contained in a Toxic Substance Control Act (TSCA) section 5(e) Consent Order and any subsequent TSCA section 5(a)(2) Significant New Use Rule (SNUR).</p> <p>For establishments manufacturing, installing and maintaining handheld extinguishers using this agent:</p> <ol style="list-style-type: none"> (1) Use of this agent should be used in accordance with the latest edition of NFPA Standard 10 for Portable Fire Extinguishers; (2) In the case that 2-BTP is inhaled, person(s) should be immediately removed and exposed to fresh air; if breathing is difficult, person(s) should seek medical attention; (3) Eye wash and quick drench facilities should be available. In case of ocular exposure, person(s) should immediately flush the eyes, including under the eyelids, with fresh water and move to a non-contaminated area; (4) Exposed person(s) should remove all contaminated clothing and footwear to avoid irritation, and medical attention should be sought if irritation develops or persists; (5) Although unlikely, in case of ingestion of 2-BTP, the person(s) should consult a physician immediately; (6) Manufacturing space should be equipped with specialized engineering controls and well ventilated with a local exhaust system and low-lying source ventilation to effectively mitigate potential occupational exposure; regular testing and monitoring of the workplace atmosphere should be conducted; (7) Employees responsible for chemical processing should wear the appropriate PPE, such as protective gloves, tightly sealed goggles, protective work clothing, and suitable respiratory protection in case of accidental release or insufficient ventilation; (8) All spills should be cleaned up immediately in accordance with good industrial hygiene practices; and (9) Training for safe handling procedures should be provided to all employees that would be likely to handle containers of the agent or extinguishing units filled with the agent.
Total flooding	2-BTP	Acceptable, subject to use conditions.	As of January 3, 2017, acceptable only for use in engine nacelles and auxiliary power units on aircraft.	<p>This fire suppressant has a relatively low GWP of 0.23–0.26 and a short atmospheric lifetime of approximately seven days.</p> <p>This agent is subject to requirements contained in a TSCA section 5(e) Consent Order and any subsequent TSCA section 5(a)(2) SNUR.</p> <p>For establishments manufacturing, installing, and servicing engine nacelles and auxiliary power units on aircraft using this agent:</p> <ol style="list-style-type: none"> (1) This agent should be used in accordance with the safety guidelines in the latest edition of the National Fire Protection Association (NFPA) 2001 Standard for Clean Agent Fire Extinguishing Systems; (2) In the case that 2-BTP is inhaled, person(s) should be immediately removed and exposed to fresh air; if breathing is difficult, person(s) should seek medical attention; (3) Eye wash and quick drench facilities should be available. In case of ocular exposure, person(s) should immediately flush the eyes, including under the eyelids, with fresh water and move to a non-contaminated area. (4) Exposed person(s) should remove all contaminated clothing and footwear to avoid irritation, and medical attention should be sought if irritation develops or persists; (5) Although unlikely, in case of ingestion of 2-BTP, the person(s) should consult a physician immediately; (6) Manufacturing space should be equipped with specialized engineering controls and well ventilated with a local exhaust system and low-lying source ventilation to effectively mitigate potential occupational exposure; regular testing and monitoring of the workplace atmosphere should be conducted; (7) Employees responsible for chemical processing should wear the appropriate PPE, such as protective gloves, tightly sealed goggles, protective work clothing, and suitable respiratory protection in case of accidental release or insufficient ventilation; (8) All spills should be cleaned up immediately in accordance with good industrial hygiene practices; (9) Training for safe handling procedures should be provided to all employees that would be likely to handle containers of the agent or extinguishing units filled with the agent; (10) Safety features that are typical of total flooding systems such as pre-discharge alarms, time delays, and system abort switches should be provided, as directed by applicable OSHA regulations and NFPA standards; use of this agent should also conform to relevant OSHA requirements, including 29 CFR 1910, subpart L, sections 1910.160 and 1910.162.