Appendix: Health risks associated with the use of substitutes for ozone depleting substances

In committing themselves to the phase out of ozone depleting substances (ODSs), Parties to the Montreal Protocol also *de facto* committed themselves to identifying and using acceptable alternatives or replacements for the ODSs, many of which had enjoyed widespread use in a number of important industrial sectors. One of the issues that needed to be considered in the introduction of new chemicals or old chemicals for new uses, was the potential health risks associated with the use of these substitutes. As a consequence, the substitutes needed to be evaluated not only for their ability to replace ODSs in terms of technical performance but also for their ability to do so within a framework of acceptable risk; that is, it would not be appropriate to replace an ODS with a substitute that poses a significant or unmanageable risk to humans or their environment.

In the United States (U.S.), the authority for identifying and assessing the risks of ODS substitutes resides with the U.S. Environmental Protection Agency (EPA) which established the Significant New Alternatives Policy (SNAP) programme to evaluate alternatives to ozone depleting substances.[1] The SNAP programme's mandate is to identify substitutes that lower the overall risks to human health and the environment. To the Environmental Effect Assessment Panel's (EEAP) knowledge, the U.S. is the only national authority to have created a programme specifically designed to evaluate substitutes for ODSs; other national authorities have chosen to conduct such evaluations under their extant programmes for assessing and managing the risks of chemicals such as the Registration, Evaluation and Authorization of Chemicals (REACH) programme in the EU, the Act on the Evaluation of Chemical Substances and Regulation of their Manufacture in Japan and National Industrial Chemicals Notification and Assessment Scheme (NICNAS) in Australia.

Because the SNAP programme is the only programme the EEAP is aware of that specifically focuses on the evaluation of substitutes, it also represents the largest source of information that could be accessed rapidly. Thus this section focuses on the assessments made by the SNAP programme with a particular focus on those assessments made in the last decade. At some later date, should the assessment of the risks of substitutes become a permanent part of

[1] Section 612 Clean Air Act Amendments of 1990

its mandate, the EEAP would hope to include information from the assessments of ODS substitutes made by other programmes.

A complete review of the SNAP programme, its legislative mandate, and the complete suite of regulatory activities it has undertaken since its inception is beyond the scope of this section. Some information critical to the decision-making process has been included; considerable additional information can be found at the SNAP website: http://www.epa.gov/ozone/snap/, and in the notices and rules that document the acceptable and unacceptable or provisionally acceptable decisions, respectively (see http://www.epa.gov/Ozone/snap/regulations.html).

When the SNAP programme was created, its mandate was not only to evaluate the traditional human health and environmental effects associated with the use of the proposed substance or process, but also to consider substitutes for their potential to mitigate ozone depletion, thereby reducing exposure to UV-B radiation and the associated health risks. This mandate permits the SNAP programme to evaluate substitutes in a comparative risk framework that is quite different from that required under other U.S. chemical review programmes. Important elements of that framework and the SNAP programme mandate include the fact that 1) substitutes are not required to be risk-free to be found acceptable, 2) the SNAP programme is required to evaluate substitutes by use, so that resulting decisions as to whether a substitute is acceptable or not are context specific, i.e., decisions were specific to the ODS being replaced, the sector, and the specific end-use(s) within which the substitute would be deployed, and 3) the comparative framework involved the use of several models considering usage patterns and health risks. These models include the Atmospheric Health Effects Framework (AHEF) model to estimate the human health risks from ODS use and compare them to similar risks from substitutes, the Vintaging model to estimate the market penetration and turn-over rates of technologies, ODSs, and substitutes that replace them; and a box model used to estimate exposure concentrations for consumers and workers who might be exposed to the substitutes, generally under both typical and worst-case scenarios of exposure.

The SNAP programme's legislative mandate (detailed in §612 of the Clean Air Act and 40 CFR 82.180) encompasses the review and evaluation of substitutes in the following industrial use sectors: Refrigeration & Air Conditioning, Foam Blowing Agents, Cleaning Solvents, Fire Suppression and Explosion Protection, Aerosols, Sterilants, Tobacco Expansion, and Adhesives, Coatings & Inks. Producers of substances they propose to introduce as substitutes within these sectors that meet certain reporting requirements are required to submit a notice of intent to introduce the substitute into interstate commerce along with a dossier[2] of information on the substance. To determine if a substitute is acceptable or not as a replacement for an ODS, the SNAP programme uses the information submitted in order to evaluate the following:

- Atmospheric effects and related human health and environmental impacts
- General population risks from ambient exposure to compounds with direct toxicity and to increased ground-level ozone
- Ecosystem risks
- Occupational risks
- Consumer risks
- Flammability
- Cost and availability of the substitute[3]

Following this review, substitutes are listed in one of the following categories: acceptable, acceptable subject to use conditions, acceptable subject to narrow use limits, or unacceptable. The initial risk screens for acceptable and unacceptable substitutes were presented in individual technical background documents entitled “Risk Screen on the Use of Substitutes for Class I Ozone-Depleting Substances” for each use sector which are available for review in the public docket[4] supporting the SNAP rule-making. More recently, as new substitutes are evaluated, individual risk screens have been added as addenda to the original background documents. Many of these risks screens are also available for review in the public docket, although in a number of instances the documents made available lack information identified as confidential business information (CBI) under the Clean Air Act, and until EPA’s decision is complete, no version of the risk screen is made public. Furthermore, no compendium of risk screens conducted has yet been assembled, nor is there a single source that summarizes all resulting decisions although tables for each sector are available at the following URL:

[2] Name and description of the substitute, physical and chemical information, substitute applications, process description, ozone depletion potential, global warming impact, toxicity data, environmental fate and transport, flammability, exposure data, environmental release data, replacement ratio for a chemical substitute, required changes in use technology, cost of substitute, availability of substitute, anticipated market share, applicable regulations under other environmental statute, information already submitted to the agency, information already available in the literature.

[3] It should be noted, however, that the SNAP programme is not charged with evaluating efficiency, or effectiveness

[4] http://www.regulations.gov/search/Regs/home.html#docketDetail?R=EPA-HQ-OAR-2003-0118.

http://www.epa.gov/ozone/snap/lists/index.html provides a list of substitutes that in the past decade have received a SNAP determination involving information from a risk screen. Substitutes are identified by the chemical or trade name under which the submission was made, the sector and end-use under consideration, the decision, the use conditions or limits, and also provides certain other information, e.g., where additional SNAP recommendations can be found, the degree to which CBI has affected the information released. Because decisions are made in the context of specific end uses, chemicals frequently appear multiple times, particularly within the larger sectors.

Table 1 ODS Substitutes Evaluated by the SNAP Programme since 2000 with Publically Available Risk Screens

Chemical	Sector	Replacing	End Use	Decision	Use Conditions/Limits[a]	Issues
HFE-7200 [1-ethoxy-1,1,2,2,3,3,4,4,4-nonafluorobutane]	Adhesives, Coatings & Inks	CFC-113, methyl chloroform, HCFC-141b		Acceptable		
N-propyl bromide[1] CAS RN: 000106-94-5	Adhesives, Coatings & Inks	CFC-113, methyl chloroform, HCFC-141b	Coatings	Proposed Acceptable, with use condition	Limited to one coatings facility which demonstrated ability to maintain acceptable workplace exposures	
N-propyl bromide[1] CAS RN: 000106-94-5	Adhesives, Coatings & Inks	CFC-113, methyl chloroform, HCFC-141b	Adhesives	Proposed Unacceptable		
N-propyl bromide[1] CAS RN: 000106-94-5	Aerosols	CFC-113, methyl chloroform, HCFC-141b	Aerosol Solvents	Proposed Unacceptable		
HFE-7000 [2] [1,1,1,2,2,3,3-heptafluoro-3-methoxy-propane]	Aerosols &Solvents	CFC-11, methyl chloroform	Electronics	Acceptable	None	workplace exposure 75 ppm; observe recommendations in MSDSs.
N-propyl bromide CAS RN: 000106-94-5[1]	Cleaning Solvents	CFC-113, methyl chloroform	Metals, precision and electronics cleaning	Acceptable		Recommendation for personal protective equipment; compliance with

Electronic Supplementary Material (ESI) for Photochemical & Photobiological Sciences

Table 1 ODS Substitutes Evaluated by the SNAP Programme since 2000 with Publically Available Risk Screens

Chemical	Sector	Replacing	End Use	Decision	Use Conditions/Limits[a]	Issues
						any future OSHA final PEL
NAF P-IV [HCFC-123, HFC-125, 4-isopropenyl-1-methylcyclohexene]	Fire Suppression and Explosion Protection	Halon 1211	Handheld & portable fire extinguisher	Acceptable	Non-residential applications	CBI restriction on % by weight information for components Additional EPA recommendations[b]
Powdered Aerosol C [3]	Fire Suppression and Explosion Protection	Halon 1301	Total flooding agent	Acceptable	Unoccupied spaces only	Additional recommendations[b]
Halotron II	Fire Suppression and Explosion Protection	Halon 1301	Total flooding agent	Acceptable	Unoccupied spaces only	
HFC227BC (FM-200 $NaHCO_3$) HFC 227ea plus bicarbonate	Fire Suppression and Explosion Protection	Halon 1301	Total flooding agent	Acceptable with use limits	$NaHCO_3$ release should be targeted so that pH levels are not adversely affected in exposed individuals. Systems containing HFC227BC should be clearly labeled as to potential hazards and appropriate handling procedures. Individuals required to be in environments protected by these systems should receive special training	
Novec 1230 [C6-perfluoroketone]	Fire Suppression and Explosion Protection	Halon 1301	Total flooding agent	Acceptable		
Novec 1230	Fire Suppression and Explosion Protection	Halon 1211	Handheld & portable fire extinguisher	Acceptable		Non-residential applications
Envirogel [amorphous silica	Fire Suppression and Explosion	Halon 1211	Handheld & portable fire	Acceptable		Residential use market

Table 1 ODS Substitutes Evaluated by the SNAP Programme since 2000 with Publically Available Risk Screens

Chemical	Sector	Replacing	End Use	Decision	Use Conditions/Limits[a]	Issues
gel]	Protection		extinguisher			
NAF S 125 [HFC-125 with 0.1% *d*-limonene]	Fire Suppression and Explosion Protection	Halon 1301	Total flooding agent	Acceptable		Additional recommendations[b]
NAF S 227[HFC-227ea with 0.1% *d*-limonene]	Fire Suppression and Explosion Protection	Halon 1301	Total flooding agent	Acceptable		Additional recommendations[b]
Carbon Dioxide	Fire Suppression and Explosion Protection	Halon 1301	Total flooding agent	Acceptable	System design must adhere to OSHA 1910.162(b)(5) and NFPA Standard 12	
PBr_3 [3]	Fire Suppression and Explosion Protection	Halon 1301	Total flooding agent	Acceptable with use conditions	For use only in aircraft engine nacelles	Additional recommendations[b]
Uni-Light Advance Fire Fighting Foam 1% water mist system [4]	Fire Suppression and Explosion Protection	Halon 1301	Total flooding agent	Acceptable	This agent is intended for use onboard ships and in off-shore installations. It may be used both in normally occupied and unoccupied areas. Additional recommendations[b]	
Envirogel [5] [3 formulations: HFC-125, HFC-227ea, or HFC-236fa]	Fire Suppression and Explosion Protection	Halon 1301	Total flooding agent	Acceptable with use conditions	Use of HFC employed in the formulation (HFC-125, HFC-227ea, or HFC-236fa) must be in accordance with all requirements (i.e., narrowed use limits) of that HFC under EPA's SNAP programme.	Additional recommendations[b]
Aero-K (Stat-X) [6]	Fire Suppression and Explosion Protection	Halon 1301	Total flooding agent	Acceptable with use conditions	For use in normally unoccupied areas	Additional recommendations[b]
FirePro	Fire Suppression	Halon	Total flooding	Acceptable		Additional

Table 1 ODS Substitutes Evaluated by the SNAP Programme since 2000 with Publically Available Risk Screens

Chemical	Sector	Replacing	End Use	Decision	Use Conditions/Limits[a]	Issues
	and Explosion Protection	1301	agent			recommendations[b]
Victaulic Vortex System [7]	Fire Suppression and Explosion Protection	Halon 1301	Total flooding agent	Acceptable with use conditions		Additional recommendations[b]
ATK OS-10[8]	Fire Suppression and Explosion Protection	Halon 1301	Total flooding agent	Acceptable		Additional recommendations[b]
H Galden [hydrofluoropolyethers]	Fire Suppression and Explosion Protection	Halons & HCFCs	Handheld & portable fire extinguisher	Acceptable with use limits	Non-residential applications	Additional recommendations[b]
Enovate 3000 [9] (HFC-245fa) with HCFC 22	Foam Blowing Agents			Acceptable		
Transcend Additive Technology[10]	Foam Blowing Agents			Acceptable		
HFC-365mfc [11] [1,1,1,3,3-pentafluorobutane; CAS RN. 405–58–6].	Foam Blowing Agents	HCFC-141b	Rigid polyurethane (PU) appliance foam, rigid PU commercial refrig and sandwich panels, flexible PU, integral skin PU, polystyrene (PS) extruded sheet, polyolefin (PO), rigid PU slabstock and other, PS extruded boardstock and	Acceptable		Mildly flammable

Table 1 ODS Substitutes Evaluated by the SNAP Programme since 2000 with Publically Available Risk Screens

Chemical	Sector	Replacing	End Use	Decision	Use Conditions/Limits[a]	Issues
			billet, rigid PU and polyisocyanurate (PIC) laminated boardstock, phenolic insulation board and bunstock			
Formacel TI [12]	Foam Blowing Agents	HCFC-22 & HCFC-142b	Rigid PU appliance foam, rigid PU spray, commercial refrigeration and sandwich panels, integral skin PU, PS extruded sheet, PO, rigid PU slabstock and other, PS extruded boardstock and billet, rigid PU and PIC laminated boardstock	Acceptable		
HFO-1234ze [13] [trans1,1,1,3, tetrafluoropropene; CAS RN: 1645-83-6]	Foam Blowing Agents	CFCs & HCFCs	Rigid PU appliance foam, rigid PU spray/commercial refrigeration/sandwich panels, PS extruded boardstock and	Acceptable		EPA recommends a preliminary acceptable exposure limit (8 hour TWA) of 375 ppm

Table 1 ODS Substitutes Evaluated by the SNAP Programme since 2000 with Publically Available Risk Screens

Chemical	Sector	Replacing	End Use	Decision	Use Conditions/Limits[a]	Issues
			billet			
IKON 12 (IKON A)	Refrigeration & Air Conditioning[c]	CFC-12	Household refrig/freezers, retail food refrig, industrial process refrig & AC, chillers, cold storage warehouses, refrig transport, commercial ice machines, vending machines, water coolers	Acceptable		
HBr Refrigerants [HFC-134a + HBr (92/8% by weight)]	Refrigeration & Air Conditioning[c]	CFC-12 & 502	Retail food refrig, industrial process refrig, cold storage warehouses, refrig transport,	Acceptable		
FOR12A [a ternary blend of 85%R134a/4%R152a/11%CF3I,]	Refrigeration & Air Conditioning[c]	CFC-12	Household refrig/freezers, retail food refrig, industrial process refrig & AC, chillers, cold storage warehouses, refrig transport, commercial ice machines, vending	Acceptable		

Table 1 ODS Substitutes Evaluated by the SNAP Programme since 2000 with Publically Available Risk Screens

Chemical	Sector	Replacing	End Use	Decision	Use Conditions/Limits[a]	Issues
			machines, water coolers			
FOR12B [ternary blend of 77%R134a; 2%DME, 21%CF3I]	Refrigeration & Air Conditioning[c]	CFC-12	Household refrig/freezers, retail food refrig, industrial process refrig & AC, chillers, cold storage warehouses, refrig transport, commercial ice machines, vending machines, water coolers	Acceptable		
Polycold HCFC Blends [16]	Refrigeration & Air Conditioning[c]	CFC 113, CFC-114, CFC- 13 & Blends	Niche Industrial Applications	Acceptable		To protect CBI, redaction of all composition, concentration info, etc
ISCEON 39TC [52.5:47.5%, 1,1,1,2-Tetrafluoroethane CAS RN 811-97-2 & 1,1,1,2,3,3,3-Heptafluoropropane CAS RN 431-89-0]	Refrigeration & Air Conditioning[c]	CFC 12	Commercial comfort AC, industrial process refrig & AC, cold storage warehouse, ice skating rinks	Acceptable		
SUVA HP63 (R404A) [HFC	Refrigeration & Air Conditioning[c]	HCFC-22	Commercial refrig systems, ice	Acceptable		

Table 1 ODS Substitutes Evaluated by the SNAP Programme since 2000 with Publically Available Risk Screens

Chemical	Sector	Replacing	End Use	Decision	Use Conditions/Limits[a]	Issues
134a, HFC-125, HFC-143a]			machines, refrig transport, water coolers			
HFE-7000 (HFE 301) methoxyheptafluoro-propane CAS 375-03-1	Refrigeration & Air Conditioning[c]	HCFC-123, CFC-113, CFC-11	Autocascade refrig systems, industrial process refrig, heat transfer systems	Acceptable		
RS-44 (2003 formulation)	Refrigeration & Air Conditioning[c]	HCFC-22	Household refrig/freezers, retail food refrig, industrial process refrig & AC, chillers, residential dehumidifiers, ice skating rinks, cold storage warehouses, refrig transport, commercial ice machines	Acceptable		
ISCEON 89 [HFC-125, R218, propane]	Refrigeration & Air Conditioning[c]	R131B	Very low temperature refrig	Acceptable		
R-407C	Refrigeration & Air Conditioning[c]	HCFC-22 & blends	Most refrig & AC end uses	Acceptable		
RS-24 (2002 formulation)	Refrigeration & Air Conditioning[c]	CFC-12	Household refrig/freezers, retail food refrig, industrial process refrig & AC,	Acceptable		

Table 1 ODS Substitutes Evaluated by the SNAP Programme since 2000 with Publically Available Risk Screens

Chemical	Sector	Replacing	End Use	Decision	Use Conditions/Limits[a]	Issues
			residential dehumidifiers, bus and passenger train AC, ice skating rinks, cold storage warehouses, refrig transport, commercial ice machines, vending machines, water coolers			
HFC-152a	Refrigeration & Air Conditioning[c]	CFC-12	Motor vehicle air-conditioning	Acceptable subject to use conditions	Engineering strategies and/or devices shall be incorporated into the system such that R–152a concentrations of 3.7% v/v or above do not occur in any of the free space of the passenger compartment for more than 15 seconds when the car ignition is on.	Only allowed for new equipment, i.e., MVAC equipment designed for this refrigerant.
Carbon dioxide	Refrigeration & Air Conditioning[c]	CFC-13, 13B1, 503	Industrial process refrig, very low temperature refrig	Acceptable		
HFC-245fa [1,1,1,3,3-pentafluoropropane; CAS RN. 460–73–	Refrigeration & Air Conditioning[c]	CFC-11, 114, 123	Centrifugal chillers	Acceptable		

Table 1 ODS Substitutes Evaluated by the SNAP Programme since 2000 with Publically Available Risk Screens

Chemical	Sector	Replacing	End Use	Decision	Use Conditions/Limits[a]	Issues
1]						
HFC-245fa	Refrigeration & Air Conditioning[c]	CFC 11, 114, 141b	Very low temp. refrigeration	Acceptable		
HFC-245fa	Refrigeration & Air Conditioning[c]	CFC 11, 113, 21 141b	Non-mechanical heat transfer	Acceptable		
HFC-245fa	Refrigeration & Air Conditioning[c]	CFC 114	Industrial process refrig & AC	Acceptable		
Carbon dioxide [14]	Refrigeration & Air Conditioning[c]	HCFC-22 & blends, CFC-12,502	Retail food refrig	Acceptable		
Carbon Dioxide [15]	Refrigeration & Air Conditioning[c]	CFC- 11, 12, 113, 114, 115	Cold storage warehouses	Acceptable		
C6 perfluoroketone; [16] Novec 649	Refrigeration & Air Conditioning[c]	CFC-113	Non-mechanical heat transfer	Acceptable		
HFO 1234yf [17] [2,3,3,3-tetrafluoropropene; CAS RN 754-12-1]	Refrigeration & Air Conditioning[c]	CFC-12	Motor vehicle air-conditioning	Proposed Acceptable, subject to use conditions	Engineering strategies and/or devices must be incorporated into the system such that HFO– 1234yf concentrations of 6.2% v/v or above do not occur in 1) the free space of the passenger compartment for more than 15 seconds; 2) the engine compartment or vehicle electric power source storage areas, or 3) proximity to exhaust manifold surfaces and hybrid/electric vehicle electric power sources. Manufacturers must adhere to all the safety requirements listed in the SAE 2009 Standard J639 and must conduct and keep on file, a failure mode and effect	

Table 1 ODS Substitutes Evaluated by the SNAP Programme since 2000 with Publically Available Risk Screens

Chemical	Sector	Replacing	End Use	Decision	Use Conditions/Limits[a]	Issues
					analysis of the MVAC per SAE J1739.	
IoGas Blends 1, 3, and 6 [18] (blends of CF_3I/CO_2/EtO)	Sterilants	HCFC-22 or blends of HCFC-22 and HCFC-124		Acceptable		

[a]Paraphrased to shorten; [b] http://www.epa.gov/ozone/snap/fire/halon.pdf; [c]Unless indicated decisions apply both to new and retrofit applications.
PU=polyurethane, PS=polystyrene, PO=polyolefin, PIC=polyisocyanurate, refrig = refrigeration/refrigerated/refrigerators, AC= air conditioning, MVAC=motor vehicle AC; refrig = refrigeration/refrigerated/refrigerator; TWA = time weighted average; SAE = Society of Automotive Engineers; CAS RN = Chemical abstract service registry number

The information provided above is a compendium of substitutes that have at a minimum undergone a risk screen under the SNAP programme. In addition to the risk screens that the SNAP programme conducts, frequently more in depth evaluations are completed to address specific issues identified in the risk screen. Most of these in-depth assessments have involved issues related to human health effects, e.g., for new chemicals, the need to develop exposure limits for occupationally exposed populations or the general public may be identified. In the case of foam-blowing agents or fire suppression agents, there may be a need to assess the toxicity of breakdown products, and for substitutes with a wide variety of consumer end-uses such as refrigerants, worst-case exposure scenario modeling may be used to assess the risks of toxicity or asphyxiation to consumers and workers following catastrophic release, or the likelihood of explosion or fire for substitutes identified as being flammable.

However, it should also be noted that the evaluations and assessments that the SNAP programme conducts are those conventionally used to evaluate the risks of chemicals which have had to evolve over time in order to assess an ever enlarging list of potential threats, e.g., ozone depletion, biomagnification, endocrine disruption, and persistence in the environment, and it seems likely that these methods will need to continue to evolve as additional threats are identified. Furthermore, as demonstrated in the examples discussed below, the SNAP programme evaluations are iterative, and the programme's decisions as presented in rules or notices may reflect additional information not present in the risk screen.

Discussion of the detailed results for two sample risk screens, one for HFO 1234yf that was recently proposed to be listed as acceptable, subject to use conditions, and the other for MT-31, which was initially listed as acceptable and subsequently listed as unacceptable, are provided below.

Example 1: HFO 1234yf

<u>Proposed as a substitute for</u>: CFC-12 in Motor Vehicle Air Conditioning

<u>Atmospheric Assessment</u>: The environmental impacts resulting from use are generally in the range of other substitutes previously examined.

<u>Flammability Assessment</u>: Flammable at a concentration in the range of 65,000 ppm to 123,000 ppm; within these concentrations, an ignition source (spark, static electric), an explosion or fire could result. Worst case modeling of releases during end-use (into automobile passenger compartment) produced concentration above the lower flammability limit (LFL), i.e., >65,000 ppm); however, field testing found concentrations equal to about 46% of the LFL. During manufacture and servicing of air condition units, catastrophic releases of large quantities could result in an explosion.

Flammability Recommendations: (1) automobile air conditioning systems using HFO-1234yf should be designed to avoid occupant exposure concentrations above 65,000 ppm in the passenger compartment for more than 15 s under any conditions (2) during manufacturing and servicing, OSHA requirements (29 CFR 1910) with regard to the proper ventilation and storage practices needed to prevent fire and explosion should be followed. If refrigerant air concentrations surrounding the equipment exceed one-fourth the lower flammability limit, the space should be evacuated and remain vacant until the space has been properly ventilated.

Asphyxiation Assessment: a series of worst-case scenario analyses were used to evaluate how much HFO-1234yf would need to be released in order to achieve oxygen to concentrations below the no observed adverse effect level (NOAEL) for hypoxia (120,000 ppm) in representative compartments of various classes of automobiles. None of the scenarios modeled resulted in releases likely to pose a risk of asphyxiation or impaired coordination. Furthermore, as the NOAEL for hypoxia (120, 000 ppm) is greater than the LFL for HFO-1234yf, the recommendation made above that concentrations in automobile compartments not exceed the LFL, should protect against the limited risk of asphyxiation.

Toxicity Assessment: EPA compared toxicity threshold values, e.g., occupational long-term exposure limit, to modeled exposure concentrations for a variety of scenarios (e.g., short-term (15 min) and longer term (8 h) worker, short-term vehicle passenger) and concluded that HFO-1234yf was unlikely to be a toxicity threat to trained professionals involved in a manufacturing facility but that consumers involved in "do-it-yourself' car repair could be exposed to concentrations far in excess of the occupational exposure limit. For vehicle passengers, the risk screen concluded that the worst case concentration to which passengers would be exposed was nearly 20-fold lower than the most relevant toxicity value, an acute LOAEL in rats.

Toxicity Recommendation: Based on the "do-it yourself" car repair scenario, the Agency recommended that HFO-1234yf not be made available to untrained workers such as those involved in "do-it-yourself' car repair.

Volatile Organic Compound Analysis: Non-attainment resulting from HFO-1234yf emissions is not likely to be a major concern for local air quality in most locations.

Additional Environmental Impacts Analysis: Trifluoroacetic acid production resulting from HFO-1234yf emissions is not expected to pose significant harm to aquatic communities.

Example 2: MT-31

Proposed as a substitute for: CFC 12 used as a refrigerant in a variety of systems, e.g., chillers, refrigerated transport, ice machines, water coolers, household refrigerators and freezers, cold storage warehouses, as well as for HCFC22 in retrofitted end-uses.

Initially (62 FR 30275), the SNAP programme concluded that this blend of components (the exact composition of which was considered to be CBI) did not contain any flammable components and that all components were low in toxicity so that this was an acceptable substitute for the end uses specified.

Subsequently (64CFR 3861) the SNAP programme received and reviewed additional toxicity information on one of the components, and upon completing a risk screen (which could not be made publically available due to the CBI concerns) determined that the presence of this unspecified chemical in MT-31 meant that the use of MT-31 as a refrigerant in the manufacture or servicing of refrigeration or air conditioning equipment was unacceptably high in risk.

These two examples provide insights into the iterative nature of the SNAP programme's evaluations. For example, the information in Table 1 for HFO1234yf is somewhat different from that summarized above from the risk screen: the latter indicated that concentrations above 65,000 ppm (6.5%) should be avoided whereas the published use limit was 6.2%. Furthermore, while the risk screen included a recommendation that HFO-1234yf not be made available to untrained workers, that recommendation was not part of the final acceptability decision. While the rationale for these changes is not immediately obvious, it seems likely that it is documented in the EPA docket, probably via the Agency's interactions with various stakeholders in this decision.
The ultimate MT-31 decision was driven by consideration of information that was not initially available to the Agency at the time of its first decision and demonstrates the SNAP programme's quick response to address a serious issue. Unfortunately, the exact nature of that issue was protected by the producers CBI claim.

References

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