Format for submitting pursuant to Article 8 of the Stockholm Convention the information specified in Annex E of the Convention

Introductory information	
Name of the submitting Party/observer	**Canada**
Contact details (name, telephone, e-mail) of the submitting Party/observer	**Cheryl Heathwood** Stockholm Convention on POPs Focal Point for Canada Chief, Hazardous Air Pollutants Transboundary Air Directorate Environment Canada 351 St. Joseph Blvd., 11th Floor Place Vincent Massey Gatineau, Quebec K1A 0H3 Canada Tel. (819) 953-7157 Email Cheryl.Heathwood@ec.gc.ca
Chemical name (as used by the POPS Review Committee (POPRC))	**Perfluorooctane sulfonate (PFOS)**
Date of submission	**January 27, 2006**

(a) Sources, including as appropriate (provide summary information and relevant references)	
(i) Production data: **Quantity** **Location**	
Other	
(ii) Uses	
(iii) Releases: **Discharges** **Losses** **Emissions** **Other**	

(b) Hazard assessment for endpoints of concern, including consideration of toxicological interactions involving multiple chemicals (provide summary information and relevant references)

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(c) Environmental fate (provide summary information and relevant references)	
Chemical/physical properties	
Persistence	
How are chemical/physical properties and persistence linked to environmental transport, transfer within and between environmental compartments, degradation and transformation to other chemicals?	**1) SUMMARY OF ENVIRONMENT CANADA'S APPROACH FOR DETERMINING POSSIBLE PFOS PRECURSORS** Environment Canada undertook the following steps to generate a list of precursors: **1. Identification of perfluorinated substances in commerce in Canada, through a mandatory request for information.** In response to a survey carried out by Environment Canada in 2000 under the authority of Section 71 of the *Canadian Environmental Protection Act, 1999* (CEPA 1999), Canadian industry was required to provide information relating to perfluorinated chemicals, and identified over 200 perfluorinated substances as being in commerce in Canada. **2. Modelling of the possible metabolic transformation of identified perfluorinated substances** A list of perfluorinated compounds was provided to a scientific team led by O. Mekenyan at the Bourgas University, "Prof. As. Zlatarov," Bulgaria. Using chemical structures and the catabolite software, CATABOL, modellers predicted the biodegradation products of these identified compounds. For each substance modelled, CATABOL generates a microbial metabolic pathway tree based upon the parent structure and a prediction for biodegradability. The metabolic pathway tree module is based on a training data set primarily from the University of Minnesota Biocatalysis/Biodegradation database (UM-BBD) and expert knowledge. The metabolic tree contains the products of microbial biodegradation from the parent compound down to carbon dioxide and water or stable metabolites. Some of the chemicals could not be modelled by CATABOL due to the lack of SMILES notation. The biodegradation simulator is based on a database of 742 substances tested by CITI (1992) using the Modified MITI Test (I), which follows the OECD 301C test methods and is one of six methods approved by the OECD for ready biodegradability. Additional detail is provided elsewhere. (1) **3. Identification of possible precursors through expert scientific judgement** A scientist with extensive expertise in perfluorinated substances, R. Purdy, was contracted to analyze the validity of the CATABOL-generated predictions of stable metabolites for approximately 247 identified perfluorinated substances. Environment Canada provided the contractor with the list of substances and their CATABOL-predicted degradation trees (down to the most stable perfluoroalkyl compound identified, particularly perfluoroalkyl sulfonates and perfluoroalkyl fatty acids). The contractor evaluated each substance's degradation tree and determined whether the transformations are plausible under environmentally relevant conditions. The chemical structures of the perfluorinated substances were assessed by

expert judgement to determine whether the non-fluorinated moieties would degrade chemically and/or biochemically. If the non-fluorinated moieties were expected to degrade, the structure of the likely final perfluorinated degradation product was predicted to determine if it was PFOS.

4. Input from industry

In summer 2002, Environment Canada provided the list of precursors, which was based on CATABOL modeling and on expert judgement, to one company for comment, after which the list was revised by Environment Canada. In October 2004, as required by CEPA 1999, the draft Assessment Report for PFOS, its Salts and Precursors was released for public comment; additional supporting documentation was available to the public on request. Comments were received on, among other subjects, the precursors identified in the Assessment Report and the approach used in the report to include them within the scope of the PFOS assessment.

5. List of PFOS and its Precursors

The revised Environment Canada Ecological Assessment Report of PFOS, its Salts and its Precursors identifies 4 PFOS salts, PFOS acid (PFOSH) and additional perfluorinated compounds, containing the $C_8F_{17}SO_2$, $C_8F_{17}SO_3$ or $C_8F_{17}SO_2N$ groups, that are expected to degrade to PFOS. The 50 precursors identified in the revised report are not considered as an exhaustive list of precursors, and there may be other perfluorinated chemicals that are also PFOS precursors. No attempt was made to identify the expected rates of transformation in the environment, nor to estimate the relative contributions of the individual precursors to the net loadings of PFOS in the environment.

Source: Unpublished document. Environment Canada, Existing Substances Division, January 12, 2005. Contace: Dr. Robert Chénier.

References:

(1)
Dimitrov, S. et al. 2004. Predicting the Biodegradation Products of Perfluorinated Chemicals Using CATABOL. SAK and QSAR in Environmental Research, Vol. 15(1), pp. 69-82.

note – full article: Dimitrov, S. et al. 2004 attached

Environment Canada. 2003. PFAS: Metabolite Trees and Reports produced by the Catabol™ model. *Unpublished compilation including:* Metabolic pathways, *generated by Ovanes Mekenyan et al 2002*; Compilation and editing, *by Pete Robinson*; and CATABOL: Microbial Catabolic Pathways Model - A Summary of the Biodegradation and Metabolic Pathways Estimation Program Developed by Prof. Ovanes Mekenyan et al., *prepared by Pete Robinson*. Environment Canada, Existing Substances Branch, 2002-2003. 154 pp.

2) Table extracted from the CEPA 1999 Ecological Assessment Report, listing certain PFOS precursors

see Table attached*

***Please note that the Environment Canada/Health Canada Draft Assessment of PFOS, its Salts and its Precursors was released for public comment in October 2004. The ecological and human health assessments have been revised and should be publicly available soon, and will be made

	available at that time. ***
Bio-concentration or bio-accumulation factor, based on measured values (unless monitoring data are judged to meet this need)	***see monitoring data below***

(d) Monitoring data (provide summary information and relevant references)

PFOS and its precursors – recent results from Canada's Northern Contaminants Program

PFOS has been measured in numerous species of arctic biota including: freshwater and marine fish, caribou, seabirds, ringed seal, beluga, narwhal, walrus and polar bears. PFOS has also been measured in the blood of humans residing in the Canadian Arctic.

Fish
Mean PFOS concentrations in burbot liver collected in 2004 from Yukon and NWT were 30.4 ng/g ww and 46.6 ng/g ww respectively. Measurements from fish collected in 1986 (Yukon) and 1996 (NWT) suggest that levels have increased more than 4-fold since that time (Stern and Tomy, 2005; Stern et al., 2005). PFOS was also measured in char liver collected from 1997 – 1999 at 5.4 ng/g ww (Tittlemier and Chan, 2005).

Caribou
Caribou liver collected from 1997 – 1999 had PFOS concentrations ranging from 3.8 – 24.4 ng/g ww (Tittlemier and Chan, 2005).

Seabirds
Seabirds from Prince Leopold Island have relatively low levels of PFOS, with means of 0.6 and 1.5 ng/g ww in liver for thick billed murre and northern fulmar respectively in 2004. Thick billed murres demonstrated an order of magnitude increase from 1975 to 2004, whereas the highest levels measured in fulmar livers was from 1993, which represented a clear increase over the previous time point of 1987 (Braune and Muir, 2005).

Ringed Seal
PFOS concentrations in ringed seal liver varied throughout the Canadian Arctic from 10-20 ng/g ww in Holman, Resolute, and Pangnirtung to 50 ng/g ww in Sachs Harbour and 120 ng/g in Inukjuaq. Temporal trend analysis in Resolute demonstrated increasing concentrations to 2000 and the suggestion of a declining trend thereafter, but this is based only on one additional time point from 2004. The doubling time from the early 1970s to 2000 was 8 years (Muir et al., 2005; Braune and Muir, Results Workshop 2005).

Beluga, Narwhal and Walrus
Concentrations of PFOS increased linearly from 1982 to 2002 in beluga liver from Pangnirtung with a mean level of about 20 ng/g ww in 2002. Concentrations of the PFOS precursor PFOSA were higher than PFOS and also increased linearly from 1982 to 2002 with mean levels of about 70 ng/g ww in 2002. PFOS and PFOSA were also measured in walrus and narwhal (Tomy et al., 2005).

Polar Bears
Concentrations of PFOS in polar bear liver are in the thousands of ng/g ww, making PFOS the most abundant halogenated organic contaminant in polar bears. Between 1972 and 2001 liver PFOS concentrations increased from below 100 ng/g ww to over 1000 ng/g ww with a doubling time of 3 years. PFHxS and PFOSA were also measured in polar bear livers though at much lower levels (order of magnitude) than PFOS. (Letcher et al., 2005). See also Smithwick et al., 2005a, b.

Humans
PFOS has been measured in blood samples collected from Canadian Inuit. Mean levels were 42.8 ng/mL in maternal blood, and did not differ significantly from levels in Caucasian mothers from the same study (Tittlemier et al., 2004). Further work by Tittlemier, examining dietary exposure from Inuit country foods, suggests, however, that country foods are an important dietary source of PFOS for Inuit (Tittlemier and Chan, 2005, Tittlemier et al., Results Workshop 2005).

References

Braune B. and D. Muir. 2005. New Contaminants in Arctic Seabirds. In: *Synopsis of Research conducted Under the 2004 – 2005 Northern Contaminants Program.* Indian and Northern Affairs Canada, Ottawa. pp. 121-127.

Braune B. and D. Muir. 2005. New Contaminants in Ringed Seals and Seabirds. Presentation to the 13th annual Northern Contaminants Program Results Workshop, Victoria B.C. Sept 27 – 29, 2005.

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Letcher R., D. Muir, and A. Fisk. 2005. Temporal and Spatial Trends of Contaminants in Canadian Polar Bears, Part II. In: *Synopsis of Research conducted Under the 2004 – 2005 Northern Contaminants Program.* Indian and Northern Affairs Canada, Ottawa. pp. 140-154.

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Muir D., M. Kwan, and M. Evans. 2005. Temporal Trends of Persistent Organic Pollutants and Metals in ringed Seals from the Canadian Arctic. In: *Synopsis of Research conducted Under the 2004 – 2005 Northern Contaminants Program.* Indian and Northern Affairs Canada, Ottawa. pp. 163-173.

Smithwick, M.M., S.A. Mabury, K.R. Solomon, C. Sonne, J.W. Martin, E.W. Born, R. Dietz, A.E. Derocher, R.J. Letcher, T.J. Evans, G.W. Gabrielsen, J. Nagy, I. Stirling, M.K. Taylor and D.C. G. Muir. 2005a. Circumpolar study of perfluoroalkyl contaminants in polar bears (Ursus maritimus). Environ. Sci. Technol. 39(15):5517-5523

Smithwick, M.M., R.J. Norstrom, S.A. Mabury, K.R. Solomon, T.J. Evans, I. Stirling, M.K. Taylor and D.C.G. Muir. 2005b. Temporal trends of perfluoroalkyl contaminants in polar bears (Ursus maritimus) from two locations in the North American Arctic, 1972-2002. Environ. Sci. Technol. Submitted.

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Stern G., P. Roach, and G. Tomy. 2005. Trace Metals and Organohalogen Contaminants in Fish from Selected Yukon Lakes: A Temporal and Spatial Study. In: *Synopsis of Research conducted Under the 2004 – 2005 Northern Contaminants Program.* Indian and Northern Affairs Canada, Ottawa. pp. 212-218.

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Tittlemier S. and L. Chan. 2005. Estimation of Dietary Exposure to Perfluorinated Carboxylates and Sulfonates via Consumption of Traditional Foods. In: *Synopsis of Research conducted Under the 2004 – 2005 Northern Contaminants Program.* Indian and Northern Affairs Canada, Ottawa. pp. 115-118.

Tittlemier S., S. Ostertag, L. Chan, K. Pepper, and G. Tomy. 2005. Exposure to PFCs via Traditional Foods: Initial Results. Presentation to the 13th annual Northern Contaminants Program Results Workshop, Victoria B.C. Sept 27 – 29, 2005.

Tomy G., T. Halldorson, and G. Stern. 2005. Time-Trend Studies On New and Emerging Persistent Halogenated Compounds in Marine Mammals from the Canadian Arctic. In: *Synopsis of Research conducted Under the 2004 – 2005 Northern Contaminants Program.* Indian and Northern Affairs Canada, Ottawa. pp. 219-222.

(e) Exposure in local areas (provide summary information and relevant references)	
- general	
- as a result of long-range environmental transport **- information regarding bio-**	

availability	

(f) National and international risk evaluations, assessments or profiles and labelling information and hazard classifications, as available (provide summary information and relevant references)

(g) Status of the chemical under international conventions