MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

INTEROFFICE COMMUNICATION

TO: Tetrafluoroethylene file (CAS # 116-14-3)

FROM: Gary Butterfield

SUBJECT: Screening level for Tetrafluoroethylene

DATE: October 18, 2007

Tetrafluoroethylene is also known as perfluoroethylene and TFE. Tetrafluoroethylene is a colorless, odorless gas. The molecular formula is C_2H_4. The molecular weight is 100 g/mol. The boiling point of tetrafluoroethylene is -76C, and the melting point is -142C. The vapor pressure at 25C is 428 mmHg. Major uses for tetrafluoroethylene include monomer for polytetrafluoroethylene (also known as Teflon) polymers, chemical intermediate and aerosol propellant.

The following references or databases were searched to identify data to determine the screening level: U.S. Environmental Protection Agency (EPA) Integrated Risk Information System (IRIS), National Institute for Occupational Safety and Health (NIOSH) Registry for Toxic Effects of Chemical Substances (RTECS), American Conference of Governmental and Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs), Michigan Department of Environmental Quality (DEQ) library, International Agency for Research on Cancer (IARC) Monographs, Chemical Abstract Service (CAS) Online (1968 - July 2007), National Library of Medicine (NLM) - Toxline, and National Toxicology Program (NTP) Status Report.

The CAS and NLM online literature searches for this evaluation were conducted on August 1, 2007. The literature search found several unpublished toxicity studies that have been submitted to the EPA. Among those studies is a subchronic 90-day inhalation study that would likely be sufficient for setting an ITSL. However, requests to the EPA's library for copies of some of those studies were not responded to. This lack of response may be in part due to the EPA's restructuring of their library system. The inability to obtain unpublished subchronic study articles from the EPA results in the ITSL not being able to be calculated for tetrafluoroethylene.

The two-year study published by NTP does provide enough data to be able to calculate cancer potency values for tetrafluoroethylene. In the two-year NTP inhalation study (NTP (1997)), groups of male F344 rats were exposed to 0, 156, 312 or 625 ppm while the female rats and both sexes of B6C3F1 mice were exposed to 0, 312, 625, or 1250 ppm for 6 hours a day, 5 days a week. NTP found clear evidence of this exposure

scenario leading to carcinogenicity in both sexes of rats and mice. The following tumor types and incidences were found at the end of the study, for control to high dose, respectively.

male rat		
	renal tubule neoplasms	3/45, 5/43, 9/47, 13/41
	hepatocellular neoplasma	4/43, 7/49, 15/45, 8/38
female rat		
	renal tubule neoplasms	0/46, 3/40, 3/41, 10/37
	liver hemangiosarcomas	0/45, 0/35, 5/38, 1/34
	hepatocellular neoplasma	0/45, 7/37, 12/40, 8/35
	mononuclear cell leukemia	16/50, 31/49, 23/49, 36/49
male mice		
	liver hemangiomas & hemangiosarcomas	0/48, 26/47, 30/48, 38/46
	hepatocelluar neoplasms	26/48, 34/47, 39/50, 35/48
	histocytic sarcomas	0/48, 12/47, 7/48, 7/45
female mice		
	liver hemangiomas & henagiosarcomas	0/47, 31/44, 28/46, 35/45
	hepatocelluar neoplasms	17/47, 33/44, 29/45, 28/43
	histocytic sarcomas	1/47, 21/44, 19/46, 18/45

After running the BMDS multistage cancer model for most of the available data, it was found that the male mice had liver hemangiomas & hemangiosarcomas with an incidence of 0/48, 26/47, 30/48 and 38/46 at exposure dose levels of 0, 312, 625, and 1250 ppm fit the model the best and had the highest potency of 0.00194 $(ppm)^{-1}$. The potency was converted to ug/m^3 and adjusted for exposure duration to result in a potency for tetrafluoroethylene of 2.6×10^{-6} $(ug/m^3)^{-1}$, see calculation below.

Tetrafluoroethylene is considered to be a Category 3 gas. The blood:air partition coefficients are not known for rats or humans, resulting in use of the default RGDR of 1 for the animal to human ratio.

$q_1^* = 0.00194\ (ppm)^{-1} = 0.00194\ (ppm)^{-1} \times (1\ ppm/4.09\ mg/m^3) \times (1\ mg/1000\ ug)$
time adjusted $q_1^* = 4.74 \times 10^{-7}\ (ug/m^3)^{-1} \times 1/(6/24 \times 5/7 \times 1) = 2.65 \times 10^{-6}\ (ug/m^3)^{-1}$

$IRSL = (1 \times 10^{-6})/(2.65 \times 10^{-6}\ (ug/m^3)^{-1}) = 0.4\ ug/m^3$ with annual average

$SRSL = (1 \times 10^{-5})/(2.65 \times 10^{-6}\ (ug/m^3)^{-1}) = 4\ ug/m^3$ with annual average

References:

NTP. 1997. Toxicology and carcinogenesis studies of tetrafluoroethylene in F344 rats and B6C3F1 mice (inhalation studies). NTP TR-450.

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