



May 4, 2000

VIA FEDERAL EXPRESS

Dr. Charles Auer
Director
Chemical Control Division
Office Of Pollution Prevention And Toxics
United States Environmental Protection Agency
401 M Street, Southwest
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Washington, D. C. 20460

Re: **Information On Perfluorooctane Sulfonates**

Dear Charlie:

Pursuant to our recent communications, 3M is enclosing additional information on perfluorooctane sulfonates. The enclosed information supplements information submitted to you previously under cover of our April 21, 2000 letter. Again, we are providing this information on a voluntary basis as part of our continuing discussions with EPA regarding fluorochemistry.

The enclosed information covers perfluorooctane sulfonates, including CAS numbers 1763-23-1 (acid); 29081-56-9 (ammonium salt); 70225-14-8 (DEA salt); 2795-39-3 (potassium-salt); 29457-72-5 (lithium salt). It consists of the following:

- ⇒ Copies of post-1975 studies and certain other information relating to the following environmental science areas: (i) physical and chemical properties; (ii) environmental fate and transport; (iii) environmental monitoring; and (iv) ecotoxicity. For each study, 3M has prepared a summary in the HPV "robust summary" format. An executive summary also has been included for each area.
- ⇒ Copies of post-1975 studies and certain other information relating to the following health effects areas: (i) acute toxicity; (ii) genotoxicity; (iii) repeated-dose toxicity;

(iv) pharmacokinetics; (v) teratology; and (vi) medical surveillance and epidemiology. 3M has included a detailed index of this information.

- ⇒ A list of all studies in progress and planned studies, along with study protocols or study plans, where available. With regard to the health effects area, this list supplements the list provided under cover of our April 21, 2000 letter to you.
- ⇒ A bibliography of pre-1976 studies in the environmental science and health effects areas on perfluorooctane sulfonates.
- ⇒ A bibliography of acute toxicity studies on perfluorooctane sulfonates, except that we are providing copies of key acute studies (with reference to the HPV guidance).
- ⇒ A bibliography of published studies on the perfluorooctane sulfonates in 3M's possession.
- ⇒ An index of submissions made by 3M to the TSCA Section 8(e) docket. This index has been subdivided by EPA docket number. Rather than attempt to segment the index for perfluorooctane sulfonates only, we have included other fluorochemical submissions on the index, as several of 3M's submissions have dealt with multiple fluorochemicals.

3M is continuing our file review and will supplement the enclosed information as appropriate. As you review this information, we ask that you bear several points in mind:

- ⇒ The enclosed information spans several boxes. We have organized the information in each box with labeled file folders and indices to aid EPA's review. To ensure that you and your staff are able to access the most pertinent information, we also are attaching to this cover letter the executive summaries for the environmental science areas and the indices covering studies and other information.
- ⇒ In some cases, the enclosed information reflects recent developments that may supplement studies and other information previously provided to you. As just one example, 3M's previously submitted document entitled "Fluorochemical Use, Distribution And Release Overview" (5/26/99) contains a qualitative assessment based on the assumption that all other fluorochemicals could breakdown to perfluorooctane sulfonates. Another document submitted by 3M entitled "Sulfonated Perfluorochemicals in the Environment: Sources, Dispersion, Fate and Effects" also provided estimates of potential exposure and waste generation based on such an assumption. Recent information in the environmental fate and transport area suggests, however, that this assumption may reflect an unrealistic

"worst case" which significantly overstates exposure potential to perfluorooctane sulfonates. In particular, this information (which is enclosed) indicates that perfluorooctane sulfonates may not be a degradation product of many fluorochemicals and that high molecular weight fluorochemical polymers and fluorochemical phosphate esters are relatively stable in the environment.

- ⇒ The enclosed information includes some studies and other information on mixtures containing perfluorooctane sulfonates. As we have discussed, 3M will be providing you with further information on other fluorochemicals within the next several weeks. We will include additional studies and other information on mixtures containing perfluorooctane sulfonates at that time.
- ⇒ 3M has not provided you with all analytical chemistry reports on perfluorooctane sulfonates. Rather, we have enclosed certain analytical chemistry reports which may prove useful to EPA in interpreting certain studies; understanding the details of analytical chemistry methods; or verifying human and biomonitoring data.
- ⇒ 3M is continuing its work to refine the analytical characterization of the perfluorooctane sulfonates test material being used for our current study program. We will keep you informed of any pertinent developments.
- ⇒ Finally, please note that some of this information qualifies as confidential business information (CBI); CBI information has been placed in a separate, labeled envelope. Also, incorrectly applied legends relating to legal privileges and proprietary protections have been removed from certain documents.

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3M looks forward to discussing the enclosed information with you and other EPA staff. In the meantime, please do not hesitate to contact me with any questions.

Very truly yours,



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Enclosures

**Attachment to Letter to C. Auer Dated
May 4, 2000: Environmental Studies on
Perfluorooctanesulfonates (Post-1975)**

Physical/chemical Properties

Title	Laboratory or Author	Completion Date	Type
Determination of the Melting Point/Melting Range of PFOS; Boiling Point (Not Conducted)	Wildlife International, Ltd.	2/24/99	Robust Summaries, Final Report, Protocol
Determination of the Vapor Pressure of PFOS Using the Spinning Rotor Guage Method	Wildlife International, Ltd.	5/5/99	Robust Summary, Final Report, Protocol
PFOS: Determination of the <i>n</i> -Octanol/Water Partition Coefficient by the Shake Flask Method - A Non-GLP Feasibility Study in Support of Wildlife International, Ltd. Project Number: 454C-108	Wildlife International, Ltd.	2/11/00	Robust Summary, Feasibility Study
Testing Results: Air-Water Partition Coefficient (K_{AW}) for PFOS	3M/Wildlife International, Ltd., U of Trent	3/19/99	Robust Summary, Letter Report
Determination of the Water Solubility of PFOS by the Shake Flask Method	Wildlife International, Ltd.	4/26/00	Robust Summary, Final Report, Protocol
Technical Report. Solubility Measurements on FC-95	3M Env. Lab	2/6/81	Brief Robust Summary, critique from Endwin Tucker (3/1/93), Final Report
Solubility Estimate of FC-95 by use of Xertex TOC Analyzer	Xertex, 3M Env. Lab	6/29/82	Brief robust summary, letter report

Environmental Fate and Transport

Title	Laboratory or Author	Completion Date	Type
Adsorption of FC 95 and FC 143 on Soil (Note: the 3M Env. Lab summary is titled: Summary of the Soil Adsorption study of the Potassium Salt of Perfluorooctanesulfonic acid, 7/22/98)	3M Env. Lab	2/27/78	Robust Summary, 3M Env. Lab Summary, Comments from Stephen A. Boyd from MSU, Final Report
FC-95/Photolysis Study Using Simulated Sunlight. (Note: the 3M Env. Lab summary is titled: summary of Photolysis Study Using Simulated Sunlight on the Potassium Salt of Perfluorooctanesulfonic acid)	3M Env. Lab	1/9/79	Robust Summary, 3M Env. Lab Summary, Final Report
Biodegradation Studies of Fluorocarbons (8/12/76) report and Biodegradation Studies of Fluorocarbons - III (7/19/78) report. (Note: both reports summarized with one robust summary)	3M Env. Lab	8/12/1976, 7/19/78	Brief Robust Summary, 2 Final Reports
BOD/COD results for FC-94-X (Li salt of PFOS)	Pace Analytical	3/30/94	Computer-generated Summary of Testing Results
BOD/COD results for FC-99 (DEA salt of PFOS)	3M Env. Lab	6/8/79	Robust Summary and final Reports
Transport between environmental compartments (fugacity modeling) included in letter from Don Mackay on the air/water partitioning coefficient calculations	DMER	No date	Robust Summary, letter report
Analysis for fluorochemicals in Bluegill fish.	3M Env. Lab	5/17/79	Robust Summary, Technical Report

Ecotoxicity Elements

Title	Laboratory or Author	Completion Date	Type
PFOS: A 96-Hour Static Acute Toxicity Test with the Fathead Minnow (<i>Pimephales promelas</i>)	Wildlife International, Ltd.	4/26/00	Robust Summary, Final Report, Protocol
PFOS: A 96-Hour Toxicity Test with the Freshwater Alga (<i>Selenastrum capricornutum</i>)	Wildlife International, Ltd.	4/26/00	Robust Summary, Final Report, Protocol
PFOS: A 48-Hour Static Acute Toxicity Test with the Cladoceran (<i>Daphnia magna</i>)	Wildlife International, Ltd.	4/26/00	Robust Summary, Final Report, Protocol
PFOS: A 96-Hour Shell Deposition Test with the Eastern Oyster (<i>Crassostrea virginica</i>)	Wildlife International, Ltd.	4/26/00	Robust Summary, Final Report, Protocol
PFOS: A 96-Hour Static Acute Toxicity Test with the Freshwater Mussel (<i>Unio complanatus</i>)	Wildlife International, Ltd.	4/26/00	Robust Summary, Final Report, Protocol
PFOS: An Activated Sludge, Respiration Inhibition Test	Wildlife International, Ltd.	4/28/00	Robust Summary, Final Report, Protocol
PFOS: A 96-Hour Static Acute Toxicity Test with the Saltwater Mysid (<i>Mysidopsis bahia</i>)	Wildlife International, Ltd.	4/26/00	Robust Summary, Final Report, Protocol
PFOS: An Early Life-Stage Toxicity Test with the Fathead Minnow (<i>Pimephales promelas</i>)	Wildlife International, Ltd.	4/26/00	Robust Summary, Final Report, Protocol
PFOS: A Semi-Static Life-Cycle Toxicity Test with the Cladoceran (<i>Daphnia magna</i>)	Wildlife International, Ltd.	4/26/00	Robust Summary, Final Report, Protocol
PFOS: A Flow-through Life-Cycle Toxicity Test with the Saltwater Mysid (<i>Mysidopsis bahia</i>)	Wildlife International, Ltd.	4/26/00	Robust Summary, Final Report, Protocol
PFOS: A Dietary LC50 Study with the Mallard	Wildlife International, Ltd.	4/26/00	Robust Summary, Final Report, Protocol
PFOS: A Dietary LC50 Study with the Northern Bobwhite	Wildlife International, Ltd.	4/26/00	Robust Summary, Final Report, Protocol
Multi-Phase Exposure/Recovery Algal Assay Test Method	3M Env. Lab	12/16/81	Brief Robust Summary, Final Report
The Effects of Continuous Aqueous Exposure to 14C-78.02 on Hatchability of Eggs and Growth and Survival of Fry of Fathead Minnow (<i>Pimephales promelas</i>) and Summary of histopathological Examinations of Fathead Minnow (<i>Pimephales promelas</i>) Exposed to 78.02 for 30 Days	EG&G Bionomics	August, 1978 December, 1978	Brief Robust Summary, Final Reports
Effect of Potassium Perfluorooctanesulfonate on Survival, etc. (Daphnid reproduction)	3M Env. Lab	2/13/84	Brief Robust Summary, Final Report
<i>Pimephales promelas</i> 96-hour Toxicity Test Data Summary. Sample FC-94-X (Li salt of PFOS)	3M Env. Lab	3/25/94	Robust Summary, Summary Page, copies of data
48-HR Acute Toxicity to <i>Daphnia</i> , <i>Daphnia magna</i> . FC-94-X (Li salt of PFOS)	3M Env. Lab	2/10/94	Robust Summary, copies of data
Microtox Microtox Toxicity Test. Sample: FC-94-X (Li salt of PFOS)	3M Env. Lab	2/7/94	Robust Summary, summary of results, copies of data.
Evaluation of FC-94-X by OECD Activated Sludge Respiration Inhibition Test #209, Review of OECD 209 and BOD/COD Test Results for FC-94-X, test data sheets (Li salt of PFOS)	3M Env. Lab	7/22/98	Robust Summary, Summary Page, copies of data
96-Hour Acute Toxicity Test on Bluegill Sunfish (FC-99, DEA salt of PFOS)	Analytical BioChemistry Laboratories, Inc.	7/13/79	Robust Summary and Final Report
Acute Toxicity to Activated Sludge (FC-99, DEA salt of PFOS)	3M Env. Lab	6/4/79	Robust Summary and copies of data
Microtox data for FM-3820 (28% PFOS)	3M Env. Lab	7/24/91	Robust Summary and data summary

Acute Toxicity to Daphnia magna for FM-3820 (28% PFOS)	EnviroSystems of Resource Analysts, Inc.)	3/26/91	Robust Summary and Final Report
Toxicity to Algae (Selenastrum capricornutum) for FM-3820 (28% PFOS)	EnviroSystems of Resource Analysts, Inc.)	June, 1991	Robust Summary and Final Report

Summary Reports

Title	Laboratory or Author	Completion Date	Type
Final Comprehensive Report: FC 95	3M Env. Lab	3/15/79	Robust Summary, comments from Stephen A. Boyd from MSU and Final Report

Environmental Monitoring

Part 1: Multi-City Study

Title	Laboratory or Author	Completion Date	Type
Design and Structure of Multi-City Study	Battelle Memorial Institute	5/1/00	Report
Low Level Drinking Water Analytical Method	3M Env. Lab	4/28/00	Method
Fluorochemical Characterization of Drinking Water Samples. Columbus, GA (W2336)	Centre Analytical Laboratories, Inc.	2/29/00	Final Report
Fluorochemical Characterization of Drinking Water Samples. Pensacola, FL (W2176)	Centre Analytical Laboratories, Inc.	2/28/00	Final Report
Fluorochemical Characterization of Drinking Water Samples. Port St. Lucie, FL (W2363)	Centre Analytical Laboratories, Inc.	2/28/00	Final Report
Fluorochemical Characterization of Drinking Water Samples. Decatur, Alabama (W1979)	Centre Analytical Laboratories, Inc.	2/28/00	Final Report
Fluorochemical Characterization of Drinking Water Samples. Mobile, Alabama (W2151)	Centre Analytical Laboratories, Inc.	2/28/00	Final Report
Fluorochemical Characterization of Drinking Water Samples. Cleveland, Tennessee (W1973)	Centre Analytical Laboratories, Inc.	2/28/00	Final Report
Draft Drinking Water Health Advisory (DWHA) - PFOS	3M Corporate Toxicology	7/7/99	Report
Battelle Field Sampling Procedures Review. Columbus Georgia City Survey regarding Empirical Human Exposure Assessment. Multi-City Study	3M Env. Lab	8/3/99	Final Report
Multi-City Study. Field Report for Cleveland Tennessee and Decatur Alabama - Battelle Duxbury Activities	Battelle Memorial Institute	7/9/99	Final Report
Multi-City Study. Field Report for Columbus Georgia and Port St. Lucie Florida - Battelle Duxbury Activities	Battelle Memorial Institute	10/26/99	Final Report
Final Multi-City Study. Field Report for Mobile Alabama and Pensacola Florida - Battelle Duxbury Activities	Battelle Memorial Institute	9/29/99	Final Report
Quality assurance Project Plan for Empirical Human Exposure Assessment. Multi-City Study Sampling Task	Battelle Memorial Institute	5/14/99	QAP
Amendment 1 to the Quality Assurance Project Plan and Associated SOP's	Battelle Memorial Institute	6/16/99	Amendment

Part 2: Biosphere Studies

Title	Laboratory or Author	Completion Date	Type
LCMSMS Analysis of Extracts Reported in: "Preliminary Report Analysis of Perfluorinated Compounds in Environmental Samples"	Michigan State University (P. Jones and K. Kannan)	4/7/99	Report
Analysis of Fluorochemicals in Wild Bird Livers	3M Env. Lab	4/28/99	Final Report
Screening of PFOS levels in Eagle and Albatross	3M Env. Lab	5/8/98	Report

Attachments to Letter to C. Auer dated May 4, 2000
Perfluorooctane Sulfonate Studies

Acute Toxicity

- 1) An Acute Inhalation Toxicity Study of T-2306 CoC in the Rat, Bio/dynamics, Inc., Project No. 78-7185, December 31, 1979. (FC-95, Perfluorooctane Sulfonate potassium salt)
- 2) Acute Oral Toxicity (LD50) Study in Rats with Fluorad® Fluorochemical Surfactant FC-95, International Research and Development Corporation, Project No. 137-083, May 31, 1978. (Note: 3M files indicate samples taken during the study were not analyzed.)
- 3) Eye and Skin Irritation Studies Report on Sample T-1166 (FC-98, Potassium Perfluoroethylcyclohexyl Sulfonate, presumed 100 %), Warf Institute Inc., Project No. 5011023, January 28, 1975.
 - a) Combined Eye and Skin Irritation Studies Report
 - b) Eye Irritation Study (with washout procedure) Report

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Perfluorooctane Sulfonate Studies**

Genotoxicity

- 1) Mutagenicity Evaluation of T-2014 CoC in the Ames Salmonella/Microsome Plate Test Final Report, Litton Bionetics Project No. 20838, Protocol No. DMT-100, February 20, 1978.
- 2) Memorandum Report from S. R. Rohfing to A. N. Welter, dated March 31 1977, on Results of the Ames Spot Test for Mutagenicity screening of various FCs, including Sample 12-583 which is FC-95, Notebook Reference 45867-24, 25.
- 3) Mutagenicity Test on T-6295 in an *in vivo* Mouse Micronucleus Assay, Final Report, Corning Hazleton, Inc. (CHV), CHI Study No. 17403-0-455, May 23, 1996, and protocol and amended protocol.
- 4) Final Report, Chromosomal Aberrations in Human Whole Blood Lymphocytes with PFOS, Covance Laboratories, Inc., Covance Study No. 20784-0-449, 3M Reference No. T-6295.18, October 25, 1999.
- 5) Final Report, Unscheduled DNA Synthesis in Rat Liver Primary Cell Cultures with PFOS, Covance Laboratories, Inc., Covance Study No. 20784-0-447, 3M Reference No. T-6295.19, November 9, 1999, and protocol.
- 6) Final Report, *Salmonella-Escherichia coli*/Mammalian-Microsome Reverse Mutation Assay with PFOS, Covance Laboratories, Inc., Covance Study No. 20784-0-409, 3M Reference No. T-6295.17, November 5, 1999, and protocol.
- 7) Final Report, *In Vitro* Microbiological Mutagenicity Assays of 3M Company Compounds T-2247 CoC and T-2248 CoC, SRI International, SRI Project No. LSC-4442-016, 3M Reference No. T-2247.1 (FC-99 Old Formula, L-4299 which is 50 % of the diethanolamine salt of perfluorooctanesulfonate in water), September 5, 1978.
- 8) Prof. Nicola Loprieno, "Evaluation of Mutagenicity Studies Developed on (PFOS) Perfluorooctane Sulfonate," prepared at the request of John L. Butenhoff, Ph.D., 3M Corporate Toxicology, January, 2000.
- 9) Final Report - Bacterial Reverse Mutation Assay of τ -1, Hita Research Laboratories, Chemical Biotesting Center, Study Code K01-1802, 3M Reference No. T-6667.1 (FC-98, Potassium Perfluoroethylcyclohexyl Sulfonate), September, 1996.

**Attachments to Letter to C. Auer dated May 4, 2000
Perfluorooctane Sulfonate Studies**

Repeated-Dose Toxicity

- 1) Ninety-Day Subacute Rhesus Monkey Toxicity Study, with Fluorad® Fluorochemical Surfactant FC-95, International Research and Development Corporation, Project No. 137-092, December 18, 1978.
 - a) Study Report
 - b) Aborted Study: Ninety-Day Subacute Rhesus Monkey Toxicity Study, with Fluorad® Fluorochemical Surfactant FC-95, International Research and Development Corporation, Project No. 137-087, January 2, 1979.
- 2) Ninety-Day Subacute Rat Toxicity Study, with Fluorad® Fluorochemical Surfactant FC-95, International Research and Development Corporation, Project No. 137-085, November, 1978.
- 3) 104-week Dietary Chronic Study and Carcinogenicity Study with Perfluorooctane Sulfonic Acid Potassium Salt (PFOS: T-6295) in Rats, Covance Laboratories Inc., Study Number 6329-183. In progress.
 - a) Summary Report - Week 53 undated
 - b) "Liver Slide Review," Marvin Case to John Butenhoff and Andrew Seacat dated April 5, 2000 relaying the results of an independent histopathologic review of liver slides from the study.
 - c) Second Draft Cell Proliferation Report, Pathology Associates International, August 24, 1999. [final interim report, to be incorporated in final report]
 - d) Study Report of Determination of Cyanide Insensitive Palmitoyl-CoA oxidation in samples from 3M Environmental Laboratory - Covance Studies 6329-183 and 6329-212, Centre For Xenobiotic Research, University of Dundee, Biomedical Research Center, Study Number XR0108, February 18, 1999.
- 4) Range-finder: 4-Week Capsule Toxicity Study with Perfluorooctane Sulfonic Acid Potassium Salt (PFOS; T-6295) in Cynomolgus Monkeys, Covance Laboratories Inc., Study Number 6329-222
 - a) Unaudited Draft Final Report, 4-Week Capsule Toxicity Study with Perfluorooctane Sulfonic Acid Potassium Salt (PFOS; T-6295) in Cynomolgus Monkeys, Covance Laboratories Inc., Study Number 6329-222 (draft not complete).

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Perfluorooctane Sulfonate Studies

- b) Cell Proliferation Report, 4-Week Capsule Toxicity Study with Perfluorooctane Sulfonic Acid Potassium Salt (PFOS; T-6295) in Cynomolgus Monkeys, Covance Laboratories Inc., Study Number 6329-222 (draft to be incorporated in final report)
 - c) Protocol - Analytical Study, Quantitative Analysis of Perfluorooctane Sulfonic Acid Potassium Salt (PFOS; T-6295) in Cynomolgus Monkeys Following Administration of a 4-Week Capsule Toxicity Study, 3M Environmental Laboratory, AMDT-041598.1
 - d) Memorandum from Marvin Case, regarding histopathology review of liver tissue in Covance Study 6329-222, July 27, 1998
- 5) 26-Week Capsule Toxicity Study with Perfluorooctane Sulfonic Acid Potassium Salt (PFOS: T-6295) in Cynomolgus Monkeys, Covance Laboratories Inc., Study Number 6329-223. In progress.
- a) Undated report covering the 26-week dosing phase and one year of recovery.
 - b) John Butenhoff, "Dose-Setting Rationale for Six-Month Chronic Oral Study in Cynomolgus Monkeys," dated July 29, 1998 and followup Aug. 3, 1998.
 - c) Fecal Urobilinogen Analysis, Mayo Clinic, Porphyrins and Nutritional Chemistry Group, Test Code: 8308.
 - i) Summary Report from Dr. Joseph P. McConnell, dated March 16, 1999.
 - ii) General information from Mayo Clinic, Porphyrins and Nutritional Chemistry Group on Urobilinogen Analysis, dated January 14, 1999.
 - iii) Individual animal urobilinogen lab reports (raw data) from Mayo Clinic, Porphyrins and Nutritional Chemistry Group.
 - d) Pathology Report (Ancillary Study), Electron Microscopic Evaluation of Liver in Cynomolgus Monkeys, Pathology Associates International, Study No. EM99.76, July 13, 1999.
 - e) Pathology Review, Marv Case to Andrew Seacat, dated July 22, 1999 relaying the results of a histopathology review of slides.

Attachments to Letter to C. Auer dated May 4, 2000
Perfluorooctane Sulfonate Studies

- f) Laboratory Report, Interim Report of Preliminary Data for 26 Week Capsule Toxicology Study with PFOS in Cynomolgus Monkeys, 3M Environmental Laboratory, Report No. FACT-TOX-030, dated March 29, 1999.
- 6) Two Week Oral Rangefinding Toxicity Study of T-2509CoC in Rats, Safety Evaluation Laboratory, Riker Laboratories, Inc., Experiment No. 179RR023, 3M Reference no. T-2509.3 (FC-99 New Formula, L-4509, 25 % diethanolamine salt of perfluorooctanesulfonate in water), February 25, 1980.
- 7) [Submitted under claim of Confidentiality]

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Perfluorooctane Sulfonate Studies

Pharmacokinetic Studies

- 1) Skin Absorption Studies on Surfactants (1983)
 - a) Report from W. C. McCormick to D. R. Ricker, dated September 26, 1983 summarizing data
 - b) 28 Day Percutaneous Absorption Study in Rabbits with FC-95, Safety Evaluation Laboratory, Riker Laboratories, Inc., Experiment No. 0979AB0632 (FC-95)
 - c) 28 Day Percutaneous Absorption Study in Rabbits with FC-99, Safety Evaluation Laboratory, Riker Laboratories, Inc., Experiment No. 0979AB0633, 3M Reference No. T-3988.1 (FC-99, diethanolamine salt of perfluorooctanesulfonate, assumed to be 25 % in water)
- 2) Single-Dose Intravenous Pharmacokinetic Study of T-6053 in Rabbits, 3M Environmental Laboratory (FC-99, diethanolamine salt of perfluorooctanesulfonate in water Lot 130, Unit 177. 0.04 % FC solids in water), November 16, 1995. Final Report – Analytical Study, which includes copy of *in vivo* Study No. AMDT-010495.1, Hazleton Wisconsin, Inc., Project No. HWI 6329-136, 3M Reference No. T-6053.1
- 3) Single-Dose Dermal Absorption / Toxicity Study of T-6053 in Rabbits, 3M Environmental Laboratory, Study No. AMDT-022195.1 (FC-99, diethanolamine salt of perfluorooctanesulfonate in water Lot 130, Unit 177. 0.04 % FC solids in water), November 22, 1995. Final Report – Analytical Study, includes *in vivo* Study Hazleton Wisconsin, Inc., Project No. HWI 6329-137, 3M Reference No. T-6053.2
- 4) Fluorochemical (FC) Levels in Naïve Rats, 3M Medical Department, Toxicology Services, Study No. T-6316.9, DT21, Draft Report for Objective 3, May 14, 1999.
- 5) Analytical Data submitted to Dr. Jennifer Seed, USEPA, by letter dated May 3, 2000, including serum measurements from two in-life studies:
 - a) Analytical data from Advanced Bioanalytical Services Study No. FACT-TOX-111, with respect to Oral (Gavage) Pharmacokinetic Recovery Study of Perfluorooctane Sulfonate in Rats, Argus Laboratories Protocol No. 418-015, 3M Reference T-6295.14.

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- b) Analytical data from Advanced Bioanalytical Services Study No. FACT-TOX-110., with respect to Oral (Gavage) Pharmacokinetic Study of Perfluorooctane Sulfonate in Rats, Argus Laboratories Protocol No. 418-013, 3M Reference T-6295.12.
- 6) In Vitro Comparative Metabolism Study in Rat and Human Hepatocytes with Various Fluorochemicals, 3M Reference T-6295.1, study of T-6292 (N-ethyl FOSE), T-6293 (N-ethyl FOSE monophosphate ester), T-6294 (N-ethyl perfluorooctane sulfonamide), and T-6295 (Perfluorooctane Sulfonate)
 - a) Range-finding Cytotoxicity Assay, SRI International Toxicology Laboratory, Study No. B010-95 – protocol and faxed results dated Oct. 26, 1995, Dec. 12, 1995, and Jan. 16, 1996
 - b) Metabolism of T-6292, T-6293, T-6294, T-6295 by Rat and Human Hepatocytes, SRI International Toxicology Laboratory, Study No. B011-95
 - c) Advanced Bioanalytical Services, Inc., Analytical Report, Additional Characterization of Metabolites of T-6292, T-6293 and T-6294 from Rat and Human Hepatocytes by TurboIonSpray LC/MS and LC/MS/MS. Semi-Quantitative Analysis of T-6295 in Rat and Human Hepatocytes Incubated with T-6292, T-6293 and T-6294 by LC/MS/MS, January 28, 1998, Report 98AGKP01.3M
 - d) Working Interpretation of Results, chart entitled Perfluorosulfonamide Metabolism in Rat vs. Human Hepatocytes, updated Feb. 5, 1998 based on ABS Jan. 1998 report

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Mechanistic

- 1) Reports from University of Minnesota Duluth Research (Kendall Wallace):
 - a) Kendall B. Wallace, Biochemical and Molecular Mechanistic Studies of N-Alkyl Perfluorosulfonamides, Research Proposal, April 8, 1997, and Updated Proposal May 7, 1998
 - b) Kendall B. Wallace and Anatoli Starkov, The Effect of Perfluorinated Arylalkylsulfonamides on Bioenergetics of Rat Liver Mitochondria, Feb. 4, 1998
 - c) Report on Covance Studies, assessment of mitochondrial bioenergetics, undated
 - d) Summary of the Effects of PFC's [Perfluorinated Compounds] on Mitochondrial Bioenergetics In Vitro, undated
 - e) Report, Effects of Selected Perfluoro-compounds on Mitochondrial Beta-Oxidation, Dec. 20, 1999
 - f) Report, Effect of Acute FC Administration on Catalase and acylCoA Oxidase Expression, January 27, 2000
- 2) Nabbefeld, et al., Displacement of a Fluorescently Labeled Fatty Acid Analogue from Fatty Acid Carrier Proteins by Wyeth - 14,643, Ammonium Perfluorooctanoate, Potassium Perfluorooctane Sulfonate and Other Known Peroxisome Proliferators, Abstract, Society of Toxicology, 1998 Annual Meeting

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Teratology

Pilot Teratology Study in Rats, T-3551 Final Report, May 13, 1983, 3M Reference T-3551.12

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Human Sera/Medical Surveillance/Epidemiology

Memorandum from D.E. Roach and S.D. Sorenson, 1983 Decatur Blood Fluoride Review, January 20, 1984

Antwerp Blood Testing Results from June 1995, by Jeffrey H. Mandel, M.D., M.P.H., and Jean Burris, R.N., O.H.N., M.P.H., November 6, 1995

Analysis of Serum Values in Decatur Workers, prepared by Michel Burlew for Larry Zobel, M.D. and Jeffrey Mandel, M.D., April 2, 1998

Laboratory Report, Analysis of FCs in Samples of Children's Sera, Laboratory Report No. FACT-GEN-011, 3M Environmental Laboratory, May 21, 1999

Laboratory Composite Report, Analytical Reports of Data for Fluorochemical Analysis in Human Sera, LIMS No. 1623, 3M Environmental Laboratory, April 28, 2000

ATTACHMENT TO LETTER TO C. AUER DATED MAY 4, 2000: ONGOING ENVIRONMENTAL STUDIES ON PERFLUOROOCTANESULFONATES

Physical/Chemical Properties

Potential Fluorochemical Combustion By-Products (involves review of results of literature search regarding potential for formation of fluorinated dioxins and furans), 3M Environmental Laboratory. Expected completion: Sept. 2000. Study paper in progress.

Fluorochemical Decomposition Process: Quantification and Assessment (involves computational chemistry calculations of bond-breaking strengths of sulfonated perfluorochemicals), Battelle Memorial Institute. Expected completion: Aug. 2000. Study paper in progress.

Environmental Fate and Transport

Abiotic Degradation Studies (hydrolysis and indirect photolysis), 3M Environmental Laboratory. Expected completion: June 2000 (hydrolysis); Aug. 2000 (indirect photolysis). (Summary study plan and screening results summary being provided to EPA)

Biodegradation Studies (aerobic acclimated closed bottle biodegradation, aerobic soil/sediment biodegradation, pure culture aerobic, and fluorochemical decomposition process, stability in water, photodegradation), Springborn Laboratories, Inc. Expected completion: Aug. 2000. (Summary study plan being provided to EPA)

Ecotoxicity Elements

PFOS: A 96-Hour Toxicity Test with the Freshwater Alga (*Anabaena flos-aquae*), Wildlife International, Ltd. Expected completion: July 2000. (Protocol being provided to EPA)

PFOS: A 96-Hour Toxicity Test with the Freshwater Diatom (*Navicula pelliculosa*), Wildlife International, Ltd. Expected completion: July 2000. (Protocol being provided to EPA)

PFOS: A 96-Hour Toxicity Test with the Marine Diatom (*Skeletonema costatum*), Wildlife International, Ltd. Expected completion: July 2000. (Protocol being provided to EPA)

PFOS: A 7-Day Toxicity Test with Duckweed (*Lemna gibba*), Wildlife International, Ltd. Expected completion: July 2000. (Protocol being provided to EPA)

Phytotoxicity – Seedling Emergence, Wildlife International, Ltd. Expected completion: July 2000. Protocol in progress.

Environmental Monitoring

Global Environmental Sampling Plan, Michigan State University. Expected completion: Dec. 2000. (Summary being provided to EPA)

Attachments to Letter to C. Auer dated May 4, 2000
Perfluorooctane Sulfonate Studies

Ongoing Research/Study Protocols

- 1) 104-week Dietary Chronic Study and Carcinogenicity Study with Perfluorooctane Sulfonic Acid Potassium Salt (PFOS: T-6295) in Rats, Covance Laboratories Inc., Study Number 6329-183. In progress. Interim data provided.
- 2) 26-Week Capsule Toxicity Study with Perfluorooctane Sulfonic Acid Potassium Salt (PFOS: T-6295) in Cynomolgus Monkeys, Covance Laboratories Inc., Study Number 6329-223. In progress. Interim data provided.
- 3) Protocol for Study: Low Level PFOS Dose versus Rat Serum and Liver PFOS, 3M Medical Department, Corporate Toxicology, Study No. T-6295.16 DT31, October 29, 1998. (Study in progress.)
- 4) Protocol for Study: Pharmacokinetic Study of POSF in Rats, 3M Medical Department, Corporate Toxicology, Protocol for Study No. T-7098.1, January 7, 1999. (Study in Progress).
- 5) Study Plan, ST-43: Standard Procedure for Liver Subcellular Fractionation, undated, 3M Toxicology Laboratory
- 6) Plan for Study Nos. T-6295.23; ST-46, Exploratory In-Vitro Percutaneous Absorption Study of Theophylline, Salicylic Acid, Perfluorooctylsulfonate, and Ammonium Perfluorooctanoate in SkinEthic Reconstituted Epidermis Model, May 4, 2000, 3M Toxicology Laboratory
- 7) Study Plan, Luebker, Perfluorooctane Sulfonic Acid Induced HMG-CoA Reductase Inhibition in Pregnant Rats and Rat Pups, January 21, 2000

**ATTACHMENT TO LETTER TO C. AUER DATED MAY 4, 2000: PLANNED
ENVIRONMENTAL STUDIES ON PERFLUOROOCTANESULFONATES**

Environmental Fate and Transport

Soil Adsorption/Desorption, 3M Environmental Laboratory. Start date: May 2000. Protocol in progress.

Multi-Media Modeling of PFOS Distribution, Mackay, D. (Trent University) Start date: June 2000. Protocol in progress.

Bioconcentration Factor, Wildlife International, Ltd. Start date: Sept. 2000. Protocol in progress.

Ecotoxicity Elements

Acute Toxicity to Bluegill Sunfish, Wildlife International, Ltd. Start date: July 2000. Protocol in progress.

Acute Toxicity to Sheepshead Minnow, Wildlife International, Ltd., Start date: July 2000. Protocol in progress.

Phytotoxicity – Vegative Vigor and Plant Uptake, Wildlife International, Ltd. Start date: June 2000. Protocol in progress.

Acute Toxicity to *Eisenia foetida* (Earthworms), Wildlife International, Ltd. Start date: June 2000. Protocol in progress.

FETAX (Frog Embryo Teratogenesis), Wildlife International, Ltd. Start date: June 2000. Protocol in progress.

Mallard Duck Reproduction (Dietary), Wildlife International, Ltd. Start date: July 2000. Protocol in progress.

Bobwhite Quail Reproduction (Dietary), Wildlife International, Ltd. Start date: July 2000. Protocol in progress.

Environmental Monitoring (Environmental Sampling & Release Estimation)

Estimation of PFOS in Life-Cycle Waste Streams, Battelle Memorial. Start date: May 2000. Protocol in progress.

Estimation of Life-Cycle Releases, Battelle Memorial Institute. Start date: January 2001. Protocol in progress.

Carpet Release Study, Battelle Memorial Institute. Start date: June 2000. Protocol in progress.

Multi-City Study, Centre Analytical Laboratories, Inc.; 3M Environmental Laboratory. Start date: June 2000. (Study plan being provided to EPA)

Multi-City Study – Analyses of Sediments. Start date: June 2000.

Multi-City Study – Analyses of Water Columns. Start Date: Sept. 2000.

Multi-City Study – Analyses of Surface Water Film. Start date: Sept. 2000.

Multi-City Study – Analyses of POTW Effluents. Start date: Sept. 2000.

Multi-City Study – Analyses of POTW Sludge. Start date: June 2000.

Multi-City Study – Analyses of Landfill Leachates. Start date: Sept. 2000.

Multi-City Study – Analyses of Fish. Start date: June 2000.

Multi-City Study – Analyses of “Market Baskets.” Start date: June 2000.

Attachments to Letter to C. Auer dated May 4, 2000
Perfluorooctane Sulfonate Studies

Planned Studies

- 1) Preliminary Study Outline, One Generation Reproduction Study of PFOS in Rats, Pharmacokinetic Analysis, May 3, 2000
- 2) Preliminary Study Outline, One Generation Reproduction Study of PFOS in Rats, Mevalonic Acid/Cholesterol Challenge and NOEL Investigation in Rats, April 27, 2000

**ATTACHMENT TO LETTER TO C. AUER DATED MAY 4, 2000:
PRE-1976 ENVIRONMENTAL STUDIES ON PERFLUOROOCTANESULFONATES**

Data from Fathead Minnow Study on FC-93 (25% NH₄ salt of PFOS in IPA and water), 3M Environmental Laboratory, Aug. 2, 1974. (Robust summary, MSDS and copies of data being provided to EPA)

Data from Fathead Minnow Study on FC-93 (25% NH₄ salt of PFOS in IPA and water), 3M Environmental Laboratory, Oct. 19, 1974. (Robust summary, MSDS and copies of data being provided to EPA)

BOD/COD results for FC-93 (25% NH₄ salt of PFOS in IPA and water), 3M Environmental Laboratory. Completion date: July 18, 1974. (Robust summary and copy of results being provided to EPA)

**ATTACHMENT TO LETTER TO C. AUER DATED MAY 4, 2000:
PRE-1976 TOXICOLOGY STUDIES ON PERFLUOROOCTANESULFONATES**

Eye and Skin Irritation Studies Report on Sample T-1117, Warf Institute Inc., Project No. 4102871, November 7, 1974, and explanatory correspondence indicating material is FC-95 (Perfluorooctane Sulfonate potassium salt)

Eye, Skin and Acute Dermal LD50 Study Report on Sample T-991 (FC-93, L-3356, Ammonium Salt of Perfluorooctane Sulfonate, 25% in 20% Isopropyl Alcohol and 55% Water), Warf Institute Inc., Project No. 4053862, June 25, 1974

Attachments to Letter to C. Auer dated May 4, 2000
Perfluorooctane Sulfonate Studies

Bibliography of Acute Toxicity Studies Not Submitted

- 1) Acute Oral Toxicity-Rats on Sample T-1389, Biosearch Inc., March 4, 1976 (FC-95, Perfluorooctane Sulfonate potassium salt).
- 2) Acute Oral Toxicity-Rats on Sample T-1390, Biosearch Inc., March 4, 1976. [FC-98]
- 3) Acute Oral Toxicity-Rats on Sample T-2297 CoC (Ammonium Perfluorooctane Sulfonate, FC-93 Solids), Biosearch, Inc. October 13, 1978.
- 4) Acute Oral Toxicity-Rats on Sample T-2275 CoC (FC-99 Old Formula, L-4299, NB 48490, which is 50 % of the Diethanolamine Salt of Perfluorooctane Sulfonate in water), Biosearch, Inc., September 25, 1978.
- 5) Primary Skin Irritation Test with T-2509CoC in Albino Rabbits, Safety Evaluation Laboratory, Riker Laboratories, Inc., Experiment No. 479EB0332, 3M Reference no. T-2509.4 (FC-99 New Formula, L-4509, 25 % Diethanolamine Salt of Perfluorooctane Sulfonate in water), June 28, 1979.
- 6) Acute Ocular Irritation Study with T-2509CoC in Albino Rabbits, Safety Evaluation Laboratory, Riker Laboratories, Inc., Experiment No. 479EB0333, 3M Reference no. T-2509.1 (FC-99 New Formula, L-4509, 25 % Diethanolamine Salt of Perfluorooctane Sulfonate in water), July 13, 1979.
- 7) Acute Inhalation Toxicity Study of T-2308 CoC in the Rat, Bio/dynamics, Inc., Project No. 78-7187, 3M Reference No. T-2308 (FC-98, Potassium Perfluoroethylcyclohexyl Sulfonate, presumed 100 %), April 12, 1979.
- 8) Acute Ocular Irritation Test with T-2960CoC in Albino Rabbits, Safety Evaluation Laboratory, Riker Laboratories, Inc., Experiment No. 0880EB0598, 3M Reference No. T-2960.2 (FC-90, L-4649, Diethanolamine Salt of Perfluoroethylcyclohexyl Sulfonate, 25 % in water), February 18, 1981.
- 9) Acute Dermal Toxicity Study with T-2960CoC in Albino Rabbits, Safety Evaluation Laboratory, Riker Laboratories, Inc., Experiment No. 0880AB0599, 3M Reference No. T-2960.1 (FC-90, L-4649, Diethanolamine Salt of Perfluoroethylcyclohexyl Sulfonate, 25 % in water), January 15, 1981.
- 10) Primary Skin Irritation Test with T-2960CoC in Albino Rabbits, Safety Evaluation Laboratory, Riker Laboratories, Inc., Experiment No. 0880EB0597, 3M Reference

Attachments to Letter to C. Auer dated May 4, 2000
Perfluorooctane Sulfonate Studies

No. T-2960.4 (FC-90, L-4649, Diethanolamine Salt of Perfluoroethylcyclohexyl Sulfonate, 25 % in water), January 15, 1981.

- 11) Acute Oral Toxicity Study with T-2960CoC in Albino Rabbits, Safety Evaluation Laboratory, Riker Laboratories, Inc., Experiment No. 0980AR0600, 3M Reference No. T-2960.3 (FC-90, L-4649, Diethanolamine Salt of Perfluoroethylcyclohexyl Sulfonate, 25 % in water), February 18, 1981.
- 12) Acute Oral Toxicity - Rats, Biosearch, Inc., 3M Reference No. T-2296 (FC-93, Ammonium Perfluorooctane Sulfonate, 25 % in 20 % Isopropyl Alcohol and 55 % Water), October 19, 1978.

**ATTACHMENT TO LETTER TO C. AUER DATED MAY 4, 2000: PUBLISHED
STUDIES ON PERFLUOROOCTANESULFONATES**

Environmental Studies

Key, B.L.; Howell, R.D.; Criddle, C.S. "Fluorinated Organics in the Biosphere," *Environ. Sci. Technol.*, 1997, 31: 2445-2454

Key, B.L.; Howell, R.D.; Criddle, C.S. "Defluorination of Organofluorine Sulfur Compounds by *Pseudomonas* Sp. Strain D2," *Environ. Sci. Technol.*, 1998, 32:2283-2287

Toxicology Studies

Belisle J, Hagan DF (1978). *Anal Biochem.* 87, 545 (Note Error: In this report the blank was erroneously reported as 0.02 mg; it should be 0.02µg.)

Belisle, J (1981). *Science* 212, pp. 1509-1510.

Guy, WS (1972). Ph.D. Thesis, University of Rochester, Rochester, NY.

Guy, WS, Taves, DR, Brey, Jr., WS (1976). Organic fluorocompounds in human plasma: prevalence and characterization. (In) *Biochemistry Involving Carbon-Fluorine Bond*, pages 117-134.

Haugom, B. and Spydevold, O. 1992. The mechanism underlying the hypolipemic effect of perfluorooctanoic acid (PFOA), perfluorooctane sulphonic acid (PFOSA) and clofibril acid. *Biochim. Biophys. Acta.* 1128, 65-72.

Ikeda, T., Fukuda, K., Mori, I., Enomoto, M., Komai, T. and Suga, T. 1987. Induction of cytochrome P-450 and peroxisome proliferation in rat liver by perfluorinated octanesulfonic acid. In: *Peroxisomes in Biology and Medicine*, H.D. Fahimi and H. Sies, Eds. Springer Verlag, New York, 304-308.

Johnson, J.D., Gibson, S.J. and Ober, R.E. 1984. Cholestyramine-enhanced fecal elimination of carbon-14 in rats after administration of ammonium [¹⁴C]perfluorooctanoate or potassium [¹⁴C]perfluorooctanesulfonate. *Fund. Appl. Toxicol.* 4, 972-976.

Nabbefeld D., Butenhoff J., Bass N. and Seacat A. 1998. Displacement of a fluorescently labeled fatty acid analogue from fatty acid carrier proteins by Wyeth-14,643, ammonium perfluorooctanoate, potassium perfluorooctane sulfonate and other known peroxisome proliferators. (SOT Abstract. Accepted, *Toxicologist* 1998).

Olsen, GW, Burris, JM, Mandel, JH and Zobel, LR (1999). Serum perfluorooctane sulfonate and hepatic and lipid clinical chemistry tests in fluorochemical production employees. *JOEM* 41:799-805.

Pothapragada V, (1975). Determination of total fluorine in serum and other biological materials by oxygen bomb and reverse extraction techniques. *Analytical Biochem* 68:512-521.

Pothapragada V, Singer R, Armstrong WD (1971). Determination of ionic (plus ionizable) fluoride in biological fluids. Procedure based on adsorption of fluoride ion on calcium phosphate. *Anal Biochem* 42:350-359.

Singer L and Armstrong WD (1959). Determination of fluoride in blood serum. *Analytical Chem* 31:105-109.

Singer L and Ophaug RH (1979). Concentrations of ionic, total, and bound fluoride in plasma. *Clin Chem* 25:523-525.

Sohlenius, A-K., Eriksson, A.M., Höglström, C., Kimland, M. and DePierre, J.W. 1993. Perfluorooctane sulfonic acid is a potent inducer of peroxisomal fatty acid β -oxidation and other activities known to be affected by peroxisome proliferators in mouse liver. *Pharmacol. Toxicol.* 72, 90-93.

Taves D (1968a). Evidence that there are two forms of fluoride in human serum. *Nature* 217:1050-1051.

Taves D (1968b). Electrophoretic mobility of serum fluoride. *Nature* 220:582-583.

Taves D, Guy W, Brey W (1976). Organic fluorocarbons in human plasma: Prevalence and characterization. In: Filler R, eds. *Biochemistry Involving Carbon-Fluorine Bonds*. Washington, DC:American Chemical Society, pages 117-134.

Ubel FA, Sorenson SD, Roach DE (1980). Health status of plant workers exposed to fluorochemicals, a preliminary report. *Am Ind Hyg Assoc J.* 41:584-589.

Yamamoto G, Yoshitake K, Sato T, Kimura T and Ando T (1989). Distribution and forms of fluorine in whole blood of human male. *Analytical Biochem* 182:371-376.

PHYSICAL – CHEMICAL PROPERTIES

A Robust Summary, Final Report, and Protocol on the physical-chemical properties of perfluorooctanesulfonate are included for each of the following parameters:

<u>PARAMETER</u>	<u>DATE OF REPORT</u>	<u>RESULTS</u>
Melting Point/Melting Point Range	2/24/99	$\geq 400^{\circ}\text{C}$
Vapor Pressure	5/5/99	$3.31 \times 10^{-4} \text{P}@20^{\circ}\text{C}$
n-Octanol/Water Partition Coefficient	2/11/00	Not calculable; three phases
Air-Water Partition Coefficient	3/19/00	$0(<2 \times 10^{-6})$
Solubility in pure water	5/3/99	570mg/l
Solubility Measurements on FC-95	2/6/81	1080mg/l

The data presented in the study "Solubility Measurements on FC-95," was determined by indirect measurement, not by actual analysis. Therefore, the data is not reliable.

Please note that the March 1, 2000 submittal to EPA entitled "Sulfonated Perfluorochemicals in the Environment Sources, Dispersion, Fate and Effects" included solubility data on water other than pure (i.e., fresh water; filtered sea water; unfiltered sea water). These data were developed, however, in support of other studies and not produced using GLP Standards. For this reason, Robust Summaries, Final Reports, or protocols for this specific data are not being provided.

ENVIRONMENTAL FATE AND TRANSPORT

This section presents information and test results from abiotic, and biotic degradation and soil adsorption studies. Degradation studies include hydrolysis, photolysis, and biodegradation. Much of this work is in progress with final reports scheduled for the June to August, 2000 timeframe.

As these studies progress, there are certain key findings that can be presented as preliminary results:

- 1. There has been no indication that perfluorooctanesulfonate undergoes any degradation from hydrolysis, photolysis, or biodegradation mechanisms.**
- 2. In all hydrolysis and photolysis studies, perfluorooctanesulfonate has not been detected as a degradation product in any conclusive experiment. This preliminary finding calls into question the assumption of expected degradation of other fluorochemicals to perfluorooctanesulfonate.**
- 3. In the studies focused on hydrolysis of fluorochemical polymers that form the structure of the specific industrial and consumer products, it has been determined that these materials are relatively stable in the environment. For example, the following half-lives are estimated for various polymers:**

<u>POLYMER</u>	<u>HALF-LIFE</u>
Acrylate and ester	1-5 years
Polyethylene glycol based	3-50 years
Urethane	>500 years

For hydrolysis to occur, polymers must be subjected to an aqueous environment, which is not expected to occur in a municipal or industrial landfill.

- 4. Relative to photolysis, the current data suggests a hypothesis that these materials will photolyze to carboxylate structures. These structures have much different properties than sulfonates in that they are much less bioaccumulative in ecological species.**

Additional discussion of these results and ongoing studies will be presented in subsequent submissions and reports.

ECOTOXICITY ELEMENTS

This section presents information and test results from a series of ecotoxicity studies on perfluorooctanesulfonates. The information is presented as Robust Summaries, Final Report and Protocol for each ecotoxicity element.

The studies performed during 1999 and in early 2000 were carried out using GLP Standards. In contrast, ecotoxicity studies performed during the period 1974 to 1998 were conducted using protocols and analytical methodologies available at the time of the study. In addition, in these older tests, the sulfonated perfluorochemical products were variable mixtures and contained more impurities. Several tests were hampered by the insolubility of the perfluorochemical and results are expressed as “greater than” the measured solubility. Therefore, the data presented in these historical reports may not be reliable.

ENVIRONMENTAL MONITORING:
PART ONE – MULTI-CITY STUDY

The multi-city study was designed to obtain preliminary data about dispersion of fluorochemicals in the environment, uptake into foods and presence in drinking water to understand the potential sources of human and environmental exposures that might result from this type of dispersion. The multi-city study paired a city having manufacturing or commercial use of fluorochemical products based on customer sales with a city that does not. Initially six cities, (three pairs) are being examined. The study may be expanded depending on further results.

The multi-city study will yield environmental distribution data as well as data on potential sources of human exposure. The cities were selected to represent urban locations with various levels of fluorochemical releases and various types of municipal water supplies. The samples to be obtained, where possible, include: urban air, surface water column and surface microlayer, sediment, river fish, drinking water intake, treated drinking water, tap water, the influent to and effluent from publicly-owned waste treatment works, sludge, and municipal landfill leachate. Additionally, a "market basket" of several food products will be sampled. These include: beef, pork, chicken, hot dogs, catfish, eggs, milk, bread, green beans, apples from grocery stores and, if possible, produce from local farmers' markets.

The attached material data provides more detail on the design and structure of the study and represents the first results from the multi-city study. Included are reports on the quality assurance plan and field sampling procedures used and the results of the drinking water samples taken from the six cities. The results indicate that drinking water in four cities (Decatur, Alabama; Cleveland, Tennessee; Mobile, Alabama; and Port St. Lucie, Florida) did not contain detectable levels of fluorochemicals. Only two cities (Columbus, Georgia, and Pensacola, Florida) contained detectable levels of sulfonated fluorochemicals in the drinking water. The results show that the levels are in the range of 40-60 parts per trillion of perfluorooctane sulfonate. Only one city, Columbus, Georgia, showed very low detectable levels of perfluorooctanoate.

Also included is a copy of a draft "lifetime" drinking water health advisory developed for PFOS. This advisory reflects a very conservative approach based on application of "safety factors." The advisory level of 1 part per billion should not be misconstrued as threshold for danger or concern, but only a reference point based on application of conservative methods and the information available to date. A comparison of the drinking water data from the multi-city study indicates that there are two orders of magnitude of safety between the draft drinking water advisory and the results from these two cities in the multi-city study.

ENVIRONMENTAL MONITORING: PART TWO – BIOSPHERE SAMPLING AND ANALYSIS

A plan to assess potential environmental exposure to perfluorooctanesulfonate and other fluorochemical substances has been developed by 3M and outside experts. One component of this plan involves characterization of the geographic distribution of fluorochemicals in biotic and abiotic receptors. Two studies are in progress, one focused in the vicinity of the 3M Decatur, Alabama manufacturing facility, and the other a much more comprehensive global biosphere monitoring program. The preliminary results obtained to date have been reported in the 3M Environmental White Paper entitled "Sulfonated Perfluorochemicals in the Environment: Sources, Dispersion, Fate and Effects."

The study in the Decatur, Alabama area is being designed to understand the impact, if any, of production operations in the local environment. Samples of the groundwater, surface water, sediments and fish and bird species will be collected in May and June, 2000 for analyses. This data will be used to evaluate the environmental presence of fluorochemicals and to assess the potential of any effects using ecotoxicological test results.

The Biosphere monitoring program was designed in consultation with Dr. John Geisy of Michigan State University. This plan is being viewed as an iterative process to assess global distribution of fluorochemicals. As results are obtained from the global environment, the plan is to concentrate on those areas where fluorochemicals are detected in samples and focus on additional sampling and analyses in those specific locations.

Initially, samples of tissues and blood plasma are being collected from archived specimens covering different species and locations. Areas of focus include North America (Great Lakes and coastal marine locations), the arctic region, and Europe. Species to be studied include lake trout, walleye, salmon, catfish, and brown trout; cormorants, eagles and albatross; mussels and shellfish; marine mammals; and other species. This sampling plan is in progress and as data is obtained and reports generated, additional submissions will be made to EPA.

Included in this section are the following documents:

- 1. LCMSMS Analysis of Extracts reported in: "Preliminary Report Analysis of Perfluorinated Compounds in Environmental Samples" by P. Jones and K. Kannan - 4/7/99**
- 2. Final Laboratory 3M Reports on Analysis of Fluorochemicals in Wild Bird Livers – 4/28/99**
- 3. Screening of PFOS levels in Eagle and Albatross - 5/8/98**