

FYI - 0500 - 1378

4651 PP



FYI-00-001378



RECEIVED  
CONFIDENTIAL  
00 MAY 25 AM 11:11

May 4, 2000



85000000006

MR 36028

**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  
Room 403 East Tower (Mail Code 7405)  
Washington, D. C. 20460

Contain NO CBI

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;

000001

(iv) pharmacokinetics, <sup>mechanistic studies</sup> (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.

Charles Auer  
May 4, 2000  
Page 4

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,



William A. Weppner, Ph.D  
Director of Environmental, Health, Safety  
And Regulatory Affairs  
Specialty Materials Markets  
3M  
Bldg 236-1B-10  
3M Center  
St. Paul, MN 55144  
E-mail: [wawepner@mmm.com](mailto:wawepner@mmm.com)

Enclosures

000004

**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

000005

## 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 complamatus</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
Microbics 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

000006

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	Ammendment

000007

## 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

**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% NH<sub>4</sub> 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% NH<sub>4</sub> 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% NH<sub>4</sub> 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)

**000009**

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

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

- 1 - 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)

Missing  
2a

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)

2b - Study Design - 3M Microbial Metabolism Program  
Ecotoxicity Elements

- 3 - 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)

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

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

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

Missing  
7

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

Environmental Monitoring

Missing  
8

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

000010

- 9 - Determination of PFOS, PFOSA, and POAA in water by Liquid-Solid Extraction and High-Performance Liquid Chromatography/Tandem Mass Spectrometry (no-date) 17 pp.
- 10 - Compound-specific  $\delta^{13}C$  and  $\delta^{34}S$  characterization of Organic Fluorochemicals in Biological Matrices, K.S. Hanson et al. (no-date), 22 pp.

**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

**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

**000012**

**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.

**000013**

**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 Pefluorooctane Sulfonate, 25 % in 20 % Isopropyl Alcohol and 55 % Water), October 19, 1978.

**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).

**000016**

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

**000017**

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] - Being handled as a separate FYI on an exploratory 28-day oral toxicity study in rats with PFOS and other test materials; also accompanying analytical report.

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

Teratology

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

**000019**

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

**000020**

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

- 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

**000021**

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

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

**000022**

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

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

**000023**

**Attachments to Letter to C. Auer dated May 4, 2000  
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  $\tau$ -1, Hita Research Laboratories, Chemical Biotesting Center, Study Code K01-1802, 3M Reference No. T-6667.1 (FC-98, Potassium Perfluoroethylcyclohexyl Sulfonate), September, 1996.

**000024**

**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

**000025**

**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: PLANNED ENVIRONMENTAL STUDIES ON PERFLUOROCTANESULFONATES**

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 *Eiseinia 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.

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

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

**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
1. Determination of the Melting Point/Melting Range of PFOS; Boiling Point (Not Conducted)	Wildlife International, Ltd.	2/24/99	Robust Summaries, Final Report, Protocol
2. Determination of the Vapor Pressure of PFOS Using the Spinning Rotor Gauge Method	Wildlife International, Ltd.	5/5/99	Robust Summary, Final Report, Protocol
3. 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
4. Testing Results: Air-Water Partition Coefficient ( $K_{AW}$ ) for PFOS	3M/Wildlife International, Ltd., U of Trent	3/19/99	Robust Summary, Letter Report
5. Determination of the Water Solubility of PFOS by the Shake Flask Method	Wildlife International, Ltd.	4/26/00	Robust Summary, Final Report, Protocol
6. 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
7. 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