INDEX TO EPA HEARINGS IN THE MATTER OF:
PROPOSED TOXIC POLLUTANT EFFLUENT STANDARDS
FOR POLYCHLORINATED BIPHENYLS

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IA

DISCUSSION THAT RELATES OR DISTINGUISHES ARCOCHLOR 1016 AND OTHER AROCHLORS

Volume Date	Page	Witness	Summary
9/27	4041-47	Nebeker	(Cross examination by Nickles:) Discussion of EPA Exhibit F in its capacity as key document supporting proposition that arochlor 1242 and 1016 are of the same relative toxicity. Nickles motion to strike exhibit for lack of background data; specific request for data; motion to strike withheld pending production of data. ("[T]here is very little in this record relating to the 1016 items, so. . . it tends to bring the 1242 data over and use it against 1016. . .")
9/27	4055	Nebeker	(Cross examination by Nickles:) In response to a question requesting sources for testimony on 1016, Nebeker cites Exhibits F, G, and E for their data on the similarity of toxicity between 1016 and 1242.
9/27	4063-64	Nebeker	(Cross examination by Nickles:) Exchange establishing that when original arochlor research began in 1970, 1016 was neither used commercially nor among the 8 studied.
9/27	4074-87	Nebeker	(Cross examination by Nickles:) Discussion of bio-assay methods and conditions in establishing effect of toxicity on fish; solubility of 1016 as distinguished from other PCB's noted; connection between solubility and level of toxicity in fish.
9/27	4092-95	Nebeker	(Cross examination by Nickles:) Exchange relating to comparison of toxicity of 1016 and 1242; admission by Nebeker that transposition of figures has occurred in Exhibit F; request by Nickles for underlying data for clarification.
9/27	4122-23	Nebeker	(Cross examination by Nickles:) Exhibit E - exchange making point that the data compares toxicity of isomers, not the total compounds 1242 and 1016 themselves.
9/27	4123-33	Nebeker	(Cross examination by Nickles:) Discussion of Exhibits F and G, as comparisons of toxicity in 1242 and 1016, in terms of

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			their methodology, testing conditions and results; EPA expected survival rate; distinctions drawn between different arochlors used.
9/27	4172-77	Nebeker	(Cross examination by Nickles:) Discussion of survival, mortality and reproduction in Columbia study, Exhibit B, table 5, and Exhibit G - clear distinction drawn between effects of different arochlors; 1016 control shows higher mortality than test at 28.5 ppb., 1016 control and test at 15.7 ppb. have same mortality rate.
9/27	4177-81	Nebeker	(Cross examination by Nickles:) Propositions made by Nebeker in testimony reviewed one by one to establish that 1016 was not studied, or that clear differences in results occur for different arochlors at different solubilities or that testing conditions were somewhat uncontrolled, or that needed back-up data has not been provided.
9/28	280	Nebeker	(Redirect by Hall:) Statement by Nebeker that 1242 and 1016 are very similar in chemistry and toxicity (referring to new data submitted (EPA 13) as requested by Nickles.)
9/28	281	Nebeker	(Question by Judge Finch:) Judge Finch asks Nebeker whether EPA 13 mentions 1016; Nebeker replies that it does not.
9/28	293-94	Nebeker	(Redirect by Hall:) Clarification of solubility levels for the record of 1221, 1016, and 1242.
9/28	326-27	Nebeker	(Recross by Nickles:) Ateempt to clarify specific solubility of 1221. Point made that solubility is difficult to establish.
9/28	347-51	Nebeker	(Recross by Nickles:) EIA - Exhibit 3 entered into evidence, "Comparative toxicity of arochlor 1016 and 1242, to flag fish and flat head minnows," Herman and Pugilisi. Discussion of study (undated) that reports

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			no information available on comparative toxicities of 1016 and 1242. Results with flag fish: neither arochlor affected survival at level tested; results with minnows - mortality rate for 1016 at control level.
9/28	431	Munson	(Cross examination by Wills:) In question about results of experiment on chlorodane, distinction drawn between 1016 and 1242, and the other arochlors.
9/29	461-63	Veith	(Cross examination by Wills:) Exchange pointing out that separating individual arochlors in residue is difficult because different PCB's break down into same isomers.
9/29	501	Veith	(Cross examination by Wills:) Discussion of bio-concentration testing and graphing procedures - variability expected between accumulations of different PCB's because PCB's are very different in makeup.
9/30	670-71	Hansen	(Cross examination by Wills:) Exchange establishing sensitivity of sheepshead minnow to 1254 and the greater magnitude of dosage of 1016 in the test.
10/5	761-62	Rizzo	(Recross by Wills:) Question on termination changes for leased adsorption devices.
10/12	781-816	Young	(Voir dire by Rosenthal:) Questions relating to relevance of DDT to the proceeding--similarity of characteristics to arochlors 1242 and 1245 (emission rates, quantities, fall out): Rosenthal motion to strike (discussion of intercalibration)
10/12	817-22	Young	(Cross examination by Glenn:) Discussion relating to mass omission levels for DDT and 1254 (correlation betwe[redacted]declining input into water stream and rate of emission - Ocean plan as an example); Question of whether further restrictions are necessary considering decrease in rate of accumulation elicits affirmative response from Dr. Young.

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10/12	822-58 861-865	Young	(Cross examination by Rosenthal:) Point made that PCB intercalibrations have been made on 1242 and 1254, but not 1016: 1016 can not be distinguished from 1242 in samples due to large quantities of DDT's and 1254 in the water; differences in measurement and reporting discussed; discussion of tests on Dover sole reported in EPA Exhibit P; questions relating to sampling process for Exhibit P; questions relating to sampling process for Exhibit P data; ocean water measurement methodology not available until very recently (problems cited: contamination) trawling patterns; populations of sole represented.
10/12	874-885	Young	(Cross examination by Rosenthal:) Discussion of Young affidavit (EPA Exhibit P) establishes again, that 1016 can not be distinguished from 1242; Exhibit J of affidavit: purpose--to see if fin erosion disease could be induced in the laboratory--conclusion: bottom contaminants not PCB's are responsible: Motion to strike references to DDT enumerated throughout testimony; Young defense of germaness of DDT material.
10/12	886-895	Young	(Re-direct by Michelet:) Discussion of the relevance of DDT studies to the proceeding (in their role as an analogy).
10/12	905-12	Gelboin	(Cross-examination by Rosenthal:) Discussion of Exhibit B of affidavit to establish which PCB's were used in testing MFO's, steroids--Gelboin indicates that 1254 was used although different arochlors will produce similar enzyme induction.
10/12	918-24	Gelboin	(Cross examination by Rosenthal:) Continued discussion of the difference in effects of 1016 and 1242 on enzyme reduction in rats; liver porferia also induced at a lower level of 1242 than 1016.
10/12	933-	Gelboin	(Recross by Rosenthal:) Discussion of relative levels of chlorination: PCB's used

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			in Ito article, (Criteria doc. Ref. #26) and 1016 and 1242.
10/13	963-964	Armstrong	(Recross by Rosenthal:) Exchange on the subject of distinguishing between arochlors in results of perchlorination tests.
10/14	1066-76	Riseborough	(Cross examination by Rosenthal:) Discussion of distinctions between different arochlors on subjects of transport and toxicity; discussion of testing methods--techniques, level of measurement, problems of interference.
10/15	1202-08	Allen	(Cross examination by Rosenthal:) Discussion of various isomers of arochlor 1248; metabolites.
10/15	1245-50	McNulty	(Recross by Rosenthal:) Exchange establishing high toxicity of particular isomers; establishes that none of these studies were made with 1016; PCDF's and TCDF's as contaminants.
10/19	1419-26	Nisbet	(Cross examination by Wills:) Exchange relating to components of various arochlors: PCDF's, TCDF's, isomers (referring to criteria document).
10/19	1478-89	Nisbet	(Cross examination by Rosenthal:) Discussion of effects of PCB's on non-human primates, (as presented in criteria document studies) minks; mention of table showing no 1016 studies; discussion of differences between effects of 1242 and 1016 (p. 1487).
10/19	1519-27	Nisbet	(Cross examination by Rosenthal:) Exchange comparing toxicity of 1016 and 1242 in all studies known to Nisbet; impairment of reproduction.
10/21	1744	Nisbet	(Recross by Rosenthal:) Comment made several times by Nisbet that arochlors 1242 and 1016 are almost identical in composition.

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10/22	2044	Guarraia	(Redirect by Rosenthal:) Questions concerning different effects and levels of accumulation for different arochlors.
10/12	929-33	Gelboin	(Redirect by Chang:) Referring to criteria document Ref. #245, point made that study concludes that effects of 1016 and 1242 become more similar after six months; violation of human integrity viewed as generally detrimental.

DISCUSSION OF BIOACCUMULATION

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9/27	4155	Nebeker	(Cross examination by Nickles:) Exchange on Exhibit C, table 3 - fathead minnows and 1242 at a concentration 270,000 times that of water (.86 ppb.) (Develops into explanation of methodology)
9/27	4168-72	Nebeker	(Cross examination by Nickles:) Exchange on establishement of ambient water quality figures: comparison of Nebeker's 270,000 and Veith's 50,000, emphasizing the questionably validity of Nebeker's base figure of 410 as out of line with other data in table, and experiment for 1242 unreplicated.
9/27	4186	Nebeker	(Cross examination by Wills:) In a series of questions on testing procedures, Nebeker states that he does not know the effect of termperature on PCB's and their rate of bio-accumulation.
9/28	295-392	Nebeker	(Recross by Nickles:) Exchange on the subject of bio-concentration and the 270,000 figure. Nickles looking for confirmation of 410 figure or further reason to believe it "out of line." Data derived from improved technology to be sought from Dr. Veith; reference to discrepancy in Nebeker 270,000 and Veith 50,000 (Nickles request for background data).
9/28	335-342	Nebeker	(Recross by Nickles:) Comparison of bio-concentration test results on 1242.
9/29	493	Veith	(Cross examination by Wills:) Exchange establishing method of calculating concentration, the bio-accumulation factor.
9/29	527-528	Veith	(Cross examination by Wills:) Statement by Veith that tests in Exhibit G were made to prove that PCB's "can bio-accumulate they are not irreversibly bound."
9/29	573-576	Veith	(Cross examination by Wills:) Discussion of the effect of time on bio-accumulation.
9/29	579-581	Veith	(Cross examination by Glenn:) Discussion of API objection to bio-accumulation figures.

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			used in proposal..
9/29	581-586	Veith	(Cross examination by Rosenthal:) Exchange relating to source of Veith bio-accumulation figure (beginning with background on methodology).
10/12	773-776		(Statement by Hall:) Report on data obtained from Dr. Nebeker to support affidavit, specifically Exhibit F.
10/12	865-874	Young	(Cross examination by Rosenthal:) Bio-accumulation figures for PCB's in Dover sole; relationship betwen PCB level and emission levels; relationship between level of bio-accumulation and sediment uptake; Rosenthal question on correlation of accumulations in sediment and benthic organisms; despite higher emissions of 1242, fish tested showed higher concentrations of 1245.
10/13	992-993	Mauk	(Redirect by Mr. Hall:) Questions asking for basis on which Mauk testifies level of treatment.
10/19	1503-14	Nisbet	(Cross examination by Wills:) Reference to Nebeker figures on bio-accumulation (fathead minnow experimental data)--comparison with other bio-accumulation figures; questions pertaining to methods used in study and interpretation of data.
10/19	1517-1519	Nisbet	(Cross examination by Glenn:) Discussion of how 274,000 figure was obtained.
10/20	1542-61; 1568-82	Nisbet	(Cross examination by Hellegers:) Questions on margin of safety with regard to acceptable level of PCB's--bio-accumulation in men, birds, fish, mink; establishment of ambient water-criterions question of criteria authorship.
10/20	1601-39	Nisbet	(Cross examination by Hellegers:) Exchange concerning draft on criteria selection (EDF Exhibit #4) and establishment of criterion; bio-accumulation as discussed in criteria

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			document (ample margin of safety); caluclation to 274,000; confidence in bio-accumulation factors; difference between bio-accumulation in nature and the lab; solubility of PCB's; mixing zone defined.
10/20	1670-93	Nisbet	(Cross examination by Hellegers and Highland:) Discussion of human intake of PCB's through fish; level of fish consumption; maximum level of PCB consumption--maximum acceptable level; calculation of level of contamination (through bio-accumulation).
10/20	1702-21	Nisbet	Comparison of Nisbet figures on cancer projections to those in EDF objections; relationship between level of fish consumption and cancer--affect of bio-accumulation factor on these computations.
10/20	1725-27	Nisbet	(Redirect by Hall:) Discussion relating to establishemnt of criterion levels; establishment of no-effect levels.
10/21	1750-54	Nisbet	(Recross by Rosenthal:) Questions pertaining to the reliability of the bio-accumulation figure 3×10^6 (for fish, see EDF - Exhibit #4); typical bio-accumulation factor for 1016 estimated by Nisbet at 1×10^6 (one million); figures estimated for fresh water.
10/21	1855-63	Guarraia	(Cross examination by Rosenthal:) Questions pertaining to sources of bio-accumulation data in criteria document.
10/21	1878-87	Guarraia	(Cross examination by Rosenthal:) Questions concerning establishment of criterion level for bio-accumulation.
10/21	1903-09	Guarraia	(Cross examination by Hellegers:) Statement by witness that his understanding of margin of safety does not include considerations of technology or cost; establishment of criterion level for margin of safety, taking into account bio-accumulation potential.

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10/22	1911-16	Guarraia	(Cross examination by Hellegers and Highland:) Discussions of the witness' opinion of Dr. Nesbit's calculations gone through on record, relating to bio-accumulation and effect level.

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TOXICITY

Volume Date	Page	Witness	Summary
9/27	4074-87	Nebeker	(Cross examination by Nickles:) Discussion of bio-assay methods and conditions in establishing effect of toxicity on fish; solubility of 1016 as distinguished from other PCB's noted; connection between solubility and level of toxicity in fish.
9/27	4090	Nebeker	(Cross examination by Nickles:) Further discussion of bio-assay methods used in establishing toxicity.
9/27	4092-95	Nebeker	(Cross examination by Nickles:) Exchange relating to comparison of toxicity of 1016 and 1242; admission by Nebeker that transposition of figures has occurred in Exhibit F; request by Nickles for underlying data for clarification.
9/27	4099	Nebeker	(Cross examination by Nickles:) Exchange relating to toxicity tests on Daphnia; 1254 established as PCB most toxic to Daphnia under continuous flow conditions.
9/27	4122-23	Nebeker	(Cross examination by Nickles:) Exhibit E - exchange making point that the data compares toxicity of isomers, not the total compunds 1242 and 1016 themselves.
9/27	4123-33	Nebeker	(Cross examination by Nickles:) Discussion of Exhibits F and G, as comparisons of toxicity in 1242 and 1016, in terms of their methodology, testing conditions and results; EPA expected survival rate; distinctions drawn between different arochlors used.
9/27	4144-46	Nebeker	(Cross examination by Nickles:) Discussion of toxicity in fish - solubility of PCB established as a factor of some importance in a continuous flow condition.
9/27	4149-53	Nebeker	(Cross examination by Nickles:) Discussion of study on arochlor 1248 done by Columbia Fish Pesticide Research Lab - results shows little difference between treated and untreated fish over extended experiment.

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9/27	4172-77	Nebeker	(Cross examination by Nickles:) Discussion of survival, mortality and reproduction in Columbia study, Exhibit B, table 5, and Exhibit G - clear distinction drawn between effects of different arochlors: 1016 control shows higher mortality than test at 28.5 ppb., 1016 control and test at 15.7 ppb. have same mortality rate.
9/28	280	Nebeker	(Redirect by Hall:) Statement by Nebeker that 1242 and 1016 are very similar in chemistry and toxicity (referring to new data submitted (EPA 13) as requested by Nickles).
9/28	347-51	Nebeker	(Recross by Nickles:) EIA - Exhibit 3 entered into evidence, "Comparative toxicity of arochlor 1016 and 1242, to flag fish and flat head minnows," Herman and Pugilisi. Discussion of study (undated) that reports no information available on comparative toxicities of 1016 and 1242. Results with flag fish neither arochlor affected survival at level tested; results with minnows - mortality rate for 1016 at control level.
9/30	656	Hansen	(Cross examination by Rosenthal:) Exchange on importance of specific testing procedures in establishing toxicity.
9/30	659-660	Hansen	(Cross examination by Rosenthal:) Definition of bio-concentration.
9/30	660-669	Hansen	(Cross examination by Rosenthal:) Toxicity level testing ; discussion of bio-assays in Exhibit 7; discussion leading to conclusion drawn from exhibit data that 1016 is less toxic than 1254.
10/14	998-1008	Ringer	(Cross examination by Rosenthal:) Discussion of rancidity in fresh water fish.
10/14	1050-52	Ringer	(Redirect by Chang:) Question clarifying use of data in cross-examination by Rosenthal.
10/14	1066-76	Riseborough	(Cross examination by Rosenthal:) Discussion of distinctions between different

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			arochlors on subjects of transport and toxicity; discussion of testing methods--techniques, level of measurement, problems of interference.
10/19	1519-27	Nisbet	(Cross examination by Rosenthal:) Exchange comparing toxicity of 1016 and 1242 in all studies known to Nisbet; impairment to reproduction.
10/20	1731-33	Nisbet	(Redirect by Hall:) Questions concerning toxicity in trout; effect on reproduction.

IC.(2)

DISCUSSION OF EFFECT ON FISH DIRECTLY REPRODUCTION

Volume Date	Page	Witness	Summary
9/27	4101-16	Nebeker	(Cross examination by Nickles:) Exchange relating to bio-assay reported in Exhibit B, table 5; Survival and Reproduction of Gammarus; infusion of 2.8 ppb. of 1242 resulted in higher rate of survival than without 1242.
9/27	4117-121	Nebeker	(Cross examination by Nickles:) Discussion of bio-assay on reproduction using arochlors 1254 and 1242.
9/28	290-291	Nebeker	(Redirect by Hall:) Clarification of objectives for mortality/reproduction experiment, Exhibit D, table 5.
9/28	314-26	Nebeker	(Recross by Nickles:) Exhibit B, table 5: Survival and Reproduction - attempt to clarify real objective of test, proposition 1.
10/20	1731-33	Nisbet	(Redirect by Hall:) Discussion concerning toxicity in trout; effect on reproduction.

ID
DISCUSSION OF PCB HARM IN MAMMALS

Volume Date	Page	Witness	Summary
10/12	905-12	Gelboin	(Cross examination by Rosenthal:) Discussion of Exhibit B of affidavit to establish which PCB's were used in tesing MFO's, steroids--Gelboin indicates that 1254 was used although different arochlors will produce similar enzyme induction.
10/20	1737-39	Nisbet	(Redirect by Hall:) Description of chronic studies on mammals using 1016.

ID.(1)

DISCUSSION OF PCB HARM IN MAMMALS
Rats

Volume Date	Page	Witness	Summary
10/12	913-915	Gelboin	(Cross examination by Rosenthal:) Referring to criteria document (Ref. #245: "A Comparative Study of Two Polychlorinated Biphenyl Mixtures, Arochlor 1242 and 1016, On Induction of Hepathatic and Drug Metabolizing Enzymes,") and study by Goldstein cited in Gelboin affidavit, results of enzyme induction in rats compared: 1016 less effective that 1254 on female rats (Gelboin agrees that study in ref. #245 does indicate this, asserting that male rats are more sensitive.
10/19	1428-41	Squire	(Cross examination by Rosenthal:) Discussion of rat lesion workshop; validity of generalizing results to other animals; cancerous states observed; relationship to Kimbrough study; Squire aware of other PCB/ Cancer studies in process, none using 1016 or 1242.
1021	1746-50	Nisbet	(Recross by Rosenthal:) Discussion of MFO's and levels of PCB's at which carcinogenic symptoms were detected in rats and mice; discussion of hyperplastic nodules.
10/21	1868-70	Guarraia	(Cross examination by Rosenthal:) Discussion of enzyme induction in rats (Ref. #243; criteria document).

ID.(2)

DISCUSSION OF PCB HARM IN MAMMALS
Minks

Volume Date	Page	Witness	Summary
10/12	915-918	Gelboin	(Cross examination by Rosenthal:) Discussion of Ref. #273, "Inhibitory Effects of Polychlorinated Biphenyls on Limer Tumor Regenesis in Rate treated with Three Methyl, Four Dimethyl Azo Benzine": PCB in capacity as enzyme inducer had effect of inhibiting carcenogenesis; witness agrees with plausibility of result, indicates that other enzyme inducers can have a similar effect; PCB-like enzyme inducers can also encourage carcenogenesis and have been proven to do so in other experimental conditions.
10/12	918-24	Gelboin	(Cross examination by Rosenthal:) Continued discussion of the difference in effects of 1016 and 1242 on enzyme reduction in rats; liver porferia also induced at a lower level of 1242 than 1016.
10/14	1008-10	Ringer	(Cross examination by Rosenthal:) Question of whether arochlor 1016 in involved in studies referred to by Ringer; request for background data.
10/14	1011-29	Ringer	(Cross examination by Rosenthal:) Discussion of tests run by Dr. Ringer; statement of objectives highlights fact that 1016 was not among arochlors used in testing; discussion of methodology and procedure used in testing with minks; relationship between toxicity and chlorine content; difference in results to be expected in acute and chronic toxicity testing; reference to 1972 (73) study showing no adverse effects with arochlor 1016 diet fed at 2/ppm.
10/14	1029-47	Ringer	(Cross examination by Rosenthal:) Exchange on effect of PCB's on mink reproductions: review of test results to ascertain statistical significance of results (figures for 2/ppm and 10/ppm do not show statistically significant variations from control).
10/14	1047-49	Ringer	(Cross examination by Rosenthal:) Discussion of mink testing methodology.

ID.(3)

DISCUSSION OF PCB HARM IN MAMMALS
Monkeys

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10/15	1095-1167	Allen	(Cross examination by Highland:) Discussion of toxicity of PCB's on monkeys - quantification of dosage; effects of exposure to PCB's; comparison to effects in Japanese women (similarity of toxication effects, tissue concentration); concentrations in breast milk; effect of PCB's in breast milk on nursing young.
10/15	1180-86	Allen	(Cross examination by Rosenthal:) Questions pertaining to methods used in monkey testing described in affidavit.
10/15	1186-1201	Allen	(Cross examination by Rosenthal:) Discussion of EIA Exhibit 5 (study concerning biological response of non-human primates to PCB's); arochlor 1248 established as PCB used; compared to Highland study; different modes of administration lead to different effects.
10/15	1203-08	Allen	(Cross examination by Rosenthal:) Discussion of various isomers of arochlor 1248; metabolites.
10/15	1210-21	Allen	(Redirect by Chang:) Questions concerning the validity of a comparison of test results between species; effect of contaminants on test results; quantities of PCDF's in arochlors 1248 and 1254.
10/15	1221-24	Allen	(Recross by Highland:) Levels of PCB's in monkey tests.
10/15	1228-43	McNulty	(Cross examination by Rosenthal:) Discussion of experiments with monkeys: methodology, results of biopsies, exposure-accumulation ratios discussed; comparison of results to other mammals.
10/15	1244-45	McNulty	(Redirect by Chang:) Questions concerning toxicity of 1242 and its effects on Rhesus monkeys.

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DISCUSSION OF PCB HARM IN MAMMALS
OTHER OR SEVERAL

Volume Date	Page	Witness	Summary
9/29	635-642	Brungs	(Cross examination by Hellegers:) Hellegers quoting from EDF, Exhibit #1, which mentions that PCB's may have adverse effects on fish, shellfish and therefore, be harmful to man; mentions carcionogenic toxic substances - all related to appropriateness of mixing zones for substances that bioaccumulate or persist.
10/12	925-27	Gelboin	(Cross examination by Rosenthal:) Discussion of PCB's as "violators of the integrity of the human organism."
10/12	929-33	Gelboin	(Redirect by Chang:) Referring to criteria document Ref. #245, point made that study concludes that effects of 1016 and 1242 become more similar after six months; violation of human integrity viewed as generally detrimental.
10/14	1058-66	Risebrough	(Cross examination by Rosenthal:) Discussion of tests relating to insecticide toxicity effects on wild birds; quantities of PCB's found in European and American samples; dibenzofurains; research relating to partitioning of PCB compounds.
10/15	1170-77	Allen	(Cross examination by Rosenthal:) Discussion of nature of intoxicant that poisoned Japanese women (PCB, PCDF).
10/15	1228-43	McNulty	(Cross examination by Rosenthal:) Discussion of experiments with monkeys: methodology, results of biopsies, exposure-accumulation ratios discussed; comparison of results to other mammals.
10/19	1442-49	Nisbet	(Cross examination by Wills:) Discussion of chickens and PCB tests - chicken aedema disease
10/19	1449-68	Nisbet	(Cross examination by Rosenthal:) Discussion of Criteria Document, Section 37 (Toxic effects in mammals - acute and subacute studies); methodology of various tests (Abrahamson's rhesus monkeys, Allen and

Volume Date	Page	Witness	Summary
			McNulty; minks and TCDD; production of PCDF's' chronic effects of PCB's on mammals and their reproduction; rats.
10/19	1478-89	Nisbet	(Cross examination by Rosenthal:) Discussion of effects of PCB's on non-human primates (as presented in criteria document studies); minks; mention of table showing no 1016 studies; discussion of differences between effects of 1242 and 1016 (p. 1487).
10/20	1639-70	Nisbet	(Cross examination by Highland:) Exchange relating to the establishment of a no effect level for toxic effects of PCB's; safety margin or level (1-200 or greater?).
10/21	1740-46	Nisbet	(Recross by Rosenthal:) Discussion of tests reported in Nisbet affidavit, (EDF Exhibit #4), V. 2 pertaining to toxicity in mammals --questions narrow focus to 1016; comment made several times by Nisbet that 1016 is almost identical in composition to 1242.
10/21	1754	Nisbet	(Recross by Rosenthal:) Reference to history of human exposure to PCB's and purpose of hearing.
10/21	1831-54	Guarraia	(Cross examination by Rosenthal:) Guarraia cites sections of the criteria document that refer to "chronic effects of PCB's in man at extremely low levels;" ample margin of safety--criteria for establishment, calculations behind it.
10/21	1864-65	Guarraia	(Cross examination by Rosenthal:) Questions concerning the effects of PCB's passed to mammals through the food chain.
10/21	1865-67	Guarraia	(Cross examination by Rosenthal:) Exchange relating to study on Rhesus monkeys (p. 179 criteria document)--toxic effect of PCB'
10/21	1870-78; 1883	Guarraia	(Cross examination by Rosenthal:) General questions relating to location of data in criteria document (chickens, dogs).
10/21	1903-09	Guarraia	(Cross examination by Hellegers:) State-

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			by witness that his understanding of margin of safety does not include considerations of technology or cost; establishment of criterion level for margin for safety, taking into account bio-accumulation potential.
10/22	2015-22	Guarraia	(Cross examination by Highland:) Questions pertaining to ingestion of contaminated oil in Yusho incident.

DISCUSSION OF EFFECT OF ACCUMULATION IN SEDIMENT ON UPTAKE

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9/29	599-607	Callaway	(Cross examination by Rosenthal:) Questions on witness' knowledge of solubility of PCB's.
10/12	865-874	Young	(Cross examination by Rosenthal:) Bio-accumulation figures for PCB's in Dover sole; relationship between PCB levels and emission levels; relationship between level of bio-accumulation and sediment uptake; Rosenthal question on correlation of accumulations in sediment and benthic organisms; despite higher emissions of 1242, fish tested showed higher concentrations of 1245.
10/13	950-60	Armstrong	(Cross examination by Rosenthal:) Discussion of Armstrong research on PCB accumulation in sediment: test methodology and procedure; discussion of data on degradation of PCB's in sediment.
10/13	961	Armstrong	(Redirect by Michelet:) Question pertaining to preferability of perchlorincation techniques.

II.A

ECONOMIC ISSUES
COST OF CONTROL TECHNOLOGY

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10/5	734-35	Rizzo	(Cross examination by Glenn:) Discussion of cost of carbon adsorption facility.
10/5	754-56	Rizzo	(Redirect by Hall:) General cost estimates for adsorption systems (reference to data in EPA - Exhibit 4).
10/5	761-62	Rizzo	(Recross by Wills:) Question on termination changes for leased adsorption devices.
10/19	1471-74		(Question by Rosenthal to Hall:) Discussion of time-table for economic analysis to be submitted to OMB.

II.A

ECONOMIC ISSUES
COST OF CONTROL TECHNOLOGY

Volume Date	Page	Witness	Summary
10/5	734-35	Rizzo	(Cross examination by Glenn:) Discussion of cost of carbon adsorption facility.
10/5	754-56	Rizzo	(Redirect by Hall:) General cost estimates for adsorption systems (reference to data in EPA - Exhibit 4).
10/5	761-62	Rizzo	(Recross by Wills:) Question on termination changes for leased adsorption devices.
10/19	1471-74		(Question by Rosenthal to Hall:) Discussion of time-table for economic analysis to be submitted to OMB.

II.B

ECONOMIC ISSUES
CONNECTED EXPENSES

Volume Date	Page	Witness	Summary
9/29	467-68	Veith	(Cross examination by Wills:) High cost of testing samples for PCB's discussed.
10/21	1802-19	Sargent	(Cross examination by Rosenthal:) Questions pertaining to control technology cost estimate work done by Versar and reported in Task 2 report: (total capital investment, annual costs); discussion of specific plants used in data tables; attention drawn to similarity between control technology reported and control technologies listed in Fed. Reg. proposal as ones that might achieve desired results; questions concerning GE control system; discussion of EPA contract with Versar out of which Task 2 Report evolved; discussion of ctonrol technologies (pre-treatment, multi-media filter).
10/21	1819	Sargent	(Redirect by Hall:) Discussion of feasibility of zero discharge.
10/22	1916-27; 1932-33	Guarraia	(Cross examination by Hellegers and Highland:) Dicsucssion of margin of safety, computation of bio-accumulation figures and establishement of criterion level for an "ample margin of safety," references to Guarraia discussions of margin with Veith.
10/22	1948-2000	Guarraia	(Cross examination by Hellegers and Highland:) Discussion of bio-accumulation factors in Federal Register notice and Criteria Document (bio-accumulation in natural environment can be much higher than in lab tests; one ppt. as ample margin of safety); Hellegers questions concerning changes in criteria document--would Guarraia agree to statements containing these modifications; questions concerning the validity of laboratory experiments on bio-accumulation because of the natural factors missing in experiments (uptake through cannibalism, hot spots).
10/22	2023-31	Guarraia	(Cross examination by Highland:) Discussion of factors used in establishing the

Volume Date	Page	Witness	Summary
			criterion level (specifically toxicity and safety factors); establishment of no effect level; FDA action level.
10/22	2031-41	Guarraia	(Cross examination by Highland:) Discussion of bio-accumulation in rats, trout and mink based on data presented in the criteria document.
10/22	2041-42	Guarraia	(Redirect by Hall:) Question eliciting answer establishing that Dr. Cooper of of NCI at no time expressed view that .001 micrograms per liter did not provide an ample margin of safety.
10/22	2044-49	Guarraia	(Redirect by Rosenthal:) Questions concerning sources used in establishement of criterion level.
10/22	2051-53	Guarraia	(Recross by Hellegers:) Questions relating to language in which Dr. Cooper agreed to ample margin of safety.

II.C

ECONOMIC ISSUES
Substitutes for PCB's--What and How Available

Volume Date	Page	Witness	Summary
10/13	975-976	Mauk	(Cross examination by Ms. Hall:) Discussion of PCB substitute most receptive to ultraviolet ozonation treatment.
10/21	1766-90	Sargent	(Direct by Hall:) Discussion of Versar project to study PCB treatment--historical background, present status, ideas for future (specifics discussed: separation of contaminated water, GE treatment of contaminated water, GE's contract with Calgon for a carbon adsorption process, areas of potential leakage of PCB's reliability and verification of GE report).

II.E

CRITICISMS OF CONTROL TECHNOLOGY

Volume Date	Page	Witness	Summary
10/21	1790-1800	Sargent	(Cross examination by Ms. Hall:) Discussion of control technology and to what level it can be effective: questions on whether required levels could not be lower than proposed--Sargent states that lower levels are possible but do not take into consideration factors such as time, money, etc.; Sargent states that both carbon adsorption and ultraviolet-assisted ozonation are capable of controlling PCB's to levels below one ppb. (Task 2 report cited for data); no facts available on possibility of control technology needed for PCB substitutes.

II.E.(1)

CRITICISMS OF CONTROL TECHNOLOGY
Carbon Adsorption

Volume Date	Page	Witness	Summary
10/5	696-722	Rizzo	(Cross examination by Garrett:) Discussion of carbon isotherm testing: results that can be expected; preferability of columnar pilot study follow-up; procedure and methods; nature of Calgon adsorption systems; reactivation of carbon.
10/5	722-24	Rizzo	(Cross-examination by Garrett:) Mechanical problems in carbon adsorption systems.
10/5	724-27	Rizzo	(Cross examination by Ms. Hall:) Degree to which carbon adsorption quantifications are made in affidavit; relationship between contact time and level of removal.
10/5	727-734	Rizzo	(Cross examination by Wills:) Carbon adsorption methodology; experience with arochlors.
10/5	756-59	Rizzo	(Redirect by Garrett:) Questions relating to possible contamination of capacitator liners or adsorption liners.
10/5	760-761	Rizzo	(Recross by Wills:) Questions pertaining to lead-time necessary for adsorption device implementation; incineration of PCB's.
10/5	761-62	Rizzo	(Recross by Wills:) Question on termination charges for leased adsorption devices.
10/5	640-54	Rizzo	(Redirect by Hall:) Reliability of carbon adsorption test results (referring back to Garrett questions on overstatement of carbon removal capabilities); problems related to suspended solids; controls for biological activity; engineering problems-hydrochloric acid; prevention of system upsets.

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10/5	696-722	Rizzo	(Cross examination by Garrett:) Discussion of carbon isotherm testing: results that can be expected; preferability of columnar pilot study follow-up; procedure and methods; nature of Calgon absorption systems; reactivation of carbon.
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10/5	724-27	Rizzo	(Cross examinatio by Ms. Hall:) Degree to which carbon adsorption quanitifcations are made in affidavit; relationship between contact time and level of removal.
10/5	727-34	Rizzo	(Cross examination by Wills:) Carbon adsorption methodology; experience with arochlors.
10/5	756-59	Rizzo	(Redirect by Garrett:) Questions relating to possible contamination of capacitator liners or adsorption liners.
10/5	760-61	Rizzo	(Recross by Wills:) Questions pertaining to lead-time necessary for adsorption device implementation; incineration of PCB's.
10/5	761-62	Rizzo	(Recross by Wills:) Question on termination charges for leased adsorption devices.
10/5	740-54	Rizzo	(Redriect by Hall:) Reliability of carbon adsoprtion test results (referring back to Garrett questions on overstatement of carbon removal capabilities); problems related to suspended solids; controls for biological activity; engineering problems-hydrochloric acid; prevention of system upsets.

II.E(2)

CRITICISMS OF CONTROL TECHNOLOGY
Ultraviolet-assisted Ozonation

Volume/ Date	Page	Witness	Summary
10/13	970-77	Mauk	(Cross examination by Ms. Hall:) Discussion of ultraviolet ozonation as a treatment for PCB's; difference in effectiveness for different arochlors; testing methodology and procedure (level of detectability of PCB's); effectiveness of ultraviolet ozonation on PCB substitutes; lead time for set-up (1 year); degree of treatment possible (0.1/ppb.).
10/13	978-85	Mauk	(Cross examination by Rosenthal:) Questions relating to patent applications for ultraviolet ozonation treatment process; practical experience in ultraviolet ozonation systems; test methodology.
10/13	985-86	Mauk	(Cross examination by Glenn:) Discussion of ultraviolet alone as a treatment for PCB's.
10/13	987-991	Mauk	(Redirect by Hall:) Discussion of degree of treatment possible for ultraviolet ozonation process; transfiguration of process and results to larger scale; potential effectiveness of process for arochlors 1016 and 1242.

III.B

CANCER HAZARD
Squire Testimony

Volume Date	Page	Witness	Summary
10/19	1428-41	Squire	(Cross examination by Rosenthal:) Discussion of rat lesion workshop: validity of generalizing results to other animals; cancerous states observed; relationship to Kimbrough study; Squire aware of other PCB/ cancer studies in process, none using 1016 or 1242

III.C

CANCER HAZARD
Other Discussion of Cancer

Volume Date	Page	Witness	Summary
10/12	915-918	Gelboin	(Cross examination by Rosenthal:) Discussion of Ref. #273, "Inhibiting Effects of Polychlorinated Biphenyls on Limer Tumor Regenesis in Rats treated with Three Methyl, Four Dimethyl Azo Benzine," PCB in capacity as enzyme inducer had effect of inhibiting carcinogenesis; witness agrees with plausibility of result, indicates that other enzyme inducers can have a similar effect; PCB-like enzyme inducers can also encourage carcinogenesis and have been proven to do so in other experimental conditions.
10/12	924	Gelboin	(Cross examination by Rosenthal:) Gelboin makes a clarification that the presence of an enzyme inducer in a population will have some effect on the incidence of cancer.
10/19	1489-1503	Nisbet	(Cross examination by Wills:) Discussion of what studies indicated carcinoma symptoms from PCB's; formation of PCDF's; human exposure to TCB's.
10/20	1693-98	Nisbet	(Cross examination by Hellegers and Highland:) Discussion of the relationship between establishement of acceptable levels of toxicity and carcinogenic effects; objection to introduction of letter relating to occupational hazards (cancer & PCB's) sustained.
10/20	1702-21	Nisbet	(Cross examination by Hellegers and Highland:) Discussion of Nisbet familiarity with linear extrapolation model; belief that PCB's do have carcinogenic effects expressed by Nisbet; comparison of Nisbet figures on cancer projections to those in EDF objections; relationship between level of fish consumption and cancer--effect of bio-accumulation factor on these computations; ample margin of safety.

Volume Date	Page	Witness	Summary
10/20	1734-37	Nisbet	(Redirect by Hall:) Exchange regarding arochlors that have a carcinogenic effect (Kanechlor 500, arochlor 1260, KC 400, arochlor 1242 and 1254).
10/21	1744	Nisbet	(Recross by Rosenthal:) Nisbet remark that tumors have been produced in rats using 1242, substance nearly identical to 1016 in composition.
10/21	1746-50	Nisbet	(Recross by Rosenthal:) Discussion of MFO's and levels of PCB's at which carcinogenic symptoms were detailed in rats and mice; discussion of hyperplastic nodules.
10/21	1827	Guarraia	(Cross examination by Rosenthal:) In answer to a question on his degree of familiarity with literature on cancer formation, the witness draws the connection to enzyme reduction.
10/22	1933-48	Guarraia	(Cross examination by Hellegers and Highland:) Discussion of criterion level of one part per trillion: Highland asks if Guarraia and Veith took carcinogenicity into account when arriving at this figure. Guarraia replies that they did not, however, Guarraia asserts that he believes this margin to provide safety considering carcinogenic effects; discussion of expert opinions on carcinogenic effects: Veith, Marcus, Kopp and Gulf Breeze Laboratory satisfied with one ppt. figure; discussion of Federal Register language relating to carcinogenesis.
10/22	2003-13	Guarraia	(Cross examination by Highland:) Questions concerning statements on carcinogenicity of PCB's in the criteria document; discussion of work by the National Cancer Institute on PCB's; consideration of cancer in setting criterion level for PCB's--Hoehl Linear Extrapolation Model.

III.C

Volume Date	Page	Witness	Summary
10/22	2041-42	Guarraia	(Redirect by Hall:) Question eliciting answer establishing that Dr. Cooper of NCI at no time expressed view that .001 micrograms per liter did not provide an ample margin of safety.
10/22	2049-51	Guarraia	(Redirect by Rosenthal:) Questions relating to experts on carcinogenicity, specifically Dr. Nesbit's inclusion among them.