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UNITED STATES ATOMIC ENERGY COMMISSION

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IN THE MATTER OF:

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.

(Indian Point Station, Unit No. 2)

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Docket No. 50-247

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UNITED STATES OF AMERICA

ATOMIC ENERGY COMMISSION

In the matter of:

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.

(Indian Point Station, Unit No. 2)

Docket No. 50-247

Room 532
Sixth and Pennsylvania Avenue, N. W.
Washington, D. C.

Wednesday, 10 January 1973

The above-entitled matter came on for further hearing, pursuant to notice, at 9 a.m.

BEFORE:

SAMUEL W. JENSCH, Esq., Chairman, Atomic Safety and Licensing Board.

DR. JOHN C. GEYER, Member.

MR. R. B. BRIGGS, Member.

APPEARANCES:

(As heretofore noted.)

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C O N T E N T S

WITNESS:	DIRECT	CROSS	REDIRECT	RECROSS
John R. Clark	7802	7806		

Exhibits

None.

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P R O C E E D I N G S

CHAIRMAN JENSCH: Please come to order. This proceeding is a further evidentiary session in the matter of Consolidated Edison Company of New York, Inc., Docket 50-247.

This session of the proceedings is convened in accordance with the order convening the proceeding, which was issued on December 15, 1972, which was the last day of the evidentiary session which was held in December of 1972. That order was reconfirmed by an order of the Atomic Safety and Licensing Board issued December 21, 1972, announcing further public hearings for this date and place. That order was given general public distribution, which included publication in the Federal Register as reflected by Volume 37 of the Federal Register, at page 28543, and the publication occurred on December 27, 1972. That order reconfirming and announcing a further public hearing for this date and place was also mailed to persons who had requested to be notified of further public hearings in this proceeding.

Appearances on behalf of the Applicant, I notice the presence of Messrs. Trosten, Cohen, and Sack. On behalf of the Regulatory Staff, Mr. Myron Karman. On behalf of the Hudson River Fishermen's Association, Mr. Macbeth. I note no other appearances at this time. If there are any others, they may so announce. I hear no such request.

At the session held on December 15, 1972, there

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was consideration given to the intended agenda for this session, which included, as I recall it, a proposed cross-examination of witnesses Clark and Aynsley. Is that still the agenda?

MR. TROSTEN: Yes, it is, Mr. Chairman.

MR. MACBETH: Yes.

CHAIRMAN JENSCH: I notice the presence of Dr. Clark here. I don't believe he has been sworn. Are you ready to proceed, Applicant?

MR. TROSTEN: Yes, I am.

CHAIRMAN JENSCH: Dr. Clark, will you come forward and be sworn, please.

Whereupon,

JOHN R. CLARK

was called as a witness on behalf of Intervenor, Hudson River Fishermen's Association, and, having been first duly sworn, was examined and testified as follows:

CHAIRMAN JENSCH: Do you have something in a preliminary way?

MR. MACBETH: Yes, I wanted to qualify Mr. Clark.

DIRECT EXAMINATION

BY MR. MACBETH:

Q Mr. Clark, I show you a document entitled, "Statement of Qualifications of John R. Clark." Was that prepared by you?

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A Yes.

Q Does it state your qualifications as a witness in this proceeding?

A Yes.

Q Do you wish to have it incorporated in the transcript as if read?

A Yes.

MR. MACBETH: May I ask to have the statement of qualifications incorporated in the transcript as if read.

CHAIRMAN JENSCH: Is there any objection to that request?

MR. TROSTEN: No objection.

MR. KARMAN: No objection.

CHAIRMAN JENSCH: The statement of qualifications of John R. Clark may be physically incorporated into the transcript and shall constitute his evidence.

MR. MACBETH: Thank you.

(The complete document follows.)

STATEMENT OF QUALIFICATIONS

OF

JOHN R. CLARK

I received my Bachelor of Science degree in Fishery Science from the University of Washington in 1949. I joined the Woods Hole Fisheries Laboratory in November 1949 where I conducted research in ichthyology and fisheries management through 1959. In 1960, I joined the United States Bureau of Sports Fisheries and Wildlife and was co-founder of the Sandy Hook Marine Laboratory in Sandy Hook, New Jersey. At that laboratory, I served as Assistant Director and conducted research in the ecology and life patterns of salt water fish, including striped bass, bluefish and fluke through September of 1970. Thereafter, I served as temporary curator of the New York Aquarium in Brooklyn, New York, from October 1970 to February 1971. I am past president and now Washington Director of the American Littoral Society, a conservation and natural history group, and a member of the American Association for the Advancement of Science, the American Fisheries Society and the Atlantic Fisheries Biologists. I am the author of the book entitled Fish and Man: Conflict in the Atlantic Estuaries, published by the American Littoral Society in 1967, and author-editor of the book entitled Sea Water Systems for Experimental Aquariums

published by the U.S. Department of the Interior in 1965. I am the author of fifty (50) scientific papers and reports, including "Thermal Pollution and Aquatic Life" published in Scientific American in March 1969.

I have had experience studying the fishes of the Hudson River and have published papers on Hudson River fish and fisheries: "Ecology of Anadromous Fish of the Hudson River." [Hearings before the Subcommittee on Fisheries and Wildlife Conservation of the Committee on Merchant Marine and Fisheries, House of Representatives, Ser. No. 91-10 (1969)]; "Seasonal Movements of Striped Bass Contingents of Long Island Sound and the New York Bight [Trans. Am. Fish. Soc., Vol. 97, No.4: pp320 - 343 (1968)]; "Migratory Fish of the Hudson Estuary." [with Susan E. Smith, in Second Symposium on Hudson River Ecology, N.Y.D.E.C. (1969)].

I have become broadly familiar with the ecology and fisheries of the Atlantic Coast with the problems affecting fish and the general biota, with the studies of those problems and with the impacts of power plants on the fisheries and on fresh water estuarine, and ocean ecosystems.

I am presently engaged by the Conservation Foundation in Washington, D.C., to direct a national study on ecology, planning, management, and development of coastal lands and waters and to write a handbook on estuarine and coastal zone development to be published by John Wiley and Sons.

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MR. MACBETH: Mr. Clark's testimony has been entered into the record by stipulation, so I think we can proceed with cross-examination.

CHAIRMAN JENSCH: Will the Applicant proceed first, or the Staff?

MR. TROSTEN: The Applicant will proceed.

I have a few preliminary remarks, Mr. Chairman. First, at the last session of the hearing, the Board required, concerning the period of testing of the thermal model, and asked that the Applicant be prepared to discuss this. We are prepared to discuss it, and in order to assure that the proper person is here at the proper time, I would like to suggest to the Board that we cover this matter sometime after noon, if that would be appropriate for the Board. We will have a witness at that time who can address this question. Is that satisfactory, Mr. Chairman?

CHAIRMAN JENSCH: Let the Board consider that and report back later on this morning.

MR. TROSTEN: Fine.

The other point I would like to make, by way of introduction, is that there may be a minor amount of repetition of the cross-examination associated with the fact that some of the same points are covered in Mr. Clark's July 14, 1972, testimony, and October 30, 1972, testimony, but we will attempt to avoid that and to cover blocks of testimony at the

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same time, even though they may be covered in the two pieces of testimony.

Finally, I would like to make a reservation, Mr. Chairman, concerning my cross-examination. It may be that following the cross-examination of Mr. Clark, that Applicant will move to strike portions of his testimony on one ground or another in accordance with the Atomic Energy Commission rules. By cross-examining Mr. Clark, with regard to those portions of his testimony, the Applicant does not waive its right to move to strike those portions at a later time.

CHAIRMAN JENSCH: That will be so understood.

MR. TROSTEN: Thank you, Mr. Chairman.

Finally, we are not proposing to cross-examine Mr. Clark with regard to his October 16, 1972, affidavit because this is associated with the matter of the Hudson River Fishermen's Association motion on the Bowline and Roseton plants. So pending a ruling by the Board on that matter, we are withholding cross-examination on that question.

Depending on how the Board rules on that, of course, we would have to consider the matter of cross-examining Mr. Clark on that affidavit.

Thank you, Mr. Chairman.

CHAIRMAN JENSCH: Proceed.

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CROSS-EXAMINATION

BY MR. TROSTEN:

Q Mr. Clark, I would like to cross-examine you at the outset on the matter of your general qualifications and particularly the statement of qualifications that has just been received in evidence. You received your Bachelor of Science degree in 1949. Is that correct, Mr. Clark?

A Yes.

Q Have you received any advance academic degree in biology?

A No.

Q What is your educational background and professional training in the field of hydrology?

A This would consist in ingredients in courses in ecology and in general experience, reading.

Q Did you say courses in ecology?

A Ecology.

Q My questions perhaps was not clear. My question was what is your educational background and professional training in the field of hydrology?

A My answer was that I have learned hydrology in my ecology courses.

Q In what sense do you learn hydrology?

A Ecology is a field of study that involves the relationship between environment and life. You study life

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and you study environment when you study the animals, proceeds, populations, physiology, and so forth, and when you study environment, you study hydrology, meteorology, weather, and the influences that act upon the critters. So in that sense I have had hydrology. I have not had a course labelled hydrology, if that is what you are looking for.

Q How would you define the subject of hydrology?

A Well, I think of hydrology as the study of water, particularly its dynamic aspects.

Q You do not have an engineering degree, do you, Mr. Clark?

A No.

Q Have you had professional training in the field of sanitary engineering?

A No.

Q Would you tell me what is sanitary engineering?

MR. TROSTEN: As I understand it, Mr. Chairman, that is a field which grew up originally associated with waste disposal systems, and the supply of water, the supply of fresh water and the disposal of waste in water. It has evolved, as I understand it, into broader fields. I would say it is involved with the subject of environmental engineering, where you are studying not just disposal of waste, but the movements of substances in water, and so forth. But I believe in the early days it was associated with

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the supply of fresh water and the disposal of waste in water.

CHAIRMAN JENSCH: Yes, that was my understanding. I was wondering if that description you have given is sufficiently precise. He has indicated, as I understand it, that he studied ecology and that it included water and dynamics of water and so forth. I didn't know whether you were attempting to separate his studies to the point where he wouldn't know in your view about water and waste treatment. I mean between the studies of ecology and sanitary engineering, I wonder if there is such a sharp line of distinction as may have been implied by the question. I think I understand. Proceed.

MR. TROSTEN: I think there are degrees given in sanitary engineering and departments of sanitary engineering in universities, so this is a recognized field.

BY MR. TROSTEN:

Q. Mr. Clark, have you received a degree in statistics?

A. No.

Q. Have you had training in the field of population dynamics?

A. Yes.

Q. Would you describe that training, please?

A. Well, at the University of Washington, where I studied statistics, there were included in these courses various aspects of fishery population dynamics studies. Also in the course of my career over the last 22 years in this business, I have attended seminars and training sessions in-house on numerous occasions in the field of population dynamics.

Q. When you mention that, you had studied statistics at the University of Washington, were these undergraduate courses in mathematical statistics, or undergraduate courses in statistics?

A. Undergraduate courses in statistics.

Q. Mr. Clark, have you had experience in the field of mathematical modeling?

A. If you would describe what mathematical modeling is to me, I think I can answer that. I'm not sure. The definition is very, very fuzzy as to what a model is. Is it a simple binomial formula with values put in it, or what

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do you mean by a model?

Q. What I was thinking of was the modeling of complex systems involving waste disposal or substances which are transported in the water. I was thinking here particularly of the type of modeling that involves the extensive use of computer technology.

A. No, I have never studied anything about sewage disposal or anything related to the movements of contaminants through water, when sewage or chemical wastes or anything like that. My studies have concentrated on the transport of larvae or eggs of fishes that don't behave as molecules do that are totally passively transported, but tend, in stages of their life, to take on behavior aspects and migrate in various directions, responds to light, and so on.

In this way the experience is different than it is with chemicals or sewage, which is just transported totally with the water.

Q. Have you had experience in the mathematical modeling of the transport of living organisms in water? I'm thinking now in terms of the mathematical modeling as I described that. This is mathematical modeling involving simulation of the transport of biological organisms in water, making extensive use of computer technology, in order to create these simulations.

A. That seems to be maybe two questions, so let me take

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1 them one at a time. During a period of about ten years when
2 I was working at Sandy Hook for the Deparment of Interior,
3 Fish and Wildlife Service, I concerned myself mostly in my
4 own research activities there with the transport of fish eggs,
5 larvae, prejuvenile and juvenile stages, through the water.
6 Our particular mission there was to attempt to
7 understand the process whereby estuaries serve as nursery
8 grounds to migratory fish. In this regard, it is necessary
9 to try to relate the transport of water and the eggs and
10 the larvae and the juvenile fishes before they have much
11 ability to swim, to relate these two factors to understand
12 how the tiny larval stages are able to get from out in
13 the ocean, where they spawn, to areas inside the estuaries
14 where they have their nursery grounds as young.
15 In this connection, I have concerned myself in
16 great detail with the transport mechanisms working to carry
17 fish eggs and larvae around. At the time I did most of my
18 work, computer technology in this particular field was just
19 developing. And I did not get to that point in the work of
20 submitting any of this to a computer.
21 Q. I understand from your answer that you have concerned
22 yourself with transport mechanisms. Have you concerned yourself
23 with transport mechanisms in the sense that you have been
24 responsible for the developments of mathematical models of
25 the transport of biological, or living organisms through the

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1 water?

2 A. Well, I think they were out to try to get this

3 straightened out so I know what question I'm answering. Is

4 your definition of a model something that is cranked out of

5 a computer, or is it a mathematical expression of a process?

6 Q. I have really two questions, and you have answered

7 the first one by saying you did not have experience with

8 computer modeling. And my other question is have you had

9 experience with mathematical modeling that does not involve

10 computer technology? You can use a slide rule or electronic

11 calculator. It just takes longer and you can't do as complete

12 a job, perhaps.

13 CHAIRMAN JENSCH: I think he is asking you for a

14 definition. Can you answer him?

15 MR. TROSTEN: I am asking him at this point about

16 his experience in mathematical modeling that does not involve

17 computers.

18 THE WITNESS: Yes, I have done that.

19 MR. TROSTEN:

20 Q. Would you describe the experience you have had?

21 A. It is very similar to some of the material that

22 has been presented here, in that you attempt to locate the

23 primary force, the parameters that effect the distribution

24 of the eggs and larvae and one you have satisfied yourself

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25 that you are able to develop in your mathematical model an

1 analogy to the environmental processes, you just simply put
2 numbers into the system and run your formula through, when
3 you put it through a computer, adding machine, or slide rule,
4 it is exactly the same.
5 All the computer does is do arithmetic faster than
6 we can.
7 Q. Have you ever been responsible for the preparation
8 of a mathematical model for the transport of living organisms
9 through water, other than the mathematical model -- I will
10 put that term in quotes -- that is contained in your October
11 30, 1972 testimony?
12 MR. MACBETH: Mr. Chairman, Why is Mr. Trosten
13 putting it in quotes? Is he suggesting Mr. Clark put
14 mathematical model in quotes?
15 MR. TROSTEN: No, I'm putting it in quotes merely
16 because I want to have it understood that I don't want Mr.
17 Clark to discuss the October 30th testimony. That is the
18 reason for it.
19 THE WITNESS: All right. Would you give me the
20 question again?
21 MR. TROSTEN: Would ~~your~~ the reporter read the question
22 back?
23 (The reporter read the question as requested.)
24 THE WITNESS: I think in late 1967 or early 1968,
25 through 1968 and on into 1969, I was involved with the ERTS

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1 program, a satellite program in cooperation with the geological
2 survey, in which we were attempting to build a complex computer
3 model to take into account all of the various oceanographic
4 factors that we have been able to measure along the Atlantic
5 coast from Cape Cod to Florida, to attempt to relate the
6 transport mechanisms and thermal conditions and other factors
7 to the kinds of measurements that you can make from a satellite
8 through various remote sensing devices.
9 And in this connection, in cooperation with two
10 fellows, Mike Dalberg and Jeffry Laurence. We attempted to
11 develop this model, so that once you got your values from the
12 satellite of the remote sensing values, you could plug it
13 into the computer and it would crank out answers for you as
14 to when the conditions would be favorable or unfavorable
15 for fish, depending upon the factors that govern their
16 survival.
17 That was a computer modeling program that was
18 developed and carried on through after I left there. I'm not
19 sure what has happened to it since. We did not in this
20 instance carry it all of the way through to the end of generating
21 the data and running it through the computer. So my experience
22 ended with developing the form of the model expressions that
23 went into this.
24 BY MR. TROSTEN:
25 Q. I take it this program did not involve mathematical

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1 modeling of the abundance or distribution of organisms in
2 an estuary, did it?
3 A. It related estuary water to oceanic water. One
4 of the primary aspects of this was to study the flow of
5 turbidity of suspended particles out of estuaries on to the
6 continental shelf, because these are observable from the
7 differences in transparency of the water, they are observable
8 by the sensors in the satellites, and you can determine the
9 turbidity field, our hypothesis was you could determine the
10 relative saline test, because the suspended particles come
11 with the fresh water out into the ocean, and by determining
12 the amount of suspended particles, you could infer what
13 the salinity would be, and once knowing what the salinity is,
14 then you have a factor that expresses the amount of estuarian
15 influence out there on to the Atlantic shelf.
16 So to that extent, we were concerned specifically
17 with the flow, and transport from esturian situations to the
18 ocean.
19 Q. Excuse me, I am a little confused. Earlier in the
20 morning you mentioned that your experience was not with the
21 transport of inorganic substances, physical substances. You
22 contrasted that with your experience with living organisms. But
23 this experience had nothing to do with living organisms, it
24 had to do with the transport of inorganic material, didn't it?
25 A. The part of it that involved the modeling of

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1 suspended nonliving material in the water was not handled by
2 me personally, it was handled by a geological survey man who
3 we were cooperating with. If you are interested in that kind
4 of experience, I mean, I have been managing research for about
5 20 years in various projects, and in that time, I have
6 experience with all kinds of things, I mean if you want to
7 know how many times I have had to learn or read about, or be
8 exposed to knowledge about the transport of nonliving material
e2 9 in water, I mean I could go on all day.
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Q No, that is not necessary. This particular substance, or this particular study did not involve the transport of or the spatial distribution or the abundance of living organisms in a river. Is that correct?

A No, that ERTS Program. Maybe you ought to just start over with the question about modeling, because it has gotten kind of diffuse.

Q No, that is not really necessary. Did you answer no, that this program did not --

A Yes, the ERTS program did not -- you will have to ask it again.

Q My question is did it involve the abundance or spatial distribution of living organisms in a river. I asked you whether the ERTS program --

A Yes, it did involve that.

Q Was the subject of this program the abundance or distribution of living organisms? Was that what the study was intended to do?

A That is what it was aimed at, estuarine distribution of young stages of fish. This was the end product we hoped to get out of it, to explain the whole process of fishes, migratory fishes that spawn in coastal and estuarine environments, whose young use estuaries along the coast for nursery grounds for their young. That was the end goal of the program.

Q End goal of the program. Okay. Mr. Clark, what

1 experience have you had in the construction of the formulae
2 that describe physical processes in mathematical terms?
3 A Please, again?
4 Q Would you read the question back?
5 (The reporter read the pending question.)
6 BY MR. TROSTEN:
7 Q Let me amend that question slightly to say
8 physical or biological processes in mathematical terms.
9 CHAIRMAN JENSCH: Mathematical what?
10 MR. TROSTEN: Mathematical terms.
11 CHAIRMAN JENSCH: Thank you.
12 THE WITNESS: Let's see if I have this right. You
13 want to know what experience I have had in formulating --
14 BY MR. TROSTEN:
15 Q The construction of formulae which describe physical
16 or biological processes in mathematical terms.
17 A You are asking me what experience I have had?
18 Q What experience have you had in that endeavor, that
19 type of endeavor?
20 A How much detail do you want?
21 Q Whatever you think is appropriate to answer my
22 question.
23 A Are you interested in a lot of detail or just a
24 couple of highlights?
25 Q Well, you know, just tell me what you think the

1 answer is.

2 A The thing is I can get out some of my papers and

3 so on.

4 Q If you think that is appropriate. I would

5 imagine it is a relatively easy thing to describe.

6 A Well, let me just describe -- are you thinking

7 of correlations, mathematical correlations associating

8 environmental properties, such as temperature, with the

9 distribution of animals, such as fish? That is a mathematical

10 formula.

11 Q Let me see if I can --

12 A I have done thousands and thousands of correlation

13 analyses, and analyses of variants. I have done many, many

14 types of formula expressing the reactions of behavior of fish

15 to fishing gear and to the kinds of environmental impacts

16 that they run into, such as salinity, this kind of thing. I

17 have constantly worked with quantitative data, in the ichthyl

18 plankton work, in my studies of age and growth of fish and in

19 the migrations of fish, striped bass, I have done a considerable

20 analysis of striped bass migrations and movements, attempting

21 to try to relate them to various factors in the environment.

22 I have worked with salinity, I have worked with temperature,

23 I have worked with sunlight, hours of darkness, hours of light.

24 And I have worked with plankton net catches, trying to quantify

25 the effects of variables that influence catches of plankton

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1 nets. I have worked trying to develop mathematical expres-
2 sions for many ecological factors. Just let me say something
3 gratuitously --
4 Q No, don't say anything gratuitously --
5 CHAIRMAN JENSCH: I think if it is an answer to
6 the question, whether it is gratuitous or not, I think you
7 should complete the answer.
8 THE WITNESS: Maybe just to save everyone a lot
9 of time. I am a fish biologist, who over the course of years
10 has turned into a fish ecologist. This is my area of
11 expertise, studying the life and behavior and habits and
12 relationships of fishes to the environment. And what they
13 eat, where they go, how they live, what fishermen do when they
14 catch fish, what happens with various kinds of impacts of
15 our progress and so on. I am not going to claim that I am an
16 expert mathematical modeler. You give these things to
17 programmers, to mathematicians, they do that work for you when
18 it comes to developing the actual mathematical, carrying out
19 the mathematical function of the computer. I don't pretend
20 to be a sewage engineer or whatever that was you asked me
21 about, or anything. I am a fishery ecologist.
22 And in the course of my training and experience in
23 almost 20 years of which has been in the management of
24 research, I have had to get into all kinds of things, learn a
25 lot of things, practice a lot of secondary arts that include

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most of the things you mentioned. But the things you mention, none of them are my primary art, which is fishery ecology.

BY MR. TROSTEN:

Q What was the specific subject of the research in the ecology and life patterns of salt water fish which you performed at Sandy Hook Marine Laboratory?

A I think it best if I give you some examples. One study I did was involved with the racial distribution of stocks of haddock which was a meristic study, which involved the counting of meristic characters of fishes and relating these to environmental values, to the temperature of the water, trying to relate this to their spawning migrations and movements, so we could determine for our management program whether we were dealing with separate stocks of fish that were influenced by separate factors, or whether we were dealing with all one stock of fish.

I spent a lot of time studying the spawning activities, principally of haddock, out along the New England coast, trying to determine the rhythm of their spawning, the fate of the eggs and larvae, trying to relate the abundance of each year group in the fishery back to factors that influenced the eggs and larval stages.

I spent a considerable amount of time studying the age and length, composition, of the catches of haddock, trying to relate this to the sizes of mesh and types of nets used

1 by fishermen and then through a process of population dynamics
2 efforts, we tried to model the population of haddock in such
3 a way that we could predict the effects of fishing on the
4 stock as it related to the individual sizes of fish. That was
5 a very complex program, involving all aspects of the life of
6 a particular fish.
7 I also had a lot of experience with fishing gear,
8 trying to devise types of nets and sizes of mesh and styles
9 of gear and mechanisms of operating the gear so as to try to
10 let fish escape. This is called net selection work, in which
11 you try to derive a net that has the best maximum potential
12 for releasing the small fish unharmed, while you catch the
13 big fish in the net. I could go on.
14 Q Mr. Clark, is the haddock an anadramous fish?
15 A No, it is strictly a marine fish.
16 Q Mr. Clark, have you conducted sampling of eggs
17 or larvae or young-of-the-year striped bass in the vicinity
18 of the Indian Point Plant?
19 A Eggs or larvae?
20 Q Or young-of-the-year striped bass in the vicinity
21 of the Indian Point Plant.
22 A Yes.
23 Q In what connection did you do that?
24 A On a research cruise into the river.
25 Q Was that the cruise of the Dolphin?

A Yes.

Q Were you on that cruise?

A Yes.

Q This was the cruise and the sampling you are referring to was the sampling that took place three days in March, 1968?

A Right.

Q Were you sampling eggs in March of '68?

A No, not eggs. You said eggs, larvae, or young-of-the-year, did I or did I not, and my answer was yes, I did.

Q I just asked if you sampled eggs.

A There aren't any striped bass eggs there at that time of year.

Q Were you sampling larvae in March, 1968?

A No, there are no striped bass larvae there either at that time. All that is there in March are the juveniles and older fishes, but no eggs or larval stages. The spawning occurs earlier, in June. These are almost a year old.

Q These are the young-of-the-year fish, so-called zero-plus age class, just about at the end of stage 5?

A Yes, this is the size of striped bass that are impinged on the screens of Indian Point.

Q What sampling did you conduct of the so-called stage 5 juvenile fish during these three days in March, 1968?

A Would you refer me to what stage 5 is?

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1 Q That is your stage 5 that appears in your testimony.
2 It is the stage that begins, you say, sometime in September,
3 or October, I believe.
4 A Is that in this testimony?
5 Q The October 30 testimony.
6 CHAIRMAN JENSCH: Could you find the page, please?
7 MR. TROSTEN: Yes.
8 THE WITNESS: Are you going to move to that
9 testimony now?
10 MR. TROSTEN: Just momentarily. Stage 5 is referred
11 to on page 24 of your October 30 testimony. It is really just
12 so we can all be talking about the same thing.
13 THE WITNESS: Right. I think we are getting to
14 the point where we all have about the same stages now. Yes,
15 that is the size of fish that we caught there.

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BY MR. TROSTEN:

Q How many of the young-of-the-year striped bass did you find during those three days?

A I don't have the records, the records for that were kept by Frank Carlson, who was aboard.

Q I assume from your testimony that you also were trawling for the larger striped bass, not just the young-of-the-year, but the adults?

A Yes.

Q Have you conducted sampling of eggs or larvae or young-of-the-year striped bass anywhere else in the Hudson River?

A Again you said eggs, larvae, or young-of-the-year?

Q Yes.

A Yes.

Q On what occasion?

A On the occasions of seining, beach seining along the edge of the river, and I think in the fall.

Q Fall of what year was that?

A I think it was the fall of -- let me be sure I have this straight -- fall of 1969.

Q Fall of 1969. What was the occasion of the seining that you were engaged in?

A We were collecting fish for the experiments we were doing on striped bass at the Sandy Hook Laboratory. We went there to get our specimens for the region on striped bass, to

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1 the Hudson River, to get the young fish.

2 Q Did you find many eggs with your seining?

3 A Well, I should explain to you that the eggs, you

4 would only expect to find in the river in May, mostly May and

5 the early part of June. Since I was there in the fall, there

6 wouldn't be any striped bass eggs in the river.

7 Q Yes, that is what I was talking about.

8 A No, the striped bass, the juvenile fish is what we

9 catch with beach seines.

10 Q Maybe I am confusing things by asking a question

11 that has three parts. Let's take it one at a time. Eggs: Have

12 you conducted sampling of eggs anywhere in the Hudson River

13 at all at any time?

14 A No.

15 Q Have you conducted sampling of larvae anywhere in the

16 Hudson River at any time?

17 A No.

18 Q Have you conducted sampling of juveniles, zero plus

19 class juvenile fish, less than one year old, other than the

20 three days of trawling that you engaged in on the Dolphin in

21 March, 1968? Is that the seining you referred to a moment ago?

22 A Was the seining done aboard the Dolphin?

23 Q You referred to some beach seining in the fall of

24 1969. Is that the other sampling of juveniles, besides what

25 you did on the Dolphin?

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A Right, yes, no, I have not done any extensive field work on striped bass in the Hudson River. I mean I have not had the opportunity to carry out an extensive program of specific work on striped bass in that specific river. Although it gets a little confused, because when you are in an administrative or executive position in science, you don't actually go out and do that much of the work yourself.

You may be closely involved, you may be directing programs, you may be concerned with the analysis of the data, with reviewing the accuracy of the program and so on. In this way you are connected with a lot of programs, but you don't go out and run the nets with your own hands.

In this connection, with striped bass, my group at Sandy Hook was responsible for reviewing the identification for the striped bass larvae and eggs to help the fellows on the Hudson River, that couldn't figure out which was a striped bass and white perch, they brought them to my group, which I had a number of experts on identity of larvae stages down there, and they helped them to sort out which was which.

In that way we had a definite working relationship, and I knew pretty well what was going on up in the river. But as far as being actually, being in the process of collecting myself, I haven't done a lot of that.

Q Have you been in charge of a project team -- I realize not everybody gets on the boat and runs the nets --

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1 but have you been the head of a project team that was respon-
2 sible for an egg sampling program in the Hudson River?
3 A Only in this connection, working with Carlson and
4 all of the Northeast Biological, whatever their name was,
5 Northeast Consultants, whatever.
6 Q You weren't in charge of the Carlson-McCann study,
7 were you?
8 A We were only responsible to try to help them identify
9 the species of larvae they caught in the program. This was
10 interdepartmental cooperation within the Fish and Wildlife
11 Service, between the Sandy Hook Region outfit and Frank Carlson's,
12 which is not a regional outfit, to cooperate together on this
13 particular program.
14 Our responsibility, for which we received funding and
15 so on, was to help in the analysis of the data which had been
16 collected all by a private consulting outfit called, whoever
17 they were, Northeast something.
18 Q But you were not in charge of the program for the
19 collection of samples?
20 Is that correct?
21 A No, sir, I was not.
22 Q Either of the eggs or larvae?
23 A No.
24 Q Or of the juveniles?
25 A No.

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Q You mentioned a moment ago, Mr. Clark, that you were involved in helping with the Carlson and McCann Study. Was your help related to the taxonomic analysis, or were you actually helping to develop the numbers, the actual data that are contained in the Hudson River Fisheries Investigation?

A Well, let me explain how this works.

As there are in many other areas of science, there are areas of sort of black art mystique, where a person, by virtue of his experience, intelligence, with a little intuition thrown in, whatever it was, has learned the process of identifying a particular kind of a critter.

At Sandy Hook, since 1964 down there, we were in a process of studying what we call a field plankton, which are the larval stages for the most part of fish. So certain of the guys that worked for me, there were three that were particularly expert, assisted the Carlson-McCann people by using their very specially developed ability, which is a kind of an art, to discriminate between different kinds of fish, young stages of fish, which are terribly difficult to separate, particularly when they are as closely related as the white perch and striped bass.

Without this kind of training, which involves years and years of looking through microscopes and comparing fish and developing this talent, you just can't sit down and tell fish apart.

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So that was the role we had, to try to help those fellows that didn't know how to do it to separate striped bass from white perch. So we went through bottles and bottles of this stuff with their men down in my laboratory with my experts showing them how to discriminate these fishes. We are not responsible for the conclusions of that report in any way, shape or form.

Q Yes, I understand. So you were helping with the toxonomic analysis, is that fair?

A That would be a very good way to say it.

Q Thank you very much. Now you served on the staff of the U. S. Bureau of Sports Fisheries and Wildlife for ten years. Is that right?

A Yes, approximately.

Q From 1960 through September 1970?

A Yes.

Q And you left in September, is that correct, 1970?

A Yes.

Q What was the occasion of your departure from the Bureau?

A The occasion of my departure from the Bureau was to take another job.

Q Which job was that?

A Over at Coney Island.

Q That is the job that you say is curator of the

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Reba 7

1 New York Aquarium?

2 A Yes. I quit one in September and took the other one

3 in October.

4 Q You say you quit in October?

5 A Isn't that the way it works? I went from one to

6 the other. The actual date of transfer is October 3rd.

7 Q I see. You quit the job in the Bureau of Sports

8 Fisheries and you immediately took the job in the New York

9 Aquarium, is that right?

10 A Yes. I quit one to take the other.

11 Q And you served with the Aquarium from October of

12 1970 until January of 1971. Is that right?

13 A Right. February, 1971, yes.

14 Q It says here January 1971. So you were with them

15 four months.

16 A Where does it say January? Do you have the same

17 copy I have?

18 Q Excuse me. I am looking at the older version. Mr.

19 Macbeth handed me another one today. Let me check. I am sorry.

20 I was looking at the version that was given to me last year

21 which said from October 1970 to January 1971. I apologize.

22 The one I was given this morning says, "Thereafter I served

23 as temporary curator of the New York Aquarium in Brooklyn, New

24 York from October 1970 to February 1971, I am sorry.

25 A Yes, to, but not including.

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Q What was the occasion of your departure from the Aquarium?

A I didn't like it.

Q From February 1971 until you became a consultant to the Hudson River Fishermen's Association in September 1971, what was your professional employment?

A Say that once again.

(The record was read by the Reporter.)

THE WITNESS: During that time I was writing a book for a book club on fish behavior, describing the reactions of fishes to light, temperature, smells, describing their feeding, describing the reproduction, describing how various facets of environmental impinge on them, about ecology, conservation, management and so forth.

A book about fish behavior, primarily for anglers, fishermen.

BY MR. TROSTEN:

Q Was this book about marine fish?

A Yes, Marine and Fresh Water.

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Q Marine and fresh water?

A And andromous.

Q Have you performed sampling or observations to determine the types or numbers of organisms which are actually entrained in the Indian Point plants?

A No, I don't think anybody has really done that. Other than your own people.

Q Yes.

A Go to Indian Point and actually sampled around there in front of the intakes?

Q That is right.

A I helpd Pete Bibko up there one night when he was all alone. That is what you would call intake sampling at the screens.

Q So what you are saying is one night when you were there at the site you assisted one of Con. Edison's personnel in connection, or ~~New York's personnel~~ New York University in connection with the sampling?

A Yes, the fellow who worked for Jerry up there. He was all by himself, so I helped him put the net out.

Q I am sure he ~~personated~~ appreciated that. It gets awfully cold up there some nights.

A It was, yes.

Q Have you performed experiements yourself on the effects on entrained organisms of passage through a steam

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electric power plant?

A No, I certainly haven't, no. I certainly have not done that.

Q Mr. Clark, what measurements or analyses, if any, have you made of the movements of Hudson River water through steam-electric power plant cooling systems other than the analysis that is contained in your October 30th testimony?

A CHAIRMAN JENSCH: May I have that question read, please?

(The reporter read the question as requested.)

THE WITNESS: I can say this, all of the data, or most everything I had to work with was the stuff that various people working for Con. Edison had collected and reported or at least made available to me. I wasn't collecting my data. My job was just to analyze what is available and then try to make the best sense out of it possible, in terms of the probably ecological consequences of it.

I tried to work with the data collected by your people and just simply to analyze it and work it through and try to see what it would indicate. Getting closer to the specific points of your question, I did a lot of messing about with data, with the data I could find beyond what appears in the testimony. To that extent, I have done more of that kind of analysis than would appear in the testimony. But I have done no separate study that is reported or available in any way.

kar 3 1 BY MR. TROSTEN:

2 Q Have you ever testified at another Atomic Energy

3 Commission hearing on a nuclear power plant?

4 A Yes.

5 Q Which one was that?

6 A Which one?

7 Q Which hearing was that?

8 A Well, there were two.

9 Q All right. Which hearings were they?

10 A Vernon and Shoreham.

11 Q Shoreham and Vernon?

12 A Vernon plant up in Vermont.

13 Q Con. Yankee.

14 A I see.

15 MR. MACBETH: Excuse me --

16 MR. TROSTEN: Excuse me, I beg your pardon, Vermont

17 Yankee.

18 THE WITNESS: Whatever the name is, below Brattleboro

19 on the Conneticut Riber.

20 BY MR. TROSTEN:

21 Q I am sorry. Have you ever submitted proposed

22 evidence in opposition to the construction of any other power

23 plants on the Hudson River other than Indian Point Two, other

24 than the evidence you submitted in this proceeding?

25 MR. MACBETH: I object to that question on the

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grounds that there is no evidence from Mr. Clark opposing construction of this power plant.

MR. TROSTEN: I will rephrase the question.

BY MR. TROSTEN:

Q Have you ever submitted evidence in any proceeding in connection with the construction or operation of any other power plants on the Hudson River?

A I am going to have to have the question read to me. It sounds like a loaded question. I want to make sure I understand it.

(The reporter read the question as requested.)

THE WITNESS: By that do you mean in any form?

BY MR. TROSTEN:

Q Any form? Not necessarily this particular form.

A In any kind of plant? Pump storage plant excluded?

Q That is right.

CHAIRMAN JENSCH: By evidence, you mean a proceeding duly convened, in other words, evidence means a hearing.

MR. TROSTEN: That is right.

CHAIRMAN JENSCH: Has there been any hearing on plants on the Hudson River other than nuclear plants or Storm King?

MR. TROSTEN: That is right, Mr. Chairman. I wanted to find out about that. But if there is one I missed --

CHAIRMAN JENSCH: Does anybody know of any other

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1 plants on the Hudson River that have had hearings?

2 MR. TROSTEN: There have been hearings, I believe,

3 in connection with fossil plants, proceedings.

4 CHAIRMAN JENSCH: Proceedings. Is that different

5 from hearings?

6 MR. TROSTEN: Well --

7 CHAIRMAN JENSCH: By evidence you mean duly sworn

8 and put on the stand or just submitting statements?

9 MR. TROSTEN: Sworn evidence. Sworn evidence in any

10 proceeding involving a power plant on the Hudson River.

11 THE WITNESS: If you are asking about Storm King,

12 yes, I have.

13 BY MR. TROSTEN:

14 Q In whose behalf did you submit that evidence?

15 A Scenic Hudson Preservation Conference.

16 Q Have you submitted sworn evidence in any other

17 proceeding besides Storm King proceeding and the Indian Point

18 Two proceeding involving a power plant on the Hudson River?

19 A I am a little rustic on something that happened

20 in about 1963 or '64. I don't remember the degree of formality

21 of the hearing. But over at Bear Mountain there was some kind

22 of state-conducted inquiry on Storm King and I gave them some

23 information on striped bass. I don't remember whether that

24 was sworn or not sworn.

25 Q You were a consultant then to parties in the

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Shoreham, Vermont Yankee and Storm King projects, is that correct?

A Yes.

Q Mr. Clark, what studies have you made of the numerical variations in fish populations -- can you hear me?

A Just bearly. There is a lot of background noise with the air system.

Q Let me start again. What studies have you made of the numerical variations in fish populations and the other factors which control these variations, other than the analyses contained in your October 30th testimony?

CHAIRMAN JENSCH: Excuse me, you asked about studies of numerical variations and other factors that control. Would the variations control?

MR. TROSTEN: Excuse me, it should be simply factors that control? "Other" doesn't belong in there. Control these variations.

THE WITNESS: Yes, that is the primary thing I have done, primary quantitative work I have done throughout my career. Like trying to relate the number of eggs in a fish to the size of the fish, or the girth of the fish or the number of different stages of eggs that are in it, the rate at which they pop out or whatever.

BY MR. TROSTEN:

Q You just have misunderstood the question. I was

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1 dealing with fish population, not fish.

2 A Now if I understand you, you are asking me whether

3 I have ahd experience with the factors that control the size --

4 Q Of fish populations.

5 A Size of fish populations?

6 Q First I asked you what studies had you made of the

7 numerical variations in the size of fish populations, not the

8 size of fish. And of the factors which control these numerical

9 variations in the size of fish populations, other than the

10 analyses that are contained in your October 30th testimony.

11 CHAIRMAN JENSCH: So I can follow it, could you

12 tell me what factors do you believe do control the fish

13 population. You say what factors did he study.

14 MR. TROSTEN: There are two general classes of

15 factors, as I understand it. One are density dependent factors

16 and the other are density independent factors. Among the

17 density independent factors are such things as fishing, river

18 flow, extremes of temperature, and so forth.

19 Among the density dependent factors are availability

20 of food, predation, things of that sort, Mr. Chairman.

21 THE WITNESS: Yes, I have studied all that, river

22 flow, fishing, the effect of fishing on stocks, effect of

23 river flow on stocks. Everything you mentioned I have studied

24 in one connection or other over the years.

25 BY MR. TROSTEN:

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Q You mean you studied it as part of general reading?

A No, I have been out there doing it on boats, ships, wading around, whatever is required, measuring the properties of fish population so we could do some statistical analyses against the environment which we also measured at the same time.

Q Have you published any paper on the subject of the factors which control fish populations?

A Yes. Do you want examples of them?

Q Yes, I would like to have an example, yes.

A Do you want me to furnish that to you later?

Q That would be perfectly all right.

A It would be easier.

Q Yes. Have you been responsible, other than the publication of a paper, for the conduct of a study to determine the factors which control a specific fish population?

MR. MACBETH: Would you, reporter, read that question back?

(The reporter read the question as requested.)

THE WITNESS: Yes.

BY MR. TROSTEN:

Q Would you tell me what that study was, please?

A Well, there have been a number of them. We are always going around, that is the biggest question in our minds, what is controlling these populations, because it is management's work and concerns itself with the numerical abundance of fish

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in relation to man's use. So the question in our minds is always, as we attack any of these problems, is what are the factors that control the populations of fish.

And I have involved a lot of my time looking into temperature, salinity effects, the relation of one population of critter to another, general climatic trends, et cetera, et cetera.

A lot of work on these has been done by people working for me.

Q Is that the answer to my question?

E. # 5 A Yes.

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Q Can you give me an example, can you tell me of a specific study that you have been responsible for to determine the factors which control a specific population? I am not referring now to general analyses of what effect weather has, what effect salinity has, things of that sort, but a specific study of a fish population, such as the study of salmon or tuna fish or something like that.

A Okay. The best example I could give you is a series called Studies of the Estuarine Dependence of Marine Fishes which is a series of publications containing the results of the project I described at Sandy Hook which was measuring fish eggs and larvae and collecting them out two years up and down the coast from Florida to Cape Cod. And that is specifically designed to answer the question of what kinds of factors are influencing the populations of fish. And those results are now coming out in a series of volumes. The first one and the second one, I understand, although I haven't seen it, are already published, and the others are in press.

Q If you could provide me the paper, I would appreciate it.

A Sure. I can get you a copy of that first volume.

Q Thank you.

I would like to turn to another subject, if I might, Mr. Clark.

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CHAIRMAN JENSCH: Before you change, I wonder if you could help me. I am having some difficulty with some of the examination on qualifications. I think you asked the gentleman did he have a degree in statistics.

MR. TROSTEN: Yes.

CHAIRMAN JENSCH: What school gives a degree in statistics? I thought they gave degrees in mathematics and statistics was a subordinate phase of that.

MR. TROSTEN: Well --

CHAIRMAN JENSCH: Could you give me, sometime -- not now, but later -- what schools give degrees in statistics alone?

MR. TROSTEN: Yes, I will be glad to check into that, Mr. Chairman.

CHAIRMAN JENSCH: I didn't know of any. Thank you.

BY MR. TROSTEN:

Q Mr. Clark, I would like to go now to your July 14, 1972, testimony, if you have a copy of that handy. So we can all be together on this, what I want to do is to discuss the introductory parts of your testimony in which you draw some generalized conclusions about the effects of power plants on fishes and certain critical functions and areas which are affected by fish. What I would like to do is explore the basis for your conclusions about the types of effects that power plants have on fishes and the types of

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critical functions and areas which are subject to being affected by power plants. On page 1 I would like to ask you what evidence in the record of this proceeding demonstrates that fish have been killed in the cooling system of the Indian Point 1 plant. I ask you this question in connection with the sentences that appear on page 1, where you say, "The operation of Indian Point Units No. 1 and 2 with once-through cooling will have very extensive adverse effects on the fish and fisheries of the ~~Hydson~~ Hudson estuary. These effects include direct killing of a large quantity of Hudson River fishes." And you refer later on on the page to the direct killing of masses of fish by steam generating plants on the screens and within the cooling system. You say that this is well documented and is the subject of other testimony.

CHAIRMAN JENSCH: What is the question again?

BY MR. TROSTEN:

Q My question is what evidence in the record of this proceeding demonstrates that fish have been killed within the cooling system of the Indian Point 1 plant as opposed to on the screens.

A Are you asking me about sentence one at the top of the page?

Q I am just asking you my question.

CHAIRMAN JENSCH: Is it your thought that you want to know what evidence there is in the record, so wouldn't

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that speak for itself, or are you asking him what he relied on for his opinion?

MR. TROSTEN: What evidence in the record he relied on.

CHAIRMAN JENSCH: Maybe he hasn't read the whole record.

THE WITNESS: You will have to repeat the question again.

BY MR. TROSTEN:

Q What evidence in the record of the proceeding demonstrates that fish have been killed in the cooling system of the Indian Point 1 plant?

A The first thing that comes to my mind is some of the stuff Jerry did, Pete Bibko, this summer up there. He found them dying in the condensers. Is that what you want to know?

Q Were you relying on Dr. Lauer's testimony that 54 percent, not less than 54 percent of the organisms that go through the plant survive?

A No, I guess I was thinking more about discussions I had with Pete Bibko that time I told you I was up there, when I actually saw, and got an idea of what was going on. We talked a little bit about it. And then Jerry's stuff that was reported out. I think that is the only direct evidence. I don't think Con Ed has done any studies, other

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than that, of what happens to the fish that go through the condensers.

Q Mr. Clark, what evidence in the record were you relying on? Let's start with that first and go to the other things you relied on.

A Why don't we just say Jerry's --

Q When did Jerry's material go in? Well, Dr. Lauer's material -- as you know, prior to April 14 there had been no work done by NYU on the particular subject of the survival of eggs and larvae through the cooling system, April 14, 1972.

A Yes.

Q Now on October 30, 1972, Dr. Lauer presented testimony in this proceeding which indicated, as I just mentioned to you, that not less than 54 percent of these organisms survived. I wanted to know if that is what you were relying on in connection with your testimony or were you relying on some other evidence in the record here?

A Just talking with Jerry, earlier on, before he actually printed it in there, I knew what he was going to say. I mean I knew that, from direct reports from the guys working up there, that they were seeing fish dying going through there. Maybe this is a technical legal point or something you are trying to put across here, I don't know.

Q No, I am just trying to establish it.

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A That is the way I found out, if that is what you want to know.

Q All right. So the evidence you are relying upon or the information that you were relying upon for drawing your conclusions as to what was being killed in the power plant within the cooling system of the power plants at Indian Point was through discussions with NYU personnel, Dr. Lauer or perhaps the discussions you had with Dr. Lawler, or witnesses for the Applicant, is that right?

MR. MACBETH: I object to that question, Mr. Chairman, on the grounds that counsel for the Applicant has described this now as information. Previously he described it as evidence in the record. There is obviously a difference between evidence in the record and information. There may well be other sources of information, papers and literature and so on, that discuss the killing of organisms of this size going through steam condenser plants. I think if Applicant's counsel wants to ask that question, it is a perfectly fair one, but to characterize, or to change from evidence in the record, to information, I think, misleads the witness.

THE WITNESS: I can give you one -- maybe this will help pin it down a little better -- I think Ed Raney, if my recollection is right, Ed Raney has a paper somewhere in all of the documents in this hearing that talks about Marcy, in

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which white perch were being killed up there, on Haddam Neck Point. I think that is in the record. I couldn't swear to it. But I think there are copies in the documents room, all of that. That means it is in the record, doesn't it?

MR. TROSTEN: No, it is not in the record.

CHAIRMAN JENSCH: Excuse me, let's deal with the objection. I think what the Fishermen's Association is trying to point out is maybe the shift from "evidence" to "information" may have been confusing to the witness. As I understand your question, it was you relied in part on the conversation with Dr. Lauer or Dr. Lawler about these matters. You didn't intend to exclude other sources of information, if there were any, did you?

MR. TROSTEN: Mr. Chairman, I have interpreted the witness's remarks to indicate that he did not rely on evidence in the record in drawing his conclusion contained in his July 14 testimony. I was at that moment getting ready to move onto the question that the Chairman suggested. That is the reason I was transferring from one to the other. Now if Mr. Clark will just confirm, so the record will be clear on that, that he was not relying in his July 14 testimony on any evidence in the record, we can then move on to the other subject.

MR. MACBETH: I think it has to be pinned down as to what part of the sentence he is discussing. The sentence

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1 concludes the direct killing of masses of fish by steam
2 generaing plants on the screens, which can clearly evidence
3 in the record, and within the cooling system. If Mr. Trosten
4 wants to break this down and discover which parts of that were
5 previous documents in the record, which were other information,
6 that is fine. But I think we have to be very precise about
7 it, if that distinction between evidence in the record and
8 other information is going to be maintained.
9 MR. TROSTEN: All right, I will break it down.
10 CHAIRMAN JENSCH: The objection is sustained.
11 I think the problem a lay witness would have, I don't know,
12 but I infer the way he answered that he may not be as familiar
13 with the state of the record as you are. So when you say
14 did you know if this is in the record or not in the record,
15 it may be confusing. I think what you are really trying to
16 find out is upon what he did rely, in or out of the record,
17 whenever it happened. I think if those factors are borne in
18 mind by the witness -- his answer indicated he didn't know
19 whether it was in the record or not.
20 MR. TROSTEN: You are right, Mr. Chairman. I
21 should have phrased it differently. Let's not worry about
22 what is in or out of the record. Let's be sure we are both
23 talking about killing of organisms within the cooling system
24 as opposed to the screens.
25

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BY MR. TROSTEN:

Q What evidence demonstrates that fish have been killed in the cooling system of the Indian Point 1 plant?

CHAIRMAN JENSCH: It is about time for a recess. I think if you would point out what the evidence is in the record, so he will have that distinction. What evidence did you rely on, of course that means it is in the record, so it is the same question in a different form.

MR. TROSTEN: No, Mr. Chairman. I agree a lay witness is not presumed to know all of the evidence that is in or out of the record. I simply asked him what evidence he relied on.

CHAIRMAN JENSCH: What information he relied on is what you are really asking, is it not?

MR. TROSTEN: All right. What information.

CHAIRMAN JENSCH: Let's take a recess. At this time, let's recess, to reconvene in this room at 10:30.

(Recess.)

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CHAIRMAN JENSCH: Please come to order. Dr. Clark has resumed the stand. Applicants, are you ready to proceed?

MR. TROSTEN: Yes, sir. Incidentally, Mr. Chairman, we are trying to get the microphone, we are making efforts to do that.

CHAIRMAN JENSCH: Very well.

BY MR. TROSTEN:

Q Mr. Clark, you were thinking about my question about what information you relied upon in preparing your July 14, 1972 testimony which demonstrated to you that fish have been killed in the cooling system of the Indian Point 1 plant.

MR. MACBETH: Mr. Chairman, I object to that. The sentence says that the direct killing of masses of fish by steam generating plants on screens within the cooling system is well documented and is the subject of other testimony. There is not a direct reference to Indian Point 1 in that sentence, if that is the sentence Mr. Trosten is inquiring about.

MR. TROSTEN: In other words, you are just talking about a theoretical problem here, you are not talking about Indian Point 1, is that what you mean, Mr. Clark?

CHAIRMAN JENSCH: Theoretical or actual, which is it? Have fish been killed at other plants, that is the question.

THE WITNESS: Yes. I go into great detail on the killing of fish at Indian Point in the other testimony. This is meant to just say that this particular piece of testimony is not

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Reba 2

concerned with that aspect. There is another piece of testimony in which I expect to get into that, or I did get into that.

MR. TROSTEN: All right, we can move on and come to that later then.

CHAIRMAN JENSCH: The objection is sustained. Proceed.

BY MR. TROSTEN:

Q Now with regard to your statement here in your July 14th testimony that the most significant external adverse impacts on fish and fisheries may occur at the non-lethal level, that is they would function "to reduce the size and vigor of natural populations without causing immediate or visible kills," would you please cite for me the study which has demonstrated that operations of steam electric power plants "has reduced the size and vigor of natural populations without causing immediate or visible kills"?

A I think probably the clearest example of this is Haddon Neck in New York where they made actual measurements of the weight, length, relationship of fish through the course of a winter when they were attracted to live in the thermal plume in the dicharge canal. The fish were tagged and measured and recaught because they lived in this thermal plume they could re-catch them, recaught and remeasured and they determined that in the course of this one winter period, the fish lost up to sixty percent of their weight, the average loss was twenty percent of their weight, and many of them had not recovered

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Reba 3

1 back their weight loss by the following autumn.

2 Q Now was that the so-called "Skinny Fish Study"?

3 Is that what you are referring to?

4 A I haven't heard it called that.

5 Q Was that a Marcy study?

6 A It was reported by Merriman.

7 Q Excuse me. That is the study you had in mind, is

8 that right?

9 A I say that is a good example. There are numerous

10 examples of these kinds of indirect effects given in the --

11 do you have the list of citations in the paper?

12 Q Yes.

13 A In Reference 2?

14 Q Yes.

15 A Yes.

16 Q Reference 2 -- just a moment. This is the list

17 of references having to do with your testimony. I have the

18 bibliography -- DeSilva, Donald P. DeSilva, right? And you are

19 relying, in addition to the Merriman Study at Connecticut Yankee

20 on the DeSilva Study of 1969 for this statement?

21 A Yes. There is a lot of general and specific infor-

22 mation on this subject. But I think the one I mentioned is

23 a good illustration, where they specifically measured what

24 happened and it is not speculation, it is an exact piece of

25 field data.

7 Reba 4

Q And you consider that the DeSilva study, or for that matter the Merriman study, demonstrated that the operation of steam electric power plants reduces the size and vigor of natural populations without causing immediate or visible kills?

A Yes, that is part of it. There is considerable more literature. Charles Coutant talks -- and other people -- talk about critters that have been thermally shocked ---

Q Critters, did you say?

A Fish that have been thermally shocked by power plants, then being returned to their natural habitat, back to the river, estuary, whatever, and they being vulnerable to predation. So where the fish are not killed outright in the plant, the size of the population is reduced, because the fish are preyed on, they are easy game for predators.

That is the way in which the population is reduced. The fish are killed by being eaten by other fish.

Q Coutant's study did not indicate the size of the population -- didn't actually make a population study, did he? He was looking at predator-prey relationships, is that right?

A Yes.

Q In the Merriman Study at Connecticut Yankee, the fish that were examined were in the fish canal, wern't they, not in the river?

A They were living in the heated discharge effluent of the plant.

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Reba 5

Q In other words, they were not actually out in the river?

A They kind of go back and forth as I understand it, they go out with the plume and come back in, they can travel freely, they can communicate between the river and the discharge canal, as I understand it.

Q But the study by Merriman was of fish in the discharge canal?

A Sure, that is where they are easy to catch.

Q Right. Now with regard to page 3 of your paper, are you familiar with the -- pages 2 and 3 actually where you talk about the effects on critical functions -- are you familiar with the temperature gradients forecast for the plume from Indian Point 2 when it is operating at full power?

A Generally familiar, yes.

Q Would you describe what your understanding of this is?

A Are you talking about a physical description of the isotherms?

Q A physical description of the heated plume as it emerges from the submerged discharge ports.

A Yes, you know, I have seen drawings and I have heard the discussions and read some of the material. And I think -- would you like me to explain how I ---

Q Yes, would you mind explaining for us ---

Reba 6

A Can I draw something?

Q Yes, if you choose to do so, go ahead.

A Looking down the river, in cross-section ---

Q Yes.

A You are going to have some kinds of an installation of a discharge, series of discharge ports and so on here, beneath the surface of the water.

Q What you are describing is the east bank of the river, is that right?

A This is the east bank and this would be the plant here (drawing on the blackboard). And this is just the river bottom, some kind of concrete thing there with holes down here, rectangular holes. My understanding is that during a warm and middle temperature part of the year, not in the winter, when the plume is buoyant, and does not sink like it does in the winter, this plume, as I understand it, would tend to rise to the surface in some such shape or fashion as this (drawing) and the heated water would tend to go off at the surface and extend across the river and would, at times, be as much as one degree on the far bank or three degrees at 2500 feet from here, so that you had a three degree there and one degree over here, you could kind of draw a two degree isotherm like this, and 3 and 4 and it would get more and more intense here, until you get down to the original delta T coming out of the discharge there.

7

Reba 7

At the surface this thing would take varying shapes and forms depending upon the tidal flow, I understand.

Q Do you understand that what would happen is as the heated water was discharged from these ports it would very rapidly entrain river water with it?

A Right.

Q This cone of water would rise very rapidly, entraining water as it rose, then it would come up to the surface, and would be being cooled all of the time as it rose to the surface, is that how you understand it?

A Yes. I understand the best jets on diffusion on this might get, oh, 10 to 1, a dilution rate of 10 to 1.

Q Right. And do you understand that the greatest delta T which would be seen just as the heated water emerged from the dicharge port would dissipate within a few feet, a foot or two? Is that the way you understand it?

A No.

end

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Q How do you understand it?

A Over some distance. I don't know what the exact distances are. You asked me for my general understanding and that is the best I can do. I don't know what the actual distance would be involved to the point where you would have say a 20 percent or 30 or 50 percent reduction in the average temperature of that body of water. It is still the same amount of heat, it is just being spread around is all.

Q You are not familiar with the actual dimensions of the isotherms as that cone of heated water rises up to the surface, are you?

CHAIRMAN JENSCH: As projected.

MR. TROSTEN: As projected, right.

THE WITNESS: I know you are shooting for a New York State thermal criteria thing, trying to meet a particular standard and I am trying to remember whether that is a 300 foot radius, four degrees, and 1.5 degrees, depending on the season or not.

BY MR. TROSTEN:

Q I am really not shooting for that. I am trying to understand your understanding of how this plume looks and operates so I can understand the basis for your testimony.

A Yes. Well, my idea would be that the main mixing area would be something like this (drawing on board), and that you would have accomplished most of your dilution

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diminishment of temperature within maybe hundreds of feet or 100 feet or some rather short distance.

CHAIRMAN JENSCH: Are you asking him to recall what is in the record, or do you want to submit the record to him, something you have projecting what would happen when the plant is operating at full power?

MR. TROSTEN: What I am trying to get at --

CHAIRMAN JENSCH: I just wonder if you would get a memory on distance that would be contributory to your consideration.

MR. TROSTEN: All I am asking him is to explain to us the plume as he understood it when he prepared his testimony and described the interferences that would occur to the critical functions.

CHAIRMAN JENSCH: Did he rely on something in the record?

MR. TROSTEN: I don't know. Perhaps he could explain that.

THE WITNESS: Yes. I have seen this projected in various ways. I have even got a drawing of the isotherms for Indian Point in my Scientific American article on thermal pollution. So starting back about in '68 or '69, I first began to get familiar with this. Now a number of Dr. Lawler's papers, as I recall it, and studies have shown this effect in various ways. And somebody from the AEC, as I

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3mil

recall it, explained in detail to us how this mixing occurs. I think it was on a trip we made to Oak Ridge when we were talking to the AEC people down there. But this still is only the summer situation. In the winter you get a whole different kind of a set-up, because the water is not going to be buoyant as it comes out of the ports. The water is going to sink after the temperature of the water gets down below about, oh, 39 or 38 degrees, you are going to have the hot water coming out of there and before the momentum of the water at the point where the momentum of the water falls, that water is going to sink, if it is hotter than the surrounding water.

In other words, if this is 33 degrees, the ambient temperature, and you are putting water in there and it gets down to, say, 40 degrees, or 41 degrees, it is going to sink, it doesn't rise. So this whole theory is completely erroneous for winter conditions.

BY MR. TROSTEN:

Q We will get to the matter of the sinking plume later. You did say earlier that you are not an engineer. Is that correct?

A I am certainly not an engineer. I am a fish ecologist.

Q Right.

A I just try to do the best I can to understand

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what these guys are all talking about.

Q Right. Now I would like to turn to the matter of the siting of power plants and the discussion that you have of critical areas for Hudson fishes. I would like to examine more the basis for your opinion about the importance of the location of the Indian Point power plant relative to the Hudson River fishery. In your opinion, Mr. Clark, is it central in siting a power plant to select a location and a mode of operation that will add the least impact on aquatic life and on the aquatic environment? I am quoting, by the way, here from page 3, I believe, of the July 14 testimony. Maybe it is -- well, it is in there.

CHAIRMAN JENSCH: I wonder if I could have the citation. I didn't understand he got into power plant siting; maybe he did.

THE WITNESS: Mr. Trosten, is it the bottom of page 2 that you are looking for?

MR. TROSTEN: Yes. No, wait a minute. We will find the reference in just a moment, Mr. Chairman. I will go to another question.

BY MR. TROSTEN:

Q With regard to page 2 of your testimony of July 14, is it true that there are very substantial variations in the reported size of populations of various fishes?

CHAIRMAN JENSCH: In the Hudson River?

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BY MR. TROSTEN:

Q In the Hudson River?

A Perhaps you could just indicate the part of the page you are referring to? It is easier for me to scrutinize your question if I can look at what you are quoting from.

Q I was simply quoting here, Mr. Clark, or referring here to page 2 in which you are referring to types of critical functions and areas, and to the importance of these critical areas and critical functions to the life of fish populations. It is a general discussion that appears under "types of critical functions and areas."

A Like in the third paragraph and fourth paragraph on that page?

Q Yes.

CHAIRMAN JENSCH: I wonder if I could have the question again, please.

BY MR. TROSTEN:

Q Is it true that there are very substantial variations in the reported size of populations of various fishes?

CHAIRMAN JENSCH: Reported by whom?

MR. TROSTEN: Reported by various fishery biologists, various investigators studying the size of fish populations.

MR. MACBETH: Could Mr. Trosten be a little more exact about which reports he has in mind? I think it would

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1 help to focus the question considerably.

2 MR. TROSTEN: I am simply getting at the question

3 of whether or not various persons who have studied the Hudson

4 River have reached different conclusions as to the size

5 and have reported that there are different size populations

6 of fish.

7 MR. MACBETH: You don't want to tell us which

8 various persons?

9 CHAIRMAN JENSCH: Fishermen, the fellow with the

10 line who goes out and complains he can't get a fish and reports

11 the population is off, is that the kind of report or documented

12 information?

13 MR. TROSTEN: I am simply getting at the question

14 of whether or not there is a question in the minds of those

15 who have studied the Hudson River as to whether the population

16 is this or that size or some other size. Would you say that

17 that is a matter of some dispute among people, among biologists,

18 among qualified persons who have studied this area?

19 THE WITNESS: What the absolute size of the Hudson

20 population of various species of fish might be?

21 BY MR. TROSTEN:

22 Q That is right.

23 A Yes.

24 Q Now would you say that such factors as temperature

25 affect the various activities that you describe as critical

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in the fourth line from the bottom on page 2? Here you are starting to talk about areas of critical function.

A You are asking me if I think heat --

Q Yes.

A Well, you have to understand that heat doesn't affect fish. That is a misunderstanding that people have in talking about power plants. It is the temperature.

Q Temperature. Excuse me.

A That is very important to discriminate.

Q I agree with you. I should have used the word temperature.

A Yes. That is what the fish are reacting to, a particular temperature is what you measure and that is how you determine it. Yes, it does affect it.

Q How about such things as drought or fresh water run-off? Would those things affect the critical functions, too?

MR. MACBETH: Could we take these one at a time, please?

BY MR. TROSTEN:

Q Sure.

A Variations in the amount of fresh water coming down the river?

Q That is right.

A All of the 12 species, or any one?

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Q Let's take any one.

A It would have an affect.

Q It would have an effect?

A Yes.

Q How about the availability of food?

A That would definitely have an effect.

Q How about the abundance of predators?

A That would have an effect.

Q Supposing the breeding function of one of these species like the striped bass, or let's take some other species -- supposing function of one of these species was disrupted one year by unusual flooding such as we had in the spring of 1972. Would this cause the size of the population, if you accept that premise, would this cause the size of the population of the species involved to decline permanently, in your opinion?

A What do I get into if I accept your premise? Do I have to to answer this question? I don't know of any deleterious effect on the spawning of any species caused by flash floods. I don't know -- by any kinds of excessive run-off. I don't know of any deleterious effect on the reproduction of any fish.

Q Would you accept the premise that severe flooding, such as we had in the spring of 1972 in the Hudson River that pushed the salt zone down, I believe, to its lowest recorded

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point in the history of the records, I think, I could be wrong about the --

A Was this hurricane Agnes?

Q In June, severe rains in June. Would you say that something like that could completely disrupt the breeding activities of a species in one year?

A If you are talking about critical functions and areas, it could conceivably move it. I would expect -- let me simplify it -- yes, I would expect a big flood of fresh water coming down the river has to affect somebody living in the river, because it is just too much of an impact not to have some kind of effect. But I wouldn't accept your premise that it is negative. It might be positive.

Q Would you accept the premise that some severe natural phenomenon like a severe flood could severely disrupt -- I won't say there was no breeding -- but really severely negatively disrupt the breeding function or some other what you call critical function of a species in the Hudson River?

A I wouldn't want to answer that one way or another. I don't think I can without, you know, really searching around to try to see if there is any definite evidence of any cause and effect relationship of that kind. It is a very complex question. I would be glad to come back to it later if you give me time to think into it.

Q So you are really not sure what it would do, one way or another.

MR. MACBETH: I object to that as a characterization of the witness' last reply.

THE WITNESS: What I am saying is I am sure it would have an impact but --

MR. MACBETH: Just a minute.

CHAIRMAN JENSCH: I think the interrogator is hoping to get into some doubt about this situation. I think he said he would have to study it to give an answer. I think there might be a question of whether your characterization truly reflects his answer. I think it may be argumentative. The objection is sustained.

BY MR. TROSTEN:

Q Would you say you are not sure at this point on the basis of your present analysis of the facts, that I have presented to you, whether this would completely disrupt --

A I would leave it open as something that could happen. It is a possibility.

Q Would you say that such an event such as I have postulated, a very severe flood, for example, would this, in your opinion, cause the population of one of these species that you have identified in Table 1 in your July 14 testimony to decline permanently?

A Would a natural --

Q Natural disaster of some sort.

A Force, or disaster, could it --

Q A very severe natural phenomenon, could it cause the population of one of these species, like the striped bass, to decline permanently?

A I think if the habitat were damaged in some permanent way, removed or altered, such that the system could no longer support the same quantity of that species, I would think it could happen.

Q But if the habitat were not permanently damaged in some way, for example, if the flood came down, but left the river pretty much the way it was before, you don't think it would cause the population to decline permanently?

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1 A I can't -- it is very hard to have an opinion
2 on a hypothetical question like that, because the issue is so
3 complicated and there are so many possibilities. As a general
4 idea in situations like this, the fish is depleted, but very
5 often other fish will move in and take its place and more
6 or less permanently exclude that other fish from building back
7 up in its population.
8 On the other hand, you could expect certain fishes
9 to be able to restore themselves.
10 Q So you say it is a pretty complicated subject, isn't
11 it?
12 A It sure is, very complicated.
13 Q How about several years of disruption? Supposing you
14 had two or three years of severe drought back in 1964, you may
15 recall we had a very severe drought and for a few years there was
16 very little water in the New York area, things of that sort.
17 Suppose you had several years of severe unusual natural
18 phenomena, like severe flooding or severe drought or very unusual
19 climatic conditions for a period of three or four years, where the
20 temperature was say five degrees maybe or more below its normal
21 range for a period, for the spring months?
22 MR. MACBETH: I object, Mr. Chairman, on the grounds
23 that there are at least three questions there. We have had
24 floods, drought and change of temperature. I think you
25 really have to take these one at a time.

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MR. TROSTEN: All right, sure.

THE WITNESS: I can give you a kind of answer --

MR. MACBETH: I would prefer Mr. Trosten restate the question.

CHAIRMAN JENSCH: The objection is sustained.

BY MR. TROSTEN:

Q Supposing you were to have a series of years of extreme flooding. Do you think that this would cause the population of one of these species you have indicated to decline permanently?

CHAIRMAN JENSCH: Do I understand the term decline permanently to mean be totally eradicated from the river.

MR. TROSTEN: No, the population would be reduced at a lower level and stay at some lower level, not necessarily nil.

CHAIRMAN JENSCH: That is you are assuming he should consider in his answer that they do not have a capacity to restore themselves, even though there may have been a diminution in numbers over a period of time, is that your thought.

MR. TROSTEN: I don't know, Mr. Chairman.

THE WITNESS: I think it would depend upon the individual type of fish in relation to the habitat in which it is attempting to live, and the degree of compensatory mechanism that is in that particular species of fish in relation to food supplies and predators and so on. There are fish that are capable of compensating for such losses and returning to their

1 their prior level, if the habitat hasn't been damaged, and
2 there are fish that tend not to do that.
3 BY MR. TROSTEN:
4 Q How about the striped bass? Do you think if
5 you were to have severe flooding for several years running, such
6 that the salt front was pushed considerably further down the
7 river than it normally is, in your judgment would that cause
8 the population of the striped bass in the Hudson River to decline
9 permanently?
10 A It probably would cause a very, very long term
11 decline, a decline of the kind that would take many, many,
12 many years to restore itself, because, you know, you have this
13 effect on the generation of spawners, and then there is
14 a feedback from that, and then there have to gradually be more
15 fish born and more spawners and so on to restore it back.
16 Q Do you think it would come back eventually?
17 A I would expect over a long term base -- I would
18 hesitate to say how many years, but you could think in terms of
19 30 years or so, 40 years, 50, it should be back.
20 Q Now, do you have any data that demonstrate that this
21 has ever occurred in a fish population in the Hudson River?
22 When I say "this" I mean through some combination of natural
23 phenomena, like flooding or drought, to take two examples, that
24 there has been a permanent decline in the fish population
25 in the Hudson River?

A That is very complex, trying to separate the natural from unnatural. There is fishing, pollution, man's effects, power plants, sewage, et cetera, and on the other hand, you know, there is rain and run-off and sunshine, sun spots, all of this stuff. There are fish populations in the Hudson River that have diminished. The white perch has gone down precipitously, the shad seems to have declined over a long range of time. The striped bass, it is difficult to know at the moment. It may be on the precipice of an extreme decline or it may be just going to drop a little and then hold its own, I am not sure. But there are examples of fish that for either natural or unnatural or some combination of these two reasons, have declined and seem to be at a lower level now in the Hudson.

Q But there are no data, are there, which demonstrate that this has actually occurred as a result of natural phenomena?

A Not to my knowledge.

Q Can you tell me what data exists -- I am referring now to page 3 of your testimony -- that the survival and high abundance of a species depends upon conditions in each of the critical areas that you describe?

A Yes.

Q Would you tell me what those data are?

A I am sorry, I misunderstood your question.

Q My question was what data exists that demonstrate that

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1 the survival and high abundance of a species depends upon
2 conditions in each of the critical areas that you describe
3 in Table 1?
4 A That is general knowledge.
5 Q Well, are you saying that it is general knowledge
6 that if conditions are poor in one of these critical areas that
7 the survival of the fish species -- I am talking about conditions
8 in one of these critical areas for a particular period of time --
9 that the survival and high abundance of that species depends
10 upon conditions in that particular area.
11 A Sure. If you kill all of the eggs or kill all of
12 the larvae on the nursery grounds, you are not going to have
13 anything left. I mean just that one impacting at one point,
14 that one critical key point in their life history will be
15 sufficient to reduce the population. You don't have to have
16 bad conditions in each one of the areas simultaneously.
17 Q What data demonstrate that the population of fish are
18 severely depleted by disrupting a breeding area, for example?
19 A Well, I would say that the salmon probably is one of
20 the best examples, where, as the breeding areas have been
21 polluted or demolished or eradicated, they have had to switch
22 to these spawning channels, they have had to actually
23 build gravel beds for them to spawn on, they have had to go
24 in and try to take the silt off and so on.
25 Q That is another one of those cases of destruction of

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1 the habitat, isn't it?

2 A Of the spawning area of anadromous fish, that would

3 be what that would be an example of.

4 Q Okay. What happened that disrupted that spawning

5 area?

6 A Erosion or pulpmill, sawmill wastes. Or the combina-

7 tion of erosion and scouring of a stream bed, once you take the

8 trees off you get fast flash floods and scour the gravel beds,

9 dig out the eggs from the rocks and they can't survive

10 unless they are down in the rocks.

11 Q Is it correct that each of the species you list

12 in Table 1, Table 1 is widely distributed and not endemic

13 to the Hudson River?

14 A Widely distributed.

15

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Q. And not endemic to the Hudson River?

A. You are asking me if they all are?

Q. Yes, is that not correct?

A. By endemic, you mean unique?

Q. Yes, peculiar to the Hudson River.

A. I don't know any other place where there are short-nosed sturgeon. You know that is an endangered species. Insofar as I know, there aren't -- they have been reduced down quite a bit and I don't know that there are short-nosed sturgeon living in any other river system in the country. This may be the last resort for that particular species.

Q. I see.

When you say in your notes to Table 1, which appear right after the table, that the estuarine areas of the Hudson are heavily impacted by Indian Point operations -- do you see where you say that? It is not a numbered page, at least mine doesn't have a number on it. It comes after Table 1 in the July 14 testimony. It is a series of notes.

A. Footnotes to the table?

A. Yes. There is an item called "HE" and the last sentence says, "This is the area heavily impacted by Indian Point operations."

Do you see that?

A. Yes.

Q. My question about that is this: When you say that

1 this estuarine area, that this is the area heavily impacted by
2 Indian Point operations, you are basing that conclusion, are
3 you not, on the assumption of percentages of entrainment and
4 complete mortatlity and the numbers of fish impinged, which
5 are contained in your October 30 testimony, isn't that true?
6 A. Well, whatever you might do with your plant up
7 there, heat or chemicals, you know, whatever we find out is
8 going to be damaging. It would be impact. That is adverse
9 impact.
10 Any of these things are adverse impacts, not just
11 entrainment or impingement.
12 Q. You are basing it on all of the conclusions that
13 are contained in your October 30 testimony about the specific
14 adverse impacts, isn't that right?
15 A. I think I am talking about what is in here. This
16 is the July 14 testimony.
17 Q. In other words, you are basing that statement on the
18 adverse impacts which you consider exist and which you
19 describe in this July 14 paper.
20 Is that right?
21 A. Yes, and what I said back in, I think April --
22 didn't we have another go around in April where I did some
23 testimony?
24 Q. You had an earlier version of your October 30
25 testimony?

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A. Yes, back in April. April 5?

Q. Right.

Now when you refer on the top of page 4 -- you have a sentence that says, "This is especially true where a power plant is located on a narrow reach of an estuary."

Is this another case where you were referring to a theoretical or hypothetical plant? You weren't referring to Indian Point I, were you?

CHAIRMAN JENSCH: What is the preceding sentence? I think the context of the preceding sentence would help.

MR. TROSTEN: "It is quite possible to deplete severly a population of fish by disrupting its breeding or nursery area, or by interfering with its movements along a migration pathway. This is especially true where a power plant is located on a narrow reach of a river or estuary."

THE WITNESS: That is an admittedly general and inprecise word when you say narrow reach of a river.

I just mean anything that constricts them in their lateral movements.

BY MR. TROSTEN:

Q. You use the term constricted on the bottom of page 5. You say, "Thus most young fish have to pass the constricted Indian Point site."

I just wondered, were you really referring to the Indian Point site there, or just anything generally?

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A. No, I am thinking --

MR. MACBETH: Could I be clear? When you say "there," are you referring to the top of page 4 or bottom of page 5?

MR. TROSTEN: Let's talk about the top of page 4.

THE WITNESS: What I am trying to do here is just set the general case -- yes, as a general situation, in general, a general problem that emerges in terms of migration of fish.

I think obviously I ma going to get back here -- you have already read past page 5, and you see, I come back to that when I talk about Indian Point later on and say that there is some kind of constriction going on there.

BY MR. TROSTEN:

Q. Yes, I see you setting the general tone there, and then building on that on the next page.

A. Right.

Q. What I wanted to know is how wide is the river at Indian Point?

A. ~~About~~ about a mile.

Q. Abour 4500 feet, isn't that right?

A. I will take your word for it.

CHAIRMAN JENSCH: Doesn't the record show something?

MR. TROSTEN: Yes, it is 4500 feet from shore-to-shore.

sw5 1 CHARIMAN JENSCH: Then let's go on.

2 BY MR. TROSTON:

3 Q. Do you consider that to be a narrow reach of a

4 tidal river?

5 A. I consider the channel area to be narrow, which is

6 the area where they are supposed to migrate, which is close

7 to the power plant.

8 The channel at Indian Point does a strange thing,

9 which is cut close to the bank where the power plant is, and

10 it brings the fish right, the ones that go up and down the

11 channel, right close to the plant. That is what I mean by

12 constricted.

13 Q. I was going to go into that later, but let's do it

14 now. Let's look at Figures 3 and 4 of your testimony.

15 Do yousee where you have drawn the channel, the

16 drawing there, that shows the channel?

17 A. Yes.

18 Q. Then on Figure 4, you show a profile of the river

19 at Indian Point, and then you have a migration pathway in

20 category A.

21 A. Yes.

22 Q. How does the U.S. Coast and Geodetic Survey define

23 the channel at Indian Point? Do you remember that map you were

24 using at the last session of the hearing?

25 A. This one?

sw6

Q. Right.

A. Is it all right if I take the time --

CHAIRMAN JENSCH: If you ask about a document, please refer to the document in every case.

THE WITNESS: I see the marker buoys, with C, B, and T, is that what you are referring to?

BY MR. TROSTEN:

Q. Does the Coast and Geodetic Survey define the channel as everything that is 18 feet or more of water? Isn't that how the U.S. C and GS defines the channel?

A. I don't know how they define the channel. I just went by the marker buoys.

Q. Is that what you were relying on?

A. I took a cross-section of this from somewhere, I don't remember where. This just traced off a cross-section of the river, maybe from Dr. Lauer's paper.

Q. Can you tell me the basis for you drawing the channel there as you did?

A. That is the natural contour of the river.

Q. What do you mean by the natural contour of the river.

A. I mean the line that you see which is supposed to represent the bottom there is a profile of the natural contour of the bottom of the river at Indian Point, if I have drawn it right.

Q. Well, the river has a profile, and it has various

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depths.

A. Well, I will tell you, I can simplify it, when I think of a channel, I think of the deepest possible part of it, and if you look at the chart, you will see that is maybe 8 800 feet, 700 feet, 600 feet, or something that looks less than a fifth of the way across the river to me, that deepest part.

That is what I think of when someone says, "Where is the channel," I say, "Where is the deepest part?"

Q. In other words, this is just your own feeling as to how you define a channel?

A. Well, I know what a channel is as well as you do. I am saying the channel is the deepest part of the river. In my opinion, you locate the channel by locating the deepest part of the river.

Q. So that is the basis on which you drew the channel?

end 10

A. Well, sure.

1 Q Is there any other basis upon which you define the
2 term channel?
3 A No, the channel is the deepest part of the river.
4 I don't see any argument about that from anybody.
5 Q All right. Let's consider that a little further.
6 Will you accept the fact that the Coast and Geodetic
7 Survey defines the channel differently than you have just
8 defined it?
9 CHAIRMAN JENSCH: Will you show him the document,
10 please.
11 MR. TROSTEN: Yes, I will undertake to do that.
12 I don't have the document.
13 CHAIRMAN JENSCH: Let's defer the question until
14 you have the document.
15 MR. TROSTEN: All right.
16 BY MR. TROSTEN:
17 Q Will you tell me, Mr. Clark, what data supports
18 your conclusion that the migration pathway of fish is as
19 shown in figure 4?
20 A I got most of that, my specific ideas on that,
21 from Dr. Raney, who spent, you know, who knows more about
22 what goes on specifically with the movements of fish in the
23 river than I do. I would say he would know more about this
24 than I would. I took it from his testimony, where he said
25 they migrate over the channel in the upper 20 feet of the

1 river.

2 Q You are saying -- are you able to tell me what

3 section of the transcript you are referring to?

4 A Sure.

5 Q Would you do that?

6 A Right. You will find it on page 5971.

7 Q Thank you.

8 You are referring to Dr. Raney's statement, "The

9 depth at which migrating fish are found varies with the

10 species, the time and surface temperature, the salinity and

11 a number of other variables."

12 A Yes. What specifically I used was his statement

13 at the end of the next paragraph where he says, "Most of

14 them are found in the upper 20 feet of the water."

15 Q "Most of them are found in the upper 20 feet of

16 the water." Is that in the next paragraph?

17 A That is based on his experience in the Delaware,

18 which he is applying to this.

19 Q "In my experience in the Delaware, and that is

20 where my experience has been --" I see.

21 Now, looking at your chart, the upper 20 feet of

22 water runs how far across the river, roughly?

23 A Excuse me?

24 Q Looking at your figure 4, how far across the river

25 would you say the upper 20 feet of water runs?

A The 20-foot depth contour on the west side of the river comes in there; it looks like about 2/5ths of the way across from west to east. Is that what you mean?

Q I want to know how far across the river would you say you get 20 feet of water.

A Well, it ends where there is no more depth of water as deep as 20 feet at a distance of about 3/5ths of the way from the power plant west going across the river. The last 2/5ths of the river apparently are shallower waters than 20 feet.

Q He is talking about migrating in the upper 20 feet, right?

A Yes.

Q That means that you could be from the surface down to 20 feet, right?

A Right.

Q How far would you say that you get, looking at your own figure here, figure 4, how far would you say you get water that ranges down toward about --

A It is less than 20 feet? Oh, you get water all the way across. Where there is water, there is water less than 20 feet. I guess I complicated the question; I am sorry.

Q In other words, if you look at where you get water that ranges down to 20 feet, it runs practically across the

1 river, isn't that right?

2 A Right.

3 Q Okay.

4 A It has got to be. If there wasn't any water,

5 there wouldn't be a river.

6 Q My point is simply that we were trying to explore

7 how you concluded you could draw that dotted line down the

8 center there --

9 A That is the channel.

10 Q Oh, that is your definition of the deepest part

11 of the river, right?

12 A The fish migrate in the channel, getting back to

13 the channel.

14 Q A moment ago you were talking about reliance upon

15 Dr. Raney's testimony as being the basis for defining the

16 migration pathway in figure 4. And we have just been

17 exploring what Dr. Raney was saying.

18 A Yes, over the channels near the surface, so the

19 first thing is, you know, where is the channel, and the

20 second thing is where is that surface block of water.

21 That is what I drew in there. I went across the channel and

22 down to the 20 feet to show a cross section of the fish, that

23 to my best knowledge might be the migratory pathway of most

24 of the fish Dr. Raney was talking about.

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25 Q Mr. Clark, at the break, would you look back at

1 the June testimony and find the place where Dr. Raney
2 testified that the fish migrating over the channel, that
3 is over the deepest part of the river near the surface, would
4 you do that for me?
5 A All right.
6 Q Let's go back to the body of the text.
7 Mr. Clark, you say on page 2 that it is absolutely
8 essential to avoid siting power plants in these areas of
9 critical function. Are you saying that it is absolutely
10 essential to avoid siting power plants in these areas
11 regardless of what the financial costs of the siting may be?
12 MR. MACBETH: I object to the question on the
13 grounds that this is really going beyond the expertise of the
14 witness. He is, I think, discussing this from the point of
15 view of the effect on fish life. If Mr. Trosten would
16 confine himself to that, I think that would be appropriate.
17 CHAIRMAN JENSCH: I can't hear you; excuse me.
18 MR. MACBETH: We are not offering Mr. Clark as
19 an economic expert.
20 CHAIRMAN JENSCH: May I have the question read,
21 please.
22 (The reporter read the pending question.)
23 CHAIRMAN JENSCH: I think he should explain his
24 statement, what factors he considered. The objection is
25 overruled.

1 THE WITNESS: I would have to explain that my
2 expertise not being in economics, it is a very difficult
3 question you have asked me to answer. I think if you read
4 the next sentence or two, you will get the tone of what I
5 am trying to say, which is using the maximum feasible
6 safeguards in situations where for some reason or another you
7 have already gone ahead and done something you should not
8 have done, at least use the maximum safeguards to try to
9 correct the situation.
10 I think in view of that you will understand what
11 I am trying to say, that it is essential to avoid putting
12 a power plant in an area where you are just going to wipe
13 out the fish, when you could just as easily put it somewhere
14 else.
15 BY MR. TROSTEN:
16 Q Just as easily?
17 A Well, almost as easily.
18 Q Do you believe that it is essential to avoid
19 siting, absolutely essential to avoid siting power plants in
20 these areas regardless of what the total environmental costs
21 of the siting in those areas versus other areas may be?
22 A I think your judgment has to be -- let me see if
23 I can get to an answer to your question and let me explain
24 and tell me if I am not really answering it, and I will try to
25 sharpen it up; but there is no exchange basis; there is no

1 coin for this, coinage for this trade-off. People are
2 always talking about between how much you can harm the
3 environment and what it would cost you to fix the plants so
4 that it worked right, or put the plant somewhere else. There
5 is always talk of trade-off between the adverse ecological
6 impact versus the economic hardships to the utility in
7 spending the extra money to site it somewhere else or put in
8 towers or whatever.
9 But there is no system that we have which can
10 compare priceless values of our natural heritage, the value
11 of the fish in recreation to people that catch the Hudson
12 River fish, not only in the river, but up and down the ocean,
13 there is no way you can compare that to "X" bucks per megawatt.
14 There is just no way of doing it.
15 So, you get me to a point of not being able to
16 answer your question, nor do I think an economist would.
17 I think it takes somebody of social wisdom to decide this,
18 not technicians, because there is no computer model; there
19 is no coin or exchange or trade-off basis.
20 All we can say is that, you know, from my stand-
21 point, let's save every way we can our fish and wild life
22 and our natural heritage and our ecology by making judicious
23 decisions about the placement and operation of these plants.
24 I can't go further and say if it is going to cost
25 you a hundred million dollars more to put the thing out in

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1 the ocean or some safer place than up in the river, that

2 that is a proper trade-off or not.

End 11

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BY MR. TROSTEN:

Q. I guess you must have misunderstood the question, I wasn't asking you about financial costs, I was asking about total environmental costs.

Could you direct yourself to the question and answer that?

CHAIRMAN JENSCH: So I can understand the question, what environmental costs do you say might be involved?

MR. TROSTEN: What could be involved, for example, Mr. Chairman, would be the matters that are considered in the Final Environmental Statement by the Staff, and that is the possibility of fogging, the possibility of adverse effects on the people in the area due to icing, the possibility of salt deposition, the possibility of adverse aesthetic effects, things of the sort that are considered in the cost-benefit analysis of the staff.

CHAIRMAN JENSCH: Now, your question is if those things are present from cooling towers, should those things be considered, is that the question?

MR. TROSTEN: My question was: Does Mr. Clark believe -- I just want to ask him this question so we can all understand the premise upon which he proceeds -- does he believe it is absolutely essential to avoid siting power plants in these areas of critical function, regardless of what the total environmental costs of siting the plant in that

1 area versus some other area or regardless of the total
2 environmental costs of the altenrative that is under con-
3 sideration versus some other alternative that is also being
4 considered.
5 THE WITNESS: No, I wouldn't say that you just
6 make an automatic choice without looking at the total
7 environmental impact. You have to look at the critical
8 functions of people, too.
9 BY MR. TROSTEN:
10 Q. Thank you, Mr. Clark.
11 Now, with regard to page 4 of your testimony,
12 the following language appears in the first paragraph:
13 "Controls on plant regulation must be
14 considered in this context. In order to provide
15 sufficient protection, these controls must be
16 based upon the worst case predictions of adverse
17 impact."
18 Do you see that?
19 A. Yes.
20 Q. I am focusing particularly on the sentence that
21 starts "In order to".
22 MR. TROSTEN: Mr. Chairman, I move to strike this
23 sentence on the grounds it is a conclusion of law and,
24 further, it is without foundation in the record for Mr.
25 Clark to express such an opinion.

1 MR. MACBETH: I object to that, Mr. Chairman, on
2 the grounds that it is Mr. Clark's opinion as to what is
3 sufficient protection, which I think is a question within
4 the area of his expertise and it is a perfectly appropriate
5 opinion.
6 The Board can take it for whatever weight it
7 wishes to give it.
8 CHAIRMAN JENSCH: The Board does not construe
9 that statement as being a statement of a legal requirement.
10 We understand the statement to be the gentleman's opinion
11 as to what he thinks is a practical operating type con-
12 sideration.
13 There may be points of disagreement about it, but
14 it is his opinion that for the protection of the environment,
15 some of these factors should be considered.
16 The motion is denied.
17 Proceed, please.
18 BY MR. TROSTEN:
19 Q. Mr. Clark, have studies been made of other
20 power plants located on rivers which are similar to the
21 Hudson River with regard to the species which you list in
22 Table 1?
23 A. I just want to clarify it, so I am sure I am giving
24 you the right answer.
25 Q. Sure.

A. You are asking whether there have been studies of fish in situations, other rivers where there are power plants?

Q. No, my question was have there been studies of other power plants located on rivers which are similar to the Hudson River with regard to the species which you have listed in your table, other power plants on rivers similar to the Hudson River concerning the species that are listed in Table 1.

CHAIRMAN JENSCH: The same species.

MR. TROSTEN: That is right.

THE WITNESS: I would answer to this extent, I don't know that all of the 12 species will have occurred in the studies of other plants, but there are power plants on other rivers -- by this you must mean estuaries, because these are mostly estuarine -- there are places where this has been studied before for some of these species, but I don't know about all of them.

Q. Could you give me some examples?

And remember, I am talking about rivers similar to the Hudson River.

A. I suppose you could think about the Delaware. I am not familiar with the study of it. I know Dr. Raney has been doing some studies down there.

Of course, I know about the Haddam Neck study.

1 I suppose that answers your question.

2 There is one big river on either side of the

3 Hudson.

4 Q. Now, the Delaware River is a pretty good sized

5 river. How large is the Connecticut River?

6 A. I think it has an average flow of around -- this

7 is stretching my memory -- I think it has an average flow

8 similar to that of the Hudson.

9 Q. Similar?

10 A. Similar.

11 Q. An average of what type of flow?

12 A. Fresh water flow.

13 Q. Average fresh water flow?

14 A. Yes.

15 MR. MACBETH: Mr. Chairman, perhaps for this kind of

16 question, it is really in the general open literature and it

17 is not directly in Mr. Clark's expertise, perhaps the

18 applicants could supply numbers and see whether Mr. Clark

19 agrees with them or not.

20 It doesn't seem too helpful to stretch Mr. Clark's

21 memory as to just what the flow is in the Connecticut. That

22 is not really a subject on which he has come prepared.

23 CHAIRMAN JENSCH: Of course, I think the premise

24 of the question is a river similar to the Hudson.

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25 From what I hear about the Hudson, there is only

1 one Hudson and none like it.

2 You can give us an enumeration of what you think

3 are similar rivers and ask him if he knows of studies on

4 those rivers.

5 I think the premise of the question is somewhat

6 confusing.

7 MR. TROSTEN: I would be prepared to have Mr.

8 Clark simply tell us the estuarine rivers where these

9 studies have taken place and we can draw our own conclusions

10 as to whether these are or are not similar.

11 CHAIRMAN JENSCH: Let the record show, if you

12 will, what you believe to be similar and maybe you can supply

13 statistics as to what the flows are in the Connecticut or

14 Delaware and the Tennessee and whatever else you think would

15 make similar conditions.

16 Let's have the question understood to be restated.

17 Do you know of any rivers whre similar studies

18 were undertaken?

19 THE WITNESS: Yes.

20 BY MR. TROSTEN:

21 Q. Which rivers were those?

22 A. Examples are the Connecticut and the Delaware.

23 Q. All right.

24 Have those studies you just cited, the studies

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25 on the Connecticut and Delaware Rivers shown that adverse

1 effects have occurred as a result of power plant operation
2 on these fish species?
3 A. I can't say about the Delaware.
4 As I mentioned before, I am not familiar with
5 their results.
6 Not too recently I read Merriman's stuff on the
7 river and to the extent that he made the measurements, he
8 hasn't found any -- well, of course, there aren't striped
9 bass there either.
10 Q. He hasn't found any what?
11 A. I say there aren't striped bass in that river
12 and that made me think what fish are we talking about.
13 Then I had to think back to the list of 12 and
14 see where we are again.
15 There are shad that go up that river.
16 Q. Are you finished, Mr. Clark?
17 A. I am trying to think about the juvenile fish and
18 larval situation up there, if I can remember. I can't
19 remember that they did any sampling, ichthyoplankton
20 sampling in that river.
21 I better defer until I have a chance to refresh
22 my memory on that.
23 Q. Let me restate the question and you can consider
24 it and answer it later.
25 My question was: Have these studies that you

1 referred to shown that adverse effects have occurred with
2 respect to these species as a result of power plant
3 operations?
4 Why don't you just consider that and come back
5 with an answer at a later time?
6 CHAIRMAN JENSCH: Is this something in addition
7 to the fish loss and weight and loss of vigor that on
8 gentleman, whoever it was, studied at the Haddam nuclear plant?
9 MR. TROSTEN: I don't know if Mr. Clark considers
10 that that is responsive to my question.
11 CHAIRMAN JENSCH: What do you mean by "adverse
12 effects," then?
13 MR. TROSTEN: I had in mind the adverse effects
14 that Mr. Clark was talking about in his July 14 paper.
15 This paper, as a matter of fact, excludes the
16 impingement and entrainment problem, which is what the
17 Chairman was referring to a moment ago at the Haddam Neck
18 plant.
19 I was wondering just whet her these various
20 types of effects that are referred to by Mr. Clark in his
21 July 14 paper had been shown to occur with other power plants
22 on other rivers.
23 CHAIRMAN JENSCH: He will check the studies and come
24 back with an answer later.
25 THE WITNESS: Yes.

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1 MR. TROSTEN: Yes, fine.

2 CHAIRMAN JENSCH: Proceed.

3 BY MR. TROSTEN:

4 Q. Now, Mr. Clark, I would like to move to another

5 subject.

6 CHAIRMAN JENSCH: Do you want a little recess

7 before you do that?

8 My thought was if there is any objection, if

9 we go through to about quarter to 1:00 or so.

10 MR. TROSTEN: Sure.

11 CHAIRMAN JENSCH: At this time, let us recess

12 to reconvene in this room at 11:55.

13 (Recess.)

end 12 14

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CHAIRMAN JENSCH: Please come to order.

The witness has resumed the stand. Will you proceed, Applicant.

MR. TROSTEN: Yes, Mr. Chairman.

BY MR. TROSTEN:

Q. I would like to turn now, Mr. Clark, to that portion of your testimony that deals with the specific impact of Indian Point 1 operations on striped bass.

I am referring now here just to your July 14, 1972 testimony.

What I would like to go over with you is the basis for your opinion that Indian Point 2 is going to have the sort of impact on striped bass that you indicate on pages 4 through 6 that it will have.

Now, you mentioned earlier that you had been --

CHAIRMAN JENSCH: Excuse me, may I inquire, was his opinion affected at all by the October 30 -- I mean, which is the later opinion?

MR. TROSTEN: The October 30 testimony, of course, is later, Mr. Chairman, but this testimony deals with a different type of effect.

He is dealing here with thermal and chemical effects.

CHAIRMAN JENSCH: Something that was not covered by the October 30 testimony.

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MR. TROSTEN: Precisely.

CHAIRMAN JENSCH: Excuse me.

Proceed.

BY MR. TROSTEN:

Q. You mentioned you were on the research vessel Dolphin in March 1968.

What were the locations at which the Dolphin trawl hauls were made that you describe on page 5 of your testimony?

A. The bottom trawling work was done from, if I recall it now, from Haverstraw Bay on up as far as approximately the Indian Point location in the river.

Q. What do you mean by approximately? Do you mean 50 feet off or what?

A. There is a cove or -- what is the name of the cove where they had the mothball fleet? Tomkins Cove. We went that far up.

Q. You were where the mothball fleet was, out in the center of the river there?

A. Yes, just outside of that mothball fleet.

Q. Were you on the east side of the fleet or the west side of the fleet?

A. We were on the west side between the channel and the fleet.

Q. Was the fleet between you and the plant?

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A. No, the other way around.

Q. The fleet was on the west side and you were there, and then there was the plant?

A. Right.

Q. Do you have any recollection as to roughly how far offshore you were from the eastern shore?

A. We were somewhere in the channel area and I don't recall without going back to the original records how many hundreds of feet we were from the plant.

But we did two things: One was midwater trawling. We had located a stratum of a high intensity of fish at a depth of around 25 to 35 feet and we were midwater trawling through there to see if we could catch those fish and see what they were. They were juveniles of a variety of species.

The other work we did was on the bottom with the bigger trawl, the fullscale auto trawl, and at that point we were confining ourselves pretty much to this range where we had found the striped bass on the bottom, the adult and adolescent fish about, well, what is shown on this figure, 35 to 40 feet or so.

Q. Were you over the deepest part of the river, is that you mean when you use the term "channel"?

A. Yes, that is my best recollection, that we were in, somewhere around or just a little to the west of the

1 deepest part of the channel, the deep central part.

2 Q. Was there a report prepared on this that you

3 could refer us to?

4 A. The only record of it that was distributed

5 was the cruise report.

6 Q. Which report?

7 A. The cruise report, which is mailed out, or was at

8 that time, anyway, mailed out on a mailing list, but other than

9 what I have said about it, and whatever we said about the

10 tag returns we got back from that, there is nothing I know

11 of that is in print.

12 Q. So this cruise report doesn't really expand on what

13 you have said here, is that right?

14 A. Well, it gives a little data on salinity, tempera-

15 ture, the actual number of striped bass we caught, and tagged,

16 and so on. It is not a publication.

17 Q. It is not a publication?

18 A. No.

19 Q. Do you have a copy of it you could make available

20 to us?

21 A. I think I have.

22 Q. I would appreciate that. It would probably

23 help us move along faster. Do you think there is any

24 possibility that that could be made available to us -- is it

25 in your office here in Washington, do you think?

dor 5

A. I either have it there or have it here, mixed up with my other papers.

Q. Let me defer further questioning about that, some aspects of that until you can determine whether you have a copy of this. Maybe that will save some time.

A. Yes, if I find it, I can get a Xerox or two made so you can have it in front of you.

Q. Fine. Thank you very much.

With respect to your statement about the vulnerability of over-wintering fish that appears on page 5, you say concentrated near Indian Point in a semidormant condition, they are particularly defenseless and vulnerable from impact from the plant.

When a fish is in a semidormant condition, as you describe it here, is it more or less likely to be attracted to a thermal gradient than when it is not in such a condition?

A. That is probably more complicated than you think, the question, talking about the motivation of a fish.

CHAIRMAN JENSCH: Can you deal directly with the question?

I think he is asking -- maybe there are many factors -- but is a fish attracted in a semidormant condition?

A. I guess I am just spinning my wheels for a minute

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1 until I think I have the right answer.

2 I don't think there is a yes or no answer to

3 that, because I think it could be either.

4 The fish are in that state because the temperature

5 is cold, and the reason that they are not more active is

6 because it is cold and if there were warmer water for them

7 to be in, they could be more active and I would think that

8 it is quite possible their choice might be to be more

9 attracted to hot water when they are in that state, because

10 they have more need for it.

11 On the other hand, there senses may be dulled to

12 the point where maybe they don't react as quickly or

13 positively.

14 BY MR. TROSTEN:

15 Q. Would you say that you don't know?

16 A. I would have to say I don't know.

17 Q. Would a fish in a semidormant condition, in your

18 opinion, be more likely to be attracted to Indian Point

19 intakes or to the Indian Point discharges as a result of the

20 presence of a thermal gradient?

21 A. Well, you have got me in the same position again

22 because it can be -- they are going to be attracted, I

23 am quite convinced there is a thermal attraction operating

24 in a situation like that, but there is also the unknown

25 quantity of attraction of a different kind, which is even

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1 given a name, thigmotaxis.

2 There is a whole idea that fish are attracted to

3 objects of various kinds and structures and entrapments,

4 hiding places, things like this.

5 And so you have an interplay between that and

6 thermal attraction, one or the other prevailing.

7 I would suspect in this situation the thermal

8 attraction might be the primary attractant that would

9 bring them into the plant side, but once there, they might

10 find themselves orienting to structures.

11 Q I wasn't asking about the combined attraction of

12 the various factors there. I was asking you about whether

13 a fish in a semidormant condition would be more likely

14 to be attracted to the intake or discharge as a result

15 of the thermal gradient.

16 CHAIRMAN JENSCH: Is there a thermal effect at

17 the intake?

18 MR. TROSTEN: There is not a thermal effect at

19 the intake, but it has been suggested in Mr. Clark's testimony

20 and elsewhere that under certain conditions and given a

21 certain discharge configuration, such as existed at Indian

22 Point in the earlier years, that there could be a recirculation

23 effect, the hot water being moved by the tide up toward the

24 vicinity of the intake.

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25 CHAIRMAN JENSCH: Excuse me. Proceed.

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THE WITNESS: Under any given set of conditions of temperature of the discharge and temperature of the river, I would think you could come to some conclusion about that if you knew how much heat was being carried back up toward the intake by the plant, and I would imagine that the fish are going to orient themselves in the plume in a place of an inbetween temperature, in between the maximum amount discharged and the final reduction of temperature down to tenths of a degree or so.

The Meldrim and Gift Work indicates fish have particular attractions to temperatures four, five, six, seven, eight and nine degrees above ambient.

Here I would expect to find a point somewhere in that discharge where the fish would be attracted, neither to the high nor to the low ends.

Then whether they were closer to the intake or discharge would depend, I suppose, on whether the tide is going upstream, carrying the heated water past the plant or going downstream and carrying it away.

end 13

BY MR. TROSTEN: Are you saying, Mr. Clark, that the fish would tend to congregate in the area of their preferred temperature and if this were in the vicinity of the discharge where the warmest water is emerging and dissipating, they would go in that direction and, of course, if for some reason it were at the intake, then they would be there. Is that what you are saying?

A Somehow they get to that intake. We have seen this happen.

Q But just answer my question.

A I can't answer that question: are they or are they not going to be more in the area of the discharge or more in the area of the intake. But I think what you are wanting me to say is they would probably be closer to the discharge, which I am quite sure would happen in certain conditions of river flow and time of year.

CHAIRMAN JENSCH: I think the question was would they seek the preferred temperature, wherever it was.

THE WITNESS: I am still thinking back to the original question. Yes, that is my understanding, they would seek a preferred temperature, wherever the temperature, wherever that temperature was in the water, yes, that is where they would go.

BY MR. TROSTEN:

Q Is that preferred temperature normally in the range

of plus 6 to 9 degrees in the wintertime? Would you regard that as a preferred temperature for a fish in the wintertime?

A I wanted to check back on the Meldrim and Gift work before I answer that.

Yes, I think it is fair to say that is in the range of preference observed by Meldrim and Gift.

Q Now, would you say that such a temperature rise would be in the vicinity of the discharge rather than the intake?

A Yes, you would find the warmest water near the discharge.

Q So, would the answer to my question be yes?

A You are always -- let's see, nearer the discharge or nearer the intake?

Q Would it be in the vicinity of the discharge rather than in the vicinity of the intake?

A Well, I can say it would be nearer the intake. Is that answering --

Q Nearer the discharge?

A Nearer the discharge.

Q Than the intake.

A The closer you are to the discharge, the warmer the temperatures would be.

Q Therefore, it would be closer to the discharge

than to the intake.

A Yes.

CHAIRMAN JENSCH: Is this for a winter condition or a general condition?

MR. TROSTEN: For a wintertime condition.

CHAIRMAN JENSCH: Thank you.

BY MR. TROSTEN:

Q Now, would you say that a fish's oxygen demand is reduced when it is in a semi-dormant state, such as you describe it on page 5?

A Yes.

Q How about his food demand?

A That would be low.

Q That would be low, too. Would you say that its responsiveness to chemical stimuli would be low when it is in a semi-dormant condition?

A It would be lower. I think it would be lower.

Q You think it would be lower.

A Lower, but I wouldn't say low, but lower.

Q It would be relatively lower.

A Yes, it would be somewhat lower. How much I wouldn't know.

Q Mr. Clark, have large fish of the sort that I believe you are describing on page 5 where you refer to adults in a state of metabolic reduction or semi-hibernating,

mea-4

1 having low response levels and showing no signs of active
2 feeding -- do you see that reference there?
3 A Yes.
4 Q Have large fish been impinged on the intake
5 screens of Unit One for the last several years?
6 A Only a few that I have seen in your records.
7 Q Do you recall what you mean by a few? Literally
8 just a few?
9 A Twenty or 30 I think it was on the day when, say
10 the most would have been there.
11 CHAIRMAN JENSCH: That was based entirely on what
12 records you saw.
13 THE WITNESS: Yes, and I can't remember exactly
14 where, but as I was going through all of the impingement
15 records for Indian Point, I came across it.
16 CHAIRMAN JENSCH: Thank you.
17 BY MR. TROSTEN:
18 Q Now, with regard to your statements on pages 5 and
19 6, you say here the following: "Most striped bass migrate
20 to areas above Indian Point for spawning, but the main
21 nursery areas are below Indian Point, and thus most young fish
22 have to pass the constricted Indian Point site on their way
23 from spawning to nursery areas. Because of tidal action and
24 salinity-induced circulation, each fish may be swept back and
25 forth in front of the plant 10, 20 or more times while it is

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in its plantonic or pelagic stage."

Do you see that?

A Yes.

Q Now, it is true, isn't it, that only those fish which are within the vicinity and the influence of the intake, which do not have the capability of avoiding the intake, or which do not choose to use that capability, would be withdrawn into the plant? Isn't that correct?

A You are asking about entrainments?

Q Yes. That is what you are talking about here, isn't that correct, when you talk about ~~plantonic~~ planktonic or pelagic stage fish?

CHAIRMAN JENSCH: Excuse me; I wonder if I could understand the question. I don't see anything about impingements or entrainments in those two sentences you have read. I think he is just describing a condition in a river and the movements of them.

MR. TROSTEN: All right. I thought you were talking about entrainments, but if you are not, we can defer that.

THE WITNESS: That is the subject of the other testimony.

MR. TROSTEN: All right. We can defer that question until another time.

BY MR. TROSTEN:

Q I do have one question that relates to not the matter of entrainment, but to the motion of the fish in the river. You are not a hydraulic engineer, is that correct?

A Right.

Q Could you tell me what training or experience you have which enables you to form a judgment as to the number of times ~~plantonic~~ planktonic or pelagic stage fish will be swept back and forth in front of the Indian Point plant?

A Well, what I think I do qualify to be able to do is express myself on fish behavior.

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End 14

Q. On what subject? I didn't hear you?

A. On fish behavior, which is the key to this. And, also, to be able to interpret for this kind of simple logic from the works of Dr. Lauer and others, simply that the tide is going back and forth about eight miles on a swing, and that that is where the larval fishes and small pre-juveniles are, in that water sloshing back and forth with the tide.

I also know enough about the behavior indications from what we have been able to study to know there is some kind of vertical orientation of the fish, which puts them into an upriver transport situation when they are on the bottom, a net movement.

So, you have the fish coming down the river, the larvae and young juveniles in the surface, getting down to a point where they have migrated down to the deeper water, and they are carried back upriver.

There is some indication that this happens daily, that the fish are in the surface water and in the bottom water at different times of the day, being in the surface water more at night and the bottom water more in the daytime.

I don't think we are completely sure that these diurnal movements are the answer to it, because there is also the visual escapement mechanisms of the fish that are involved in the gear problem.

But not to labor that subject now, you have fish

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1 going upriver in the upward net non-tidal flow on the bottom,
2 coming downriver on the top, migrating between the two, which
3 has the effect that they can return and go through more of
4 these tidal sloshings by going upriver than coming back down
5 and up and back.
6 So, there is a mechanism for them to be cycled
7 around, back and forth in front of the plant continuously,
8 and not to be just swept out of the river.
9 This has the effect of repeated exposure of the
10 fish to the area in front of the plant.
11 Now, exposure happens on every cycle of the tide
12 for so long as they are in front of the plant. And the tidal
13 oscillations in that river are something on the order of 10
14 times the average discharge of the river, which means that
15 each things that is floating, either up or downriver, is
16 being sloshed back and forth, back and forth, in front of that
17 intake, for, perhaps, eight or ten or twelve tidal cycles.
18 Then, if it returns and goes through it again, you
19 can multiply that by factors of two or three, depending on
20 the total life of the planktonic or pelagic stage of the fish.
21 Q Now, Mr. Clark, in order to analyze the behavior
22 of these organisms in front of the plant, you would have to
23 know their biological characteristics, is that correct?
24 For example, you would have to know the particular tendencies
25 to migrate in the water column at the particular stage of the

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life history of the organism, is that correct?

A. You should know where they are. I don't think you have to know their motivation for being there.

Q. I was just saying you would have to know where they are --

A. Okay, I agree.

Q. If they have a tendency to migrate diurnally, you have to make a judgment of this sort as to their vulnerability?

A. You should know where the fish are.

Q. In the vertical water. Now, you would also have to know where the fish are in order to determine their vulnerability in the sense of where they choose to be in the horizontal water column, is that correct?

For example, if they choose to be in a particular portion of the river, or a particupar depth of the river, to determine their vulnerability, you would have to know that, is that correct?

A. You should know where the fish are in the river, yes, vertically and horizontally.

Q. In addition to knowing these biological characteristics, two of which we just named, you would also have to know certain physical characteristics of the Hudson River itself.

Let's go through some of these and see if you agree you would have to know those things.

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You would have to understand the freshwater flow and what this means in relation to the tidal flow. Is that correct?

A. In order to what, please?

Q. In order to determine whether these organisms are going to be swept back and forth in front of the plant 10, 20 or more times.

A. Yes.

Q. You would have to understand the phenomena of density-induced ~~density~~ and circulation, is that correct?

A. Yes.

Q. You would have to understand the other mixing characteristics of the Hudson River, is that correct?

A. Are you speaking about tidal dispersion or diffusion?

Q. I am speaking in terms of the phenomena that I understand to be net non-tidal flow.

A. We already said yes on that one, and you aksed if we have to know something about mixing. I am asking whether you mean tidal dispersion or whether you are talking about diffusion.

Q. Tidal dispersion.

A. Yes.

Q. All right.

Now, have you prepared calculations which support

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your conclusion that the fish will be swept back and forth in front of the plant 10, 20, or more times?

A. Yes, I have done this. I guess the answer is yes.

Q. Could you present those calculations to me? I don't mean this instant, but could you --

A. You would like to know how I got to that number?

Q. First of all, I want to know whether you actually have made calculations which support this. You just said yes.

A. Right. I have a little model of how that works.

Q. Then I want to know will you present that to me as soon as you can, so we can look at it.

A. Well, it would take me a little time, because I would have to put it in a finished form.

Q. Well, it can be in an unfinished form.

A. I will do my best.

Q. Would you do that and then we will return to this when you have given that to me.

Now, with regard to page 6, there is a part there entitled "External Impacts on the Indian Point Plant," and there is a sentence in there, the last sentence of that heading that says, "The additional plants in the area, Lovett, ~~Danskammera,~~ Danskammer Roseton, and Bowline plants, will, of course, heighten the effects."

MR. TROSTEN: Mr. Chairman, I move to strike that sentence on the grounds that insofar as the Roseton and Bowline

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1 plants, this is irrelevant to the issues in this proceeding for
2 the reasons that are covered in the papers before the Board.
3 And I move to strike the references to Lovett and Danskammera
4 plants on the grounds that there is lack of foundation in the
5 record for such an opinion by this witness.
6 MR. MACBETH: I oppose that, Mr. Chairman, as far
7 as Roseton and Bowline plants are concerned for the reasons
8 stated in various papers before the Board.
9 And I don't think any further foundation as to
10 Lovett and Danskammera is needed.
11 If Mr. Trosten wishes to inquire of the witness
12 whether he considered these plants in writing that sentence, I
13 think that would be perfectly appropriate, but I don't think
14 any further foundation is needed for that particular sentence.
15 There has been a general discussion of steam-
16 electric plants, which, of course, both Lovett and Dammskammera
17 are, so that is a general foundation, and that should be
18 sufficient.
19 MR. TROSTEN: My position, Mr. Chairman, with regard
20 to Lovett and ~~Danskammera,~~ Danskammera is that this evidence does not meet
21 the standard of reliability called for in the AEC regulations
22 for the admissibility of evidence in these proceedings.
23 MR. MACBETH: I think it does meet that standard.
24 There has been discussion of steam-electric generating plants,
25 generally. The Applican't counsel has cross-examined on that.

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A further foundation for those opinions has been introduced into the record and I think that is perfectly sufficient to express these opinions that are expressed in this particular sentence as to the Lovett and Danskammera plants which everyone knows, both from the Final Environmental Statement, and from general knowledge, are steam-electric plants on the Hudson River, with effects at least comparable to Indian Point, obviously in different parts of the river and different total amounts of water withdrawal and heating, but they are certainly comparable.

I think that there is a perfectly sufficient foundation throughout this document for the opinion expressed here.

CHAIRMAN JENSCH: The Board has considered the motion as well as the statements in reference thereto, and it is the conclusion of the Board that as to the existing conditions in the Hudson River, the Lovett and ~~Kanskammera~~ Danskammer plants have been in operation for some time, so whatever they are doing if having and effect on the river, and as to the Roseton and Bowline matter, the Staff, as I recall it, has submitted something in that regard.

In any event, this witness has dealt with the Roseton and Bowline matter in his October statement. Of course, the Clark testimony is considered in the composite, both the July and October presentations. The Board believes these data

sw8

are of importance in considering the effects in the river.

Whether you use the word "add to the effects" or "heighten the effects" may not be too important for the moment.

The motion is denied.

MR. TROSTEN: All right, Mr. Chairman.

I will reserve, then, on cross-examination of Mr. Clark, with regard to the Bowline and Roseton plants, pending the Board's ruling on the motion by the Hudson River Fishermen's Association.

As far as the Lovett and Danskammera plants, I do have one or two questions.

CHAIRMAN JENSCH: Proceed.

BY MR. TROSTEN:

Q. Mr. Clark, the Lovett and Danskammera plants have been on the river for more than 20 years, is that correct?

A. Yes.

Q. Have you made any calculations using Husdon River striped bass data, which show that Lovett and ~~Danskammera~~ Danskammer will "of course, heighten the effects"?

The quotation is from page 6 of your testimony.

A. I think I had in one of my analyses, I took into consideration the Lovett and ~~Danskammera~~ Danskammer plants. But this is not in a final form.

Q. Mr. Clark, if you have any calculations which are

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not in final form, but which underlie your testimony here, will you provide them to us?

A. I will do what I can about that. I will go back and see. I am not just exactly sure what condition they are in, or how long it would take me to put it in form where you could use it.

end 15

Q Will you report back to the Board and myself as to what the status of this matter is?

A Sure.

Q Now, I would like to turn to another subject, Mr. Clark. I would like to turn now to the matter of the relationship of thermal and chemical effects which is dealt with on pages 8 and 9. I would like to defer consideration of the strictly thermal effect until tomorrow, if I may, and turn to the relationship of thermal and chemical effects

Now, would you say, Mr. Clark, that fish generally respond to an adverse sublethal chemical concentration of chlorine, for example, by moving away from it?

A There is evidence that that kind of thing happens.

Q You say as a matter of fact there is an avoidance reaction at .001 of a part per million or less with respect to chlorine, is that right?

A Let me clarify something on that. I have the decimal point in the wrong place on those. On page 11 and 12 and also in figure, whatever it is, that --

Q Figure 3.

A In Figure 3, instead of the 0.001 ppm it should be 0.01 and the 0.01 should be 0.1. I made a mistake in writing those down and I am a decimal point out.

Q Thank you for the correction. So, we should interpret, for example, the extended effects isotherm for chemicals in

1 Figure 3 as reading a tenth of a part per million and the
2 repulsion of marine forms as reading one-hundredth of a part
3 per million?
4 A Yes, if you will, please.
5 CHAIRMAN JENSCH: Will the Hudson River Fishermen's
6 Association counsel undertake correcting the original
7 which is on file in the public documents room of the Atomic
8 Energy Commission?
9 MR. MACBETH: I will, yes.
10 BY MR. TROSTEN:
11 Q Mr. Clark, are there any data that indicate to you
12 that fish will move along a rising thermal gradient, notwith-
13 standing the presence of an adverse chemical concentration?
14 A No, that is the crux of the question, what the
15 interplay between those two factors will be. We know that,
16 we are quite sure they would be attracted in some fashion by
17 temperature. We also have good reason to think that the
18 contamination of the water would have a repelling effect.
19 I don't have the answer as to which of those it is, but it would
20 be a good idea to find out through experimental work.
21 Q Do I understand you to say,then,that you don't know,
22 it is just unknown at the present time what would happen?
23 A In that circumstance I think we don't know.
24 Q Yes. What measurements have you made of chlorine
25 concentrations in the vicinity of the Indian Point Plant?

1 A None.

2 Q In your Figure 3, you show a thermal plume of six

3 degrees F and a chemical plume of a half part per million of

4 chlorine covering the same area. Do you see that in Figure 3?

5 A Yes.

6 Q Are there any data which justify your conclusion

7 that the thermal and chemical plumes would have the same or

8 similar configuration?

9 MR. MACBETH: I object to that question, the inclu-

10 sion of the word "conclusion." The Figure is headed,

11 "Hypothetical Non-Scale Diagram."

12 I really don't think on that basis it is fair to

13 characterize this as a conclusion.

14 MR. TROSTEN: I don't know, Mr. Macbeth, on that

15 basis perhaps I should just move to strike Figure 3 on the

16 ground that it has no relationship to this hearing.

17 CHAIRMAN JENSCH: Whatever youdo later, let's

18 get the question again. Would you read the question, please.

19 (The reporter read the record as requested.)

20 CHAIRMAN JENSCH: Well, I think that while the Figure 3

21 is designated, "Hypothetical," I think the question is, are

22 there any data that could be used for such a representation

23 that you have set forth in Figure 3. The objection is

24 overruled.

25 THE WITNESS: I think, if I understand the question

1 properly, the answer is that a substance like a chlorine
2 substance, any material of this type in the water, will be
3 homogenously distributed. It will be mixed and carried
4 along with the water coming out from the plant, and that other
5 than the heat flux which is eliminated in this, there should be
6 heat loss, other than dilution, there should be a direct one-
7 to-one relationship between the concentrations of anything and the
8 temperature.

9 Now, the way this has been done by hydrographers
10 and such has been with dye. They put dye in the water and
11 then assume a temperature situation in relation to the spreading
12 of the dye, interpreting from concentrations of the material
13 to temperatures of the water, and in this case assume
14 no loss of heat from the plume, just assuming cooling by dilution.

15 BY MR. TROSTEN:

16 Q Do I understand the answer to my question to be that
17 there are no data which justify your representation, but this
18 is a representation that you have made based upon your general
19 understanding of the way chemical substances and heat behave
20 in bodies of water, is that right?

21 A Yes, that would be a good answer.

22 Q All right. Now, could you provide the data which
23 in your opinion justifies your representation with regard
24 to the comparative chemical concentrations and thermal isotherms
25 for the one degree Fahrenheit and the tenth of a part per million

1 extended effects, in other words, the chemical and thermal plumes
2 which you depict as being congruent with regard to one degree
3 Fahrenheit and a tenth of a part per million?
4 A I understand the area that you are asking about.
5 What is the information you wish?
6 Q I am asking you what data in your opinion, justify
7 your representation?
8 A Oh, of that .1 parts per million and one degree
9 Fahrenheit line? Do I have that right?
10 Q Would you say that again?
11 A It is the 0.1 chlorine level that you are interested
12 in?
13 Q Yes, that is right, and the one degree Fahrenheit
14 isotherm.
15 A That is reference number 6.
16 Q In other words, you are saying the McKee and Wolf
17 1963 justifies the representation of the same extent of
18 a one degree isotherm and a tenth of a part per million level of
19 chlorine concentration.
20 A No, that is what we had already decided. I did
21 on the basis of general knowledge that chemicals mix in a certain
22 way with water and so on. Now, I thought you were -- maybe
23 you better ask it again?
24 Q I was asking the same question I asked the moment
25 before with regard to the representation of the six degree F

eak6

isotherm and the half part per million chemical concentration as being the same. Then I wanted to ask you with regard to your representation of the one degree F isotherm and the tenth of a part per million concentration being the same. You depicted these as being the same, as if the heat and the chemicals were being dissipated in the same fashion.

A Yes.

Q I was asking you for the data or measurements that justified that representation?

A There aren't any, this is the same thing, it is just by proportion.

Q All right. Now, in your depiction of this view, given you any consideration to the interaction of chlorine demand in the Hudson River with the residual chlorine in the discharge?

A No.

Q Is it not true that since the maximum discharge concentration of chlorine from Indian Point 2 is limited to a half part per million, that your Figure 3 assumes that there would be no chlorine demands in the river water?

A I don't know that I am qualified to answer that. I am not sure of the premise either.

Q Did you assume --

A I am not sure where these data came from to show on a year round average basis there is a half part per million of chlorine demand in the Hudson River water, that,

1 you know, could be --

2 Q In drawing Figure 3, did you assume that there

3 would be no chlorine demand in the river water?

4 A I am assuming that if there is a release in the river

5 of discharge water with that concentration, half a part per

6 million of chlorine, it is going to be discharged into the

7 river in that concentration, that these other things are likely

8 to happen, it is likely to spread out.

9 Q Did you assume no chlorine demands in the river?

10 A No, I haven't included chlorine demands of the river

11 in this reduction from one stage to another.

12 Q All right.

13 CHAIRMAN JENSCH: Is this a convenient place to

14 interrupt your examination?

15 MR. TROSTEN: If the Chairman wishes, yes.

16 CHAIRMAN JENSCH: Is two o'clock a convenient

17 time to reconvene?

18 MR. TROSTEN: Yes, I think so.

19 CHAIRMAN JENSCH: At this time let us recess to recon-

20 vene in this room at two o'clock.

21 (Whereupon, at 12:45 p.m., the hearing was recessed,

22 to reconvene at 2 p.m., this same day.)

23

24

25

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Reba 1

AFTERNOON SESSION

2:00 P.M.

CHAIRMAN JENSCH: Please come to order.

Mr. Clark has resumed the stand. Are you ready to proceed, Applicants' counsel?

MR. TROSTEN: Yes, sir.

Whereupon,

JOHN R. CLARK

the witness on the stand at time of recess, resumed the stand, and having been previously duly sworn, was examined and testified further as follows:

CROSS-EXAMINATION (Resumed)

xxx

BY MR. TROSTEN:

Q Just before we adjourned, Mr. Clark, I believe you indicated that you did not take into account the chlorine demand of the river water in drawing these comparative distributions of chlorine and the heat in the river. Is that correct?

A Yes, that is correct.

Q Is it correct that you also did not take into account dilution of chlorine in the jet plume?

CHAIRMAN JENSCH: Excuse me, chlorine in the jet plume?

MR. TROSTEN: Jet plume, yes, Mr. Chairman. As it comes out.

CHAIRMAN JENSCH: Oh, yes.

#17

Reba 2

THE WITNESS: I neither did nor did not. I merely assumed that -- I set up a hypothetical case, where there would be a half part per million of chlorine associated with a discharge temperature of 5 or 6 degrees.

How it got to be five or six degrees, I don't know. Or in fact whether that would be probable in terms of the amount of chlorine action you are going to have to use at different times of the year and so on. I don't know. I am just setting that up as a hypothetical case.

If that were the prevailing situation in the discharge, what kind of spread you might get across the river.

BY MR. TROSTEN:

Q Now you recognize that the half part per million is the maximum permitted concentration, that is the maximum permitted by the State of New York regulations, and that the actual discharge concentration is expected to be considerably less than a half part per million. Is that correct?

A Good.

Q And you recognize also that there will be dilution taking place very, very rapidly as that heated plume of water rises, so that any chlorine that is contained in the water will be diluted rapidly by the swirling mass of water as it rises.

A Good.

Q But in drawing up this hypothetical representation, you did not purport to take that into account?

#17

Reba 3

A No, I started where the plume, during a rise in plume situation, where it would surface out with a temperature of so and so, and the chlorine amount of so and so. It is hard to do much else. The Delta T varies from one season to another, the amount of chlorine you will probably have to use I am sure will vary from season to season, depending on the biotic activity you are trying to control, et cetera.

I don't want to leave the impression that I am saying that I expect this will be the quantity of chlorine necessarily that will be there at any time. It is a hypothetical case.

Q Did you take into account the dilution of the chlorine concentration by the currents in the river in drawing up this hypothetical ---

A No, it does not.

Q Would you agree, Mr. Clark, that in fact, notwithstanding the representation that appears here, given the facts of the discharge concentration from Indian Point and given the fact that there is some degree of chlorine demand of the Hudson River water, given the fact that there will be dilution in the jet plume and given the fact that there will be dilution by river currents, that the concentration of a half-part per million which you show as being coincident with the six degree Fahrenheit isotherm, could not in fact occur?

A Well, you have given such a long list of premises I can't accept them all, so I can't answer the question. But

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#17

Reba 4

But if you want to sort of pare them down or something -- the one about the dilution of the plume as it goes up is not involved in this for instance, at all. I am taking the temperature, a temperature at the surface, and a chlorine amount at the surface and going from there across the river.

Q Excuse me, I don't think that is quite the point. You are getting a chlorine concentration in the water as it leaves the submerged jet. And there is going to be dilution of the water as it leaves that jet. And this dilution is going to affect the chlorine concentration when it reaches the surface. Isn't that true?

A (Drawing on the Blackboard) That is the place I am starting from, at the surface. And assuming this case at the place where the center of the plume hits the surface of the river.

Q So you are simply assuming that there is a concentration of a half-part per million at the surface?

A Right. That is strictly a hypothetical case.

Q Would you agree that that is, that hypothetical assumption, cannot, in fact, represent the facts, the situation at Indian Point, because there is not in the first place even going to be a half-part per million in the discharge, but even if there were, there would be these other factors we have been discussing which would affect the concentration?

A Yes, surely, surely you would want to use actual

#17

Reba 5

numbers if you actually knew what they would be to put them in here. So as far as we have I think a variety of predictions. I don't think any of them are fully agreed upon by the parties.

I don't think there is a consensus of acceptance of any particular temperature or amount of chlorine yet at the surface of the river where the plume comes up. That I could have used in this case. If those numbers were lower there, certainly the whole scale owuld be different, it would in proportion lower the scale across the river.

Q Would you say this is indeed just a hypothetical representation that is not interpreted to represent the facts?

A Yes, it is a hypothetical representation intended to show the kind of effects you can get.

end # 17

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Q. Now, in preparing this hypothetical representation, is the Board to understand then that the consequences which you were saying might occur as a result of the presence of chlorine or the presence of heat, are purely hypothetical as well, and have no bearing one way or another with regard to the Indian Point plant situation?

A. Except in my mind they represent the worst possible case. As I can determine, it would be the worst possible case you might get there.

Q. I see.

A. You might get worse, but I wuldn't think so from what I know.

Q. In other words, this represenation of the distribution of chlorine and the distribution of heat represents in your judgment what would be the worst possible case at Indian Point, but not necessarily the case as it actually exists?

A. No, in my judgment it would be the worst possible case.

Q. Now, if you accept your theory as to the distribution of the chlorine relative to the thermal plume, at what depth would you -- at what depth in your hypothetical plume would you find a chlorine concentration of 100th part per million? How far below the surface?

A. May I have a moment?

Q. Yes, certainly.

A. It would be where the zero point 1 degree Fahrenheit isotherm would come. I can't, I don't have it in front of me right now to say what depth that would be at various points across the river.

My belief is about this that it would take the form of the thermal plume. It is the bottom of the thermal plume or the point at which you reach a tenth of a degree Fahrenheit.

I thought i had it, but I have it for a different plume configuration than the recent one.

Q. Could you just sort of draw it roughly as to what you think it might look like in terms of how far below the surface would it get?

A. (Drawing on board.) Without trying to do it to scale or anything, it is a question of a fairly shallow layer, when it is buoyant, not in the winter.

Q. In other words, the heat rises, so it creates a thin layer at the top of the river.

A. Right.

Q. And that is where this hundredth part per million concentration of chlorine might exist?

A. Yes.

Q. Now, would that be up like around a foot or two from the surface or within a foot of the surface, something

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1 like that?

2 A. I would think that is fair, out toward the middle of

3 the river, perhaps deeper nearer to the discharge.

4 Q. What percent of the cross section of the river

5 would you say would be outside the sphere of influence of

6 this?

7 In other words, the river comes up like this

8 (drawing), roughly. What percent of the cross section of the

9 river would be outside the sphere of influence, if this is, say

10 20 feet, of this chlorine concentration of one hundredth part

11 per million?

12 A. I would expect it to be less than 50 percent.

13 Q. Less than 50 percent of the river cross section

14 would be outside the sphere of influence?

15 A. No, would be inside.

16 Q. In other words, you are saying that with this

17 plume rising like this, spreading out across within, say, the

18 top foot of the river, less than 50 percent --

19 A. Of the cross section would be involved with the --

20 Q. Would it be like two percent?

21 A. I would think more. If you could show me a

22 plume configuration for the most recent type of port

23 system that you have, I could very easily give you something

24 more specific.

25 Q. In making your assumption about the spreading of

1 the chlorine plume, I will call it that, are you assuming
2 that decay kinetics of chlorine and heat are the same?
3 A. No, I haven't refined this example to that degree.
4 Q. Mr. Clark, what data support the hypothesis stated
5 in Figure 3 that intermittent exposure to chlorine in the
6 amount of one 100th part per million would repulse mobile
7 forms which are fond in the river?
8 A. You are asking for a reference to this?
9 Q. Yes.
10 Is this McKee and Wolf?
11 A. No. The information on repulsion is from another
12 source.
13 In trying to check this through myself, I got a
14 little bit confused, and I am going to have to
15 clarify that later. I have somehow not carried through into
16 this the suitable reference for that particular value. I
17 rather anticipated the question, so in trying to check it out,
18 I find I had a missing item in my bibliography, which I will
19 try to rectify for you.
20 But in the meantime, in a book called "Biological
21 Aspects of Thermal Pollution," page 173, there is a statement
22 of research done by Trembley showing that chlorinated plumes
23 had somewhat less fish in them, less fish of each species,
24 but not a lesser number of species.
25 Q. You will supply then the data reference for the

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repulsion, is that correct?

A. I will try to find the one that relates specifically to a numerical estimate.

Let me give it to you now and still check it later and make sure, but I think it is Sprig and Drury.

Q. Sprig and Drury?

A. Yes. Would you like me to read it?

Q. Yes, please.

A. It is Sprig, J.B., if you have the EIS in front of you, it is also listed in page B-95. This is Item 28.

That will avoid having to spell it out.

Q. All right.

Now, Mr. Clark, if, in fact, fish were repulsed by concentrations of one 100th part per million, wouldn't this fact safeguard them against exposure to higher concentrations of chlorine?

A. Yes.

end 18

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Q Do you have any data to support the conclusion that migrations of fish have been blocked by concentrations of chlorine at Indian Point Unit No. 1?

MR. MACBETH: Are you quoting directly from the testimony at that point?

MR. TROSTEN: No. I am drawing an inference from Figure 3.

THE WITNESS: No.

BY MR. TROSTEN:

Q Do you have any data which suggest that migrations of fish have been blocked by concentrations of chlorine at another power plant?

A Well, that that I mentioned, there being -- wait a minute, excuse me. I have learned that the migrations of the fish tend to be disrupted, that fish have been found to be deflected in their passage by the plume. And my understanding is that so far as we know at present, a good number of these fish are able to swim around the plume and continue on their way. If the fish are in the middle of the channel in their swimming and your plume is close to the bank, there would be little problem or little disturbance in their migration.

However, this would be for salmon, and I am quite sure the same applies for shad, that they would tend to swim around the plume and continue on their way. The amount of substantive data behind this is not very impressive, as I

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2mil 1 recall it, but nevertheless it is the prevailing opinion of
2 the people who studied those two situations. The question is
3 simply whether in this particular situation, in this river,
4 with this situation, whether we would be that fortunate.
5 Q You say you have learned it. Could you provide
6 us with the report or the data which demonstrate that migrations
7 of fish have been blocked by concentrations of chlorine at
8 another power plant?
9 A I don't think I said they have been blocked and I
10 don't mean to infer that I know of a situation where the migra-
11 tion of the fish has absolutely been stopped by temperature.
12 We know that it can be stopped, as it is in the Delaware River,
13 by things that will repel the fish, in that case a lack of
14 oxygen. I do not know, and I don't want to convey to you
15 the idea that I do know any situation where a thermal block
16 has absolutely stopped a migratory mass of fish going up a
17 river.
18 Q I was referring to a chemical.
19 A Yes. Only the oxygen thing is the only one I know
20 of.
21 Q The oxygen is the only one you are aware of.
22 A Non-thermal. There may very well be, but I don't
23 know of any myself.
24 Q What is the degree of oxygen reduction which is
25 shown -- do you recall the degree of oxygen reduction that is

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shown to occur as a result of Indian Point 1 and proposed Indian Point 2 operation?

A There seem to be two figures in dispute, the one, the data from, I think Ratheon, where there may have been some problem with an instrument, a sensor, and then there seem to have been more recent data collected, I think, this year by Lawler and I don't remember the numbers, but I remember that there was a great variation, in that everyone who has looked -- everyone seems to accept there is some oxygen decrease, but the exact amount does not seem to be accepted. It may be a half part per million as a kind of resolving some fractions of a part per million and something over a part per million in different experiments. I would be willing to think that something around a half part per million might represent a worst case basis.

Q And there is evidence that shows it could be much less than a half part per million?

A There are actual measurements that show it has been less than that across the Indian Point condensers, as I recall it.

Q Now on page 11 you express the conclusion that fish attracted to the warmer parts of the thermal plume will be subject to adverse effects from oxygen reduction. Is that correct?

A Yes.

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Q Could you tell me what data support the conclusion that if the fish were attracted to the warmer parts of the thermal plume, that they would be subjected to adverse effects?

A Could you give me the line that is on? Page 11, you say?

Q Yes, the last line of the third paragraph. You say --

A Oh, yes.

Q You say the same would hold true for oxygen reductions.

A It would hold true for oxygen reductions, providing the amount of the reduction was enough under the circumstances to have an adverse effect.

Q In other words, if there were a serious enough oxygen reduction and they were indeed held to it for that period of time, then they would be subjected to adverse effects?

A Yes.

Q But are there data which indicate that the oxygen reduction will indeed be so severe that they will indeed be held to it for so long that they will be subject to an adverse effect?

A Just let me have a moment. I was just checking my opinion with the Staff's, and I agree with them, that there

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will probably be times when, there could very well be times when the oxygen falls to a level below the tolerable amount.

Q So you are simply relying on the Staff conclusion?

A I am relying on the Staff, because I am not ready yet to accept that there will be a particular, a specific reduction in oxygen operating at specific times of the year well enough to want to predict it.

Q All right. Mr. Clark, let's turn to another subject now.

I would like to talk to you a little bit further about your section in the October 30 testimony now and I would like to turn to this, leaving, for the moment, your July 14 testimony, simply because I would like to be able to cover this while Dr. Lauer is able to be here. This is the section on mortality of removals. It appears on pages 47 through 49 of the October 30 testimony.

A Am I referred to a particular page?

Q Pages 47 through 49. Now in this section you discuss what you consider to be the likelihood that organisms which are entrained in the Indian Point 1 and 2 plants will be killed as a result of the entrainment experience. You also refer generally to this subject on page 6, where you talk about adverse effect on striped bass and you have the following quotation, which appears on page 6 as sort of a lead-in

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to the discussion on pages 47 through 49. You say the following, "In this first year of life, each brood of striped bass is exposed to a predictable risk from the power plants that draw water from the Hudson for the cooling of their steam condensers. During the first few months the larvae and young fish are entrained when the water pumped into the plants during entrainment, they are subject to lethal conditions of thermal impact, mechanical damage, exposure to toxic chemicals, pressure changes, and other possible effects, such as reduction of dissolved oxygen." Do you see that there?

A Yes.

Q I have a few questions to ask you about that. Have you conducted experiments to determine the temperature tolerance of various developmental stages of striped bass in the Hudson River?

A No.

Q How about the temperature tolerance of striped bass from some other source?

A Striped bass --

Q From some other plants?

A Moncks Corner, South Carolina.

Q You have conducted temperature tolerance experiments there?

A Yes.

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Q Would you describe those, please?

A At Sandy Hook while I was there we shipped up from Moncks Corner, South Carolina, from the hatchery, some of the hatch of those eggs that they hatched out down there, and had them at Sandy Hook during one season to explore various factors about the survivability of those larvae under various conditions of degree of salt in the water and temperature.

Q Would you tell me the numbers of larvae that you exposed to -- what sort of temperature experiments were these?

A They were just a very simple tank set up with thermistors, heating elements in them, controlled by eight mathematic temperature recording devices, solenoid switches, as I remember -- no, thermistors.

Q These were experiments being supervised by you, is that right?

A Right, I mostly supervised, but did some of it myself.

Q What were the times of exposure of these organisms to the increased -- were they increased temperature experiments?

A No, we just kept them at several ambient temperature conditions in order to try to detect what the best conditions for survival were. That was our goal, to see whether they survived better at a temperature range between 60 and 65, 65

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and 70, 70 and 75, as I remember the numbers.

Q I see. Were these a series of experiments where you took larvae and kept them in various temperatures and ascertained their survivability in these various temperatures?

A Right. None of them survived very well. We didn't have very good luck.

Q You didn't subject them to sharp increases in temperature?

A No.

Q Have you conducted experiments to determine the tolerance of various developmental stages of striped bass from the Hudson River to mechanical damage?

A No.

Q How about to toxic chemicals?

A No.

Q Pressure changes?

A No.

Q How about some combination of them?

A No.

Q Now have you performed experiments to determine the effects of entrainments on organisms? By this I mean fish eggs and larvae, which are passed through a power plant, which have passed through a power plant.

A No.

Q I understand from your responses to my questions

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that you do not have personal experience which you rely upon as substantiation for your statement that during the first few months the larvae and young fish are entrained when the water is pumped through the plants, and during entrainment they are subject to lethal conditions of thermal impact, mechanical damage, exposure to toxic chemicals, pressure changes, and other possible effects, such as reduction in dissolved oxygen.

A The answer is no.

Q Would you say that your statement, then, is simply a speculation on your part?

A No, it is far more than a speculation. It represents my best understanding of the literature and experience of people that I have talked to that have yet to report in the literature.

Q Would you care to refer me to some particular piece of the literature that you are relying upon?

A The Marcy papers is an example. The work as yet unreported done at Brayton Point --

Q At where?

A Brayton Point, where they are estimating 164 million fish killed in one day.

Q Where is Brayton Point?

A Mount Hope Bay, Rhode Island.

Q Are there any striped bass at Mount Hope Bay?

10mil 1 A Well, there are striped bass, but not the young.
2 I know of no evidence that there is successful spawning of
3 striped bass. But in Mount Hope Bay they winter there, the
4 striped bass.
5 Q What kind of fish are being killed at this plant?
6 A Menhaden is the principal one that is subject to
7 entrainment there.
8 Q How about flounder, is that a fish being subjected
9 to entrainment there?
10 A I think you may be thinking of another study in
11 Rhode Island where Jeffreys has shown that I think it is a one
12 degree increase in the temperature of the bay will result in
13 a 50 percent decline in the flounders. But that doesn't have
14 to do with a specific power plant. That is just the
15 responsivity of the flounder population to temperature
16 changes. One degree increase in the temperature, 50 percent
17 reduction in the flounder, I think is his figure. That is a
18 very recent study, still in the manuscript stage.
19 Q Are you relying fundamentally on Marcy, since
20 these other studies are unpublished and unevaluated yet?
21 A I think Marcy is probably the best piece of work
22 we have to go on.
23 Q By this I assume you are referring to the
24 "Survival of Young Fish in the Discharge Canal of a Nuclear
25 Power Plant," by Barton C. Marcy, Essex Marine Laboratory,

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published in 1971.

A Yes, the Fisheries Research Board of Canada?

Q This appears in the Journal of Fisheries Research Board of Canada, that is right.

A Yes, that is right. Should I get that out now?

Q Yes, would you please get it out.

A Mr. Trosten, do you have an extra copy of that? I don't seem to be able to find mine.

Q Yes. (Handing to witness.) Why don't you use that and if I have to come over there, I will. Now, Mr. Clark, what kind of sampling gear was used by Marcy, do you know?

A Well, he used a plankton net.

Q Was that the basic fear he used in order to sample those eggs and larvae?

A A half meter number two mesh plankton net.

Q Do you know its efficiency for sampling the larvae of various species and sizes?

A I do not.

Q Do you know what the velocity of the water entering the nets was?

A No.

Q Do you know the precise depths at which Marcy collected larvae from the plant cooling intake ports?

A No. If some of this information is in here, I

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could search and try to find it, but I am answering more or less off the top of my head.

Q Right. It has been pointed out to me he does say in the second column on page 1050 -- I have another copy here now -- "The intake station was sampled at its median depth and the discharge canal stations at the surface, middle, and bottom depths."

A I found that, yes.

Q Considering that Marcy sampled only at the median depth at the intake and compared these results to sampling data from the surface, middle, and bottom depths at the discharge canal stations, do you know for certain that the sampling efforts were equally representative of the actual average abundances and condition of larvae that were passing through the sampling station?

A Well, number one, since he used flow meters in his nets, and related the catch to the number of cubic meters of water coming through, he is on the basis of a catch per unit of water, so the fact that he used three nets at one end and only one on the other is not going to triple the number of fish at the other end. The effect that it would have would be to give a more complete sampling through the water column at the discharge end than the intake end.

Q Isn't it true that concentrations of larvae can vary with depth?

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A Yes.

Q So if you were sampling only at the surface -- excuse me, at the median depth at the intake, is it possible there were varying concentrations at the surface and at the bottom?

A I think if you have a choice to make, your best choice is in the middle. If, for whatever operational reason, you only use one net, you are better off to do it in the middle, as he did, than either the surface or the bottom. I think you would get less bias.

Q But he did sample at three locations at the discharge, and only one, the median, at the intake?

A Yes. And I don't understand that at all. I haven't talked to him about it.

Q Aren't larvae more abundant at the bottom, usually?

A Depending on the time of day, they could be.

Q How did Marcy calculate the survival of the fish which he observed in the discharge canal?

A Simply by subtracting his control deaths and then just comparing the two catch figures.

Q In other words, as I understand it, he divided the number of living larvae per cubic meter at each discharge canal station by the number of living larvae per cubic meter at the intake?

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A Yes.

Q Considering your answer to the previous question that I asked you about the sampling locations that Marcy used, which I interpret to be that you do not know if the sampling of the intake and discharge were equally representative of true abundance and conditions, isn't it true that computations of survival done in the manner that Marcy did could possibly be subject to a larger error?

A Yes, that happens in all of this kind of sampling work. If you had to pass, if you had to go through very rigid statistical tests and use only data with a high probability, I think that a good deal of our work with ichthyoplankton would be down the drain. The kinds of variability that you get in plankton work are such that you have to regard all the results of ichthyoplankton work with a great deal of caution. In the best sense of analysis, you should have statistical confidence limits included with each data group that you attempt to interpret something from. I couldn't guess from what he has here what sort of statistical confidence one might put in his data.

Q I take it from your answer that Marcy's publication did not report his data statistically analyzed for significance at any stated confidence level. Is that correct?

A I don't remember his -- there is nothing here that conveys the statistical evaluation on anything like a number

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per number basis. If we are comparing that 174 to that 19 in the top row in Table 1, there is nothing there in that table to suggest to you how much reliance you can place on that 174. I mean that might be 204 or 153, as likely as it could be 174, when you don't have the statistical confidence on it.

Q He didn't report any statistical confidence?

A No, not here.

Q Have you performed a statistical -- have you analyzed his data statistically to determine the confidence level?

A No, I have not.

Q Mr. Clark, are the inner components, by that I mean the pumps, pipes, condensers, and discharge canal, of the Connecticut Yankee and Indian Point 1 plant, the same?

A The fundamental operation of the two, insofar as I know, is similar. The lengths of the discharge canal, the actual structure, the condenser assembly, all of that I would not know. The configuration of water boxes, all of this kind of thing.

Q They are both steam electric power plants, but you haven't analyzed these internal arrangements at Indian Point 1 --

A I have not -- oh, Indian Point 1, in my visits there I have had a look at the inside of the Indian Point 3 they were putting together, to get an idea of what is inside

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the condenser tube assembly and I have seen the configuration of the water boxes, studied the diagrams of the pump and pump arrangements and flows, but I have not done the same thing for Haddam.

Q So you don't know whether these configurations are the same in these two plants?

A No.

Q You are aware, however, that the discharge canal for the Connecticut Yankee plant is considerably longer than the discharge canal for Indian Point 1?

A Yes.

Q And you are aware that the transit time is considerably longer, is that correct?

A Yes.

Q In fact, the transit time for the Connecticut Yankee plant from the intake -- are you aware of what the transit time is, excepting that it is longer, from the intake to the outfall at Connecticut Yankee?

A I think he has it here in the paper somewhere.

Q I am sorry. There ~~is it~~ it is. "A non-screenable organism is exposed to an elevated temperature in the canal for 50 to 100 minutes." Is that correct?

A Could you give me the page reference, so I can follow you.

Q It is the first column, the fourth line from the

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bottom.

A Yes. Thank you.

Q Do you know the total number of samples on which Marcy's results were based?

A Which are the samples you are speaking of? Of all his tests?

Q The number of samples that he used for his, the combined intake samples and the combined discharge samples?

A Well, Table 1 I think shows his whole sampling array.

Q Do you know how much water passed through the net for each sample?

A No, I don't recall that if it is in here. That would be expected to vary from sample to sample.

Q How many larvae did March collect altogether? Is it not --

A Do you wish the total?

Q Yes, the total number of larvae. Is it not 2681? This is the first line on the second page.

A Yes, page 1058, right.

Q How many of these were striped bass?

A None. None were identified as striped bass.

Q Incidentally, just to pick up a loose end here, looking at the diagram of the Connecticut River and the Connecticut Yankee power plant that appears on the page

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there, would you say that the width of the Connecticut River at the plant is roughly 1625 feet or about 500 meters?

A At the discharge or intake point?

Q At the intake.

A Yes.

Q And that is approximately -- that can be compared with the width of the Hudson River at Indian Point of 4500 feet?

A It is about one-third as wide.

Q Right. Now you mentioned a moment ago that there were no striped bass reported by March in this study. Is that correct?

A Unless he had striped bass mixed up with his white perch, which were reported.

Q In other words, unless the people who were examining the larvae might have made a mistake?

A Yes. Nobody thinks there are any striped bass larvae in that river, but part of the problem might be that the few that are there could get easily confused with white perch.

Q Because you can't always tell whether you have a white perch or striped bass, is that right?

A As I explained earlier, it takes a high degree of knowledge to separate the two.

Q But he didn't report any striped bass?

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A He did not report any striped bass.

Q Would you then, in view of the fact that Marcy did not report any striped bass in the study, say that your extrapolation of Marcy's results to the Indian Point 1 plant, insofar as it deals with the effects of the Indian Point 1 plant on striped bass, is simply a speculation? Is that correct?

A No, it is more than a speculation. It is dealing with the most closely-related species to striped bass that we know about and it is also following along what a lot of us had to do in this particular study, which is look at white perch and striped bass together; sometimes because we don't know the difference, we haven't had time to separate them, or there haven't been enough striped bass. Pretty much through the thing, we have all kind of had to carry this particular thing along of looking at white perch and striped bass as sort of analogues to each other.

Q Do you know for a fact that striped bass and white perch larvae would experience the same effects due to entrainment in a power plant?

A It would be similar at a certain size, as indicated by the Meldrim and Gift work on juvenile sizes of fish. I don't think, though, I would want to try to interpolate back from fish of that size to say a larvae of the striped bass and white perch would react in exactly the

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same way to temperature. They suggest that any such hypothesis is probably okay.

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Q So what you are doing is, you are assuming that because white perch and striped bass are closely related species, effects on one would be the same as the effects on the other?

A Well, to this extent, that in this particular study, the white perch were killed immediately at the discharge from the plant. They were all dead. So that that is the most severe case.

In other studies, in studies of some of the other species which were also killed at higher temperatures, there was apparently, at these lower temperatures, the ones that killed the white perch, survival. But at the higher temperatures, there weren't.

The herring and other larvae that went through there are apparently also reacting in nearly the same fashion, but at a slightly more elevated temperature for a slightly longer exposure time to actually kill them.

Q Would you say temperature is the factor that you really look at when you determine these things?

A You have to look at them all.

Q But I mean a moment ago you mentioned that at higher temperatures you saw these things.

A Right.

I think very definitely temperature plays an important role. And with everything else the same, I would

1 expect to get a higher kill in the condensers at a higher
2 temperature.
3 Q You mentioned a moment ago that these were white
4 perch and you didn't know for sure whether the white perch
5 and the striped bass would have been subject to the same
6 effect. And you also mentioned that you didn't know what the
7 similarities or differences were in the inner workings of the
8 Indian Point 1 plant and the Connecticut Yankee plant.
9 On the basis of these facts, isn't it true that you
10 can't say for certain that an effect that was observed by
11 Marcy at the Connecticut Yankee plant will be found for the
12 same species say at Indian Point, like white perch?
13 A I think that in a situation where you have no
14 other data you are justified in drawing an analogous, using
15 an analogous comparison of this kind.
16 It is not what you want. If you could have it, you
17 would want the actual results of a competent and detailed
18 study with efficiency, with gear of non-efficiency under
19 various conditions and so forth in y our subject plants, or in
20 the nearest kind of plants to it, and as close to that site as
21 possible to get the same kinds of fish under the same influences.
22 Obviously that would be the goal.
23 I didn't have information like this to work with.
24 The nearest thing to it would be the white perch, and I
25 can't think of any reason, myself, why, if all of the white

mm3 1 perch were killed, why striped bass would be expected to
2 survive, when even the herring only survive a little better
3 than the white perch, and then only until the temperature
4 got higher.
5 Q. You say in a situation where you have no other
6 data, if you had other data would you feel thatthen you should
7 use that other data and not rely on Marcy?
8 A. Certainly.
9 Q. How many white perch did Marcy collect for the
10 results given in his 1971 paper?
11 A. I think there were, what comes into my
12 head is 28 fish. Let me check.
13 Q. I think it is 35.
14 A. Is it 35?
15 Q. yes.
16 A. All right.
17 Q. It appears in the second group of numbers, June 30,
18 July 2, July 6, in Table 2, 35 total, 21, 9 and 5..
19 What was the range and median lengths of these
20 white perch larvae?
21 These are given in Table 2.
22 A. I am a little confused by the --
23 Q. I am referring now to the list, June 30, July 2,
24 July 6. There are 35 larvae and a range of size.
25 A. I am sure I don't have a complete copy here.

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Q. I will show you mine.

What does he report as being the range and median lengths of those larvae?

A. Between the -- the mean is between 3 and 4 millimeter, the range is between 2 and 4.

Q. So actually the range is from 2 to 3.9 and the median is about 3.2 roughly?

A. Median?

Q. yes.

Simply becausemost of them are in the first group of 21, you see.

A. Well, the median would have to be calculated.

Q. Okay.

Isn't it true that those sizes, that is a range of 2 to 3.9 and the median of about 3.2, I say, you say between 3 and 4, that those sizes are much smaller than the vast bulk of range of sizes that are treated in your testimony as being susceptible to entrainment at Indian Point, that is the striped bass larvae, which are susceptible to being entrained?

I call your attention to the fact that on page 15 of your testimony, you report that striped bass are 3.1 millimeter at hatching.

A. Well, the data that I had to rely on -- this is the October 30 testimony we are talking about, right?

Q. Right.

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A. The data here are almost all from Carlson-McCann, and from plankton tows, Hudson River.

What we are talkingabout when we talk about all of these possible dangers are larvae of the size that we sampled in that Carlson-McCann study.

Now as I remember it, they had some very poor catches of yolk sac stage larvae. What I guess from that is that the larvae were so small, skinny, that once the yolk sac was ruptured, they slipped through the mesh of the net.

So in view of a possible high loss of these with mesh sizes around zero plankton net size, I don't know whether -- I don't think this size, I don't know that this size is represented fully in the samples.

In other words, the total number of these -- you will notice I made some estimates in here of the population in the year '66 and '67. That population estimate of larvae based on Carlson-McCann might have to be considerably higher if there were a fairer and more representative sampling of the skinny little larvae that could get through the net.

So it complicates the answer to your question to that extent.

Q. I am sorry, I don't quite see why it complicates it, because Marcy reported a range from 2.0 to 3.9 millimeters. Striped bass eggs are 3.1 millimeter when they hatch. I think that is pretty well accepted. I don't think there is

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much question about that.

You report that striped bass are being entrained to a size of approximately 2 inches, which is approximately 50 millimeters. So I would say, and would you not agree, that the vast bulk of the larvae which you report as being entrained, the striped bass larvae, are larger than the larvae that Marcy reported as being entrained?

A. No, you have to cope with the very high mortality of these very young stages, so you have a very, very dense population of yolk sac larvae in comparison, numerically, in comparison to the number of larger fish you have.

If you are talking about numbers, you might be killing as many as 50 times, or 25 times as many of these yolk larvae as you would another vulnerable stage a week or two away.

Maybe I can simplify it for you by saying that this is an exceptionally small size of larvae in relation to the size we have been talkingabout.

Q. Would you agree that the larvae that you reported as being subject to entrainment and subject to lethal conditions in the Indian Point plant range up to 50 millimeters in length?

A. Yes, until they are screenable.

Q. And this is to be contrasted with the white perch larvae that Marcy was looking at, which never exceeded 3.9 millimeters?

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A. All right.

Q. Is that correct?

A. Yes, but there is something else more I should add tothat, and that is that if you will notice in this paper, Marcy says that the larger the specimens were,the worse condition they were in.

I will read this to you:

"The majority of dead specimens were mangled, and this condition was more apparent in larger specimens."

Q. Were the larger specimens that he was reporting on that you just read, were they white perch?

A. At station D -- I am not sure, it is not clear from the passage, but there is an indication --let me see.

Q. Let me put it this way --

CHAIRMAN JENSCH: Go ahead and let him look at it.

THE WITNESS: July 2 there were white perch in that station D on that date. I don't think he discriminates between the species there. I think that is a class statement, sort of general statement.

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BY MR. TROSTEN:

Q. Mr. Clark, isn't it true that larger larvae than observed by Marcy could have higher resistance to the potential stress experienced during entrainment, larger than the 3.9 millimeter?

A. Could have a greater resistance?

Q. A higher resistance to the potential stresses which are experienced?

A. Not according to Marcy.

The bigger the fish are, the more mangled they get.

Q. You mean there were some larger fish and it is not apparent whether these were white perch or not?

A. No, it was not clear to me he meant to specify any particular species. It seemed to me he was talking about all kinds of larvae that he got.

Q. But the white perch never got beyond 3.9 millimeters, right?

A. Right. So we don't know specifically what would have happened for them if they had been larger. Of course, they were all dead at that size, so we can't get much worse than that.

Q. Would you say, Mr. Clark, that your assumptoin of a complete kill or virtually complete kill, which you state on page 47 of your testimony -- do you see where you state

1 that?

2 The last line, last sentence, rather, in the

3 second paragraph.

4 A. Yes.

5 Q. (continuing) -- may not apply to all or any of

6 the sizes of striped bass larvae which you have stated to

7 be susceptible to entrainment?

8 A. Excuse me, are you quoting me or asking a question?

9 Q. I am quoting you and asking a question.

10 MR. MACBETH: Could the reporter read the

11 quotation?

12 MR. TROSTEN: I want you to bear this in mind,

13 Mr. Clark, that the particular statement that you are making

14 here in the second paragraph on page 47 deals with the

15 effects of temperature, not mangling.

16 THE WITNESS: With not what, please?

17 BY MR. TROSTEN:

18 Q. Not pressure.

19 A. Right.

20 Q. So I am asking you if you confine your analysis

21 to the effects of temperature, isn't it true that your

22 assumption of a complete kill or virtually complete kill may

23 not apply to all or any of the sizes of striped bass larvae

24 which you have stated to be susceptible to entrainment?

25 A. Well, I don't, I certainly didn't mean to confine

1 myself to temperature.

2 Q. Is that you were talking about in the second

3 paragraph here?

4 A. No, this has to do with synergism. This has to do

5 with the effect of temperature acting in concert with all of

6 the other effects, oxygen depletion, toxicity, pressure change,

7 mechanical damage, and so on.

8 The higher the temperature, the more it not only

9 has a thermal effect, the more it complicates the other

10 effects.

11 Q. It is interesting the way you phrase this on

12 page 47, Mr. Clark. You say the following:

13 "This work done at the Connecticut River plant

14 in the Connecticut River shows clearly that white perch larvae

15 are all killed by passage through the plant, at least when

16 temperatures are elevated to 83 degrees F. or higher, at the

17 discharge. This temperature condition would be reached in

18 the cooling water of Indian Point Number 2 in early June

19 and remain until early October, the period when Hudson

20 ambient temperatures exceed 68 degrees F. Marcy got a

21 complete kill at 83 degrees F., but tried no lower

22 temperatures. Therefore, it is quite possible that a

23 complete kill or virtually complete kill would occur at

24 even lower temperatures."

25 Are you saying now you are not confining your

1 discussion there, or not relating your discussion to the
2 realtive effects of temperatures?
3 A. What I am saying there, when I talk about
4 March's work and the temperature, this wasn't a simulation,
5 this was the actual plant, and not only is there a
6 temperature characteristic, but there are all of these
7 other things going on, too.
8 I am discussing at this moment the temperature
9 variable, which is one among a number which probably contributed
10 to the cause of death of those fish.
11 Q. Are you implying or inferring here that the
12 temperature variable is the critical one, because if you
13 are not inferring that, why do you say:
14 "Therefore, it is quite possible a complete
15 kill or virtually complete kill would occur at
16 even lower tempeartures"?
17 A. I think, yes, I can't say it is the paramount
18 variable, but it is one of the most important. It is the
19 one we can compare directly to the Hudson.
20 Q. Isn't it true, Mr. Clark, that Kerr reported in
21 1953 that 85 to 90 percent of striped bass, 1.8 to 3.2 inches
22 long survived test plume exposures to temperature increases of
23 18 degrees F. up to maximum final temperatures of about
24 90 degrees F, based on observations five days after
25 exposure?

1 CHAIRMAN JENSCH: Would you give him the document
2 that reflects that?
3 MR. TROSTEN: Yes.
4 THE WITNESS: Is this in summary form as you have
5 read it in the paper?
6 BY MR. TROSTEN:
7 Q. I don't think it is stated as such in the
8 abstract, but this is, I believe, a fair summary of it.
9 Do you disagree with that?
10 A. Is it possible to juse accept what you say
11 and say, yes, and then check it and come back later, if I
12 find you are in error?
13 Q. That is entirely all right with me.
14 A. I have knowledge of the study, except that there
15 were survivals, under those experimental conditions, of the
16 fish you mentioned and I am just not sure of the exact
17 number.
18 Q. If you determine on your review of Kerr's report
19 that you disagree with my characterization of it, you can
20 let me know.
21 Now, isn't it also true that Kerr reported that
22 95 percent of striped bass, 0.8 to 1.8 inches long, survived
23 passage through the condensers of the Contra Costa steam plant
24 in California, this determination also being based on
25 observations of the fish five days after they had passed

1 through the plant?

2 A. I am not willing to accept that they passed

3 through the plant or went through the condensers, because the

4 experimental conditions of that were such that it did not

5 simulate the actual passage through a plant. All the guy

6 did was took a hose on each end of a condenser tube and gave

7 them a ride through in some hot water. It did not attempt

8 to simulate turbulence, mechanical shock, the water boxes,

9 the way they back around and get abraded, and all of that.

10 Q. So you feel there is inadequacy in the test

11 conditions?

12 A. Yes, that is an experiment.

13 Q. Are you aware that Chadwick and Stevens later

14 reported in 1971 results of temperature tolerance studies

15 on striped bass larvae from one third inch, which is about

16 8 millimeters, to one and a quarter inches, or 31

17 millimeters, which supported Kerr's Contra Costa conclusion

18 that little direct mortality occurs at temperatures below

19 90 degrees F?

20 A. Discharge temperatures?

21 Q. At temperatures, that is right, at discharge

22 temperatures below 90 degrees F.

23 CHAIRMAN JENSCH: If you don't have the documents,

24 would you identify the name of the documents? I think it

25 would be more helpful when we refer to a document to tender

dor 7

1 the documents to the witness.

2 MR. TROSTEN: Right.

3 This is a document called "Evaluation of Effects

4 of Thermal Discharges in the Western Sacramento-San Joaquin

5 Delta on Striped Bass, King Salmon and the Opossum Shrimp,"

6 by Harold K. Chadwick and Donald E. Stevens.

7 This is the State of California, Resources

8 Agency, California Department of Fish and Game, Anadromous

9 Fisheries Branch.

10 THE WITNESS: Would it be possible for me to have

11 a look at that during some recess?

12 I would rather just be able to answer your

13 question now than keep saying, you know, I will come back

14 later.

end 22. 15

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MR. TROSTEN: We will provide you a copy of this and you take a look, because you have a copy of that, and then we will discuss this.

THE WITNESS: I have this one too but I would feel better if I could look at it a little bit.

BY MR. TROSTEN:

Q Let's return to your testimony at the top of page 48. You state that striped bass entrained in the Indian Point Unit 2 cooling water would be exposed to the conditions of the Marcy experiment and would die. Do you see that there?

A Yes.

Q Now, we have agreed that there were no striped bass in the Marcy Studies, correct?

A That he didn't report them.

Q And based on your previous answers, you don't know, in fact, that the pumps or inner passages or other hardware surfaces or the turbulence or the pressure changes to which larvae would be exposed, are the same at the Connecticut Yankee Plant which was studied by Marcy and at the Indian Point No. 1 Plant. Is that correct?

A That is correct. I know that, know only that it is generally a similar system, but I do not know the specific details of contour, turns and kinds of thing that could have an influence.

Q Do you know, or are you aware of the fact that the

1 Connecticut Yankee Power Plant contains a weir made of trap rock
2 over which the water drops before reaching the discharge canal
3 locations used by Marcy. He refers to this in his documents. Are
4 you familiar with that?
5 A Is this shown on the map?
6 Q It is not shown on the map, but it is discussed on
7 the first page and they talk about the weir.
8 A The outfall weir?
9 Q "The heated water then flows over a weir and continues
10 down a canal 60 foot wide," and so forth.
11 A Is that not the point labled B on the map?
12 Q Yes. I believe that B -- I am sorry, in the second
13 column, page 1057, he says B is below the outfall weir. Do
14 you see that in the third line of the first full paragraph?
15 A So it is somewhere between point A and point B.
16 Q That is correct. But you are aware, are you not,
17 that there is this weir over which the water flows?
18 A Yes.
19 Q Prior to the time that the discharge sampling
20 point B is reached?
21 A Right.
22 Q Does Indian Point PLant discharge canal contain such
23 a weir?
24 A Not to my knowledge.
25 Q We have agreed a moment ago that the Connecticut Yankee

1 discharge canal in transit time is longer than will be the case
2 at Indian Point 2 or Indian Point 1?
3 A Yes.
4 Q So, you are aware of some differences between the
5 Connecticut Yankee physical configuration and the Indian Point
6 physical configuration?
7 A Right.
8 CHAIRMAN JENSCH: Excuse me, could you tell me what
9 the significance of those differences are? If there is shorter
10 transit time you will get more heat out faster at
11 Indian Point?
12 THE WITNESS: In this case, talking about the white
13 perch, they were all killed when they came out of the
14 plant anyway, so the length of the discharge canal is not
15 involved with the white perch. But with the herring larvae it
16 is, because under certain experimental sets there was
17 progressive mortality as they passed from Point B to C to D to
18 E on this map. So, presumably it could detain and delay them and
19 increase their mortality over what would happen if they got
20 quickly back to the river and got mixed with the ambient water.
21 DR. GEYER: What kind of weir is this? Is it a
22 free overfall weir or submerged cell? Weirs are all sorts of
23 things.
24 MR. TROSTEN: Are you asking me, sir?
25 DR. GEYER: Anybody that knows, just to have a better

1 picture of what we are all talking about. It is not a
2 Niagra Falls weir.
3 DR. LAUER: I have been there and seen it and also
4 talked with them about the nature of the weir. IT is composed
5 of trap rock rubble and my understanding is the purpose is to
6 prepare a higher level of water on the back side of the plant,
7 to produce back pressure against the pumps. It is of a height
8 such that water would tumble down over it, under lower river
9 flows as much as maybe a two or three foot drop and under high
10 river stages there would be no actual drop, you know, if the
11 river stayed high.
12 DR. GEYER: It is to hold a constant discharge
13 level on the system.
14 BY MR. TROSTEN:
15 Q Mr. Clark, is it not true that the Delta T across
16 the condenser is substantially higher at Connecticut Yankee
17 than at Indian Point 1 or 2. In fact, it is 22.5 degrees, is
18 that not the case?
19 A It wasn't the case during the time that --
20 Q You say it was not the case?
21 A Yes. It wasn't the case during the white perch,
22 during that period when so many of those white perch were killed.
23 As I recall the Delta T was about 10 or 11 degrees.
24 Q Could you point out to me where that is indicated?
25 A Here it gives -- it is in here somewhere. It gives

1 the temperature --

2 Q These are Centigrade references on page 1059, is that

3 correct?

4 A Yes. THese are the discharge temperatures in TAble 1.

5 Q On July 2, do you see the reference there, was

6 the Delta T there not approximately 22 degrees?

7 A Excuse me, let me start with June 30, where it

8 was six degrees centigrade, which is around, what, 11, a Delta T

9 of 6 or Fahrenheit difference of 11.

10 Q Correct.

11 A That was the day when the most white perch were

12 killed.

13 Q What was it July 2?

14 A It is 11.5 and that is around 20 degrees F, if I

15 am right.

16 Q Roughly 22?

17 A Right. So white perch were killed at a Delta T

18 of 11 or so and a gain of 20 or so.

19 Q What was the July 6?

20 A Over 20 degrees Fahrenheit.

21 Q Now, you indicated a moment ago, I believe, that

22 you do know of some differences between these two plants, and we

23 were just going over the differences in the physical situations

24 at Indian Point and Connecticut Yankee. Now, in view of these

25 differences, was water temperature the similar condition you

1 were referring to when you compared the Marcy experiment
2 to the June period of peak striped bass early larvae
3 occurrence in the Hudson, on page 48 when you said, "Since the peak
4 of striped bass early larvae abundance occurs in June in the
5 Hudson, those entrained in the cooling water would
6 be exposed to the conditions of the Marcy Experiment and would
7 die. See Marcy Experimental Set A for June 30." And you refer
8 to the Marcy experiment. My question to you is was water
9 temperature the similar condition that you were referring
10 to?
11 A Yes.
12 Q Now, in the next paragraph on page 48, you
13 relate that Marcy found the majority of dead larvae from the plant
14 were mangled and that this condition was more apparent in larger
15 species. Is that correct?
16 A Larger specimens.
17 Q Larger specimens. Is that correct?
18 A Yes.
19 Q Now, lethal temperatures don't mangle larvae, do they?
20 A Excuse me.
21 Q I say lethal temperatures don't mangle larvae, do
22 they?
23 A No, sir.
24 CHAIRMAN JENSCH: Is this a convenient place to inter-
25 rupt your examination?

MR. TROSTEN: Certainly.

CHAIRMAN JENSCH: AT this time, let us recess to reconvene in this room at 3:45.

(Recess.)

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CHAIRMAN JENSCH: Please come to order.

The Board is working out some schedule conflicts and will need a little further time. At this time we will recess to reconvene in this room at 3:50 p.m.

(Recess.)

CHAIRMAN JENSCH: Please come to order.

Mr. Clark has resumed the stand.

Is Applicant's counsel ready to proceed?

MR. TROSTEN: Yes.

CHAIRMAN JENSCH: Please proceed.

BY MR. TROSTEN:

Q Mr. Clark, before the recess we were discussing the effects of mangling on larvae and the effects of temperatures and so forth.

You had indicated that lethal temperatures did not mangle larvae.

My next question is, is it not true that Marcy reported all white perch larvae he collected to be dead as they emerged from the plant?

CHAIRMAN JENSCH: Do you have Marcy's report?

Would that help you?

THE WITNESS: Yes, I have a copy with me.

CHAIRMAN JENSCH: I think when he is talking about a document, I think you should be sure your answer is directly related to what Marcy said.

mm2

1 THE WITNESS: Yes, sir.

2 As they emerged from the plant, they were dead, yes,

3 that is my recollection.

4 BY MR. TROSTEN:

5 Q. Is it true that most of these were mangled?

6 A. That most of the white perch were mangled?

7 Q. Yes.

8 A. It says, "No living white perch larvae were

9 observed after passing through the plant at Station B."

10 I don't come across the passage where he says the

11 white perch were mangled.

12 Q. He says on page 1058, under the heading "Results,"

13 towards the middle of the paragraph, "The majority of dead

14 specimens were mangled."

15 A. Yes.

16 Q. So that most of the white perch, presumably, were

17 mangled?

18 A. Well, not most. Majority means something over 50

19 percent. It could be 51 percent.

20 Q. All right.

21 Now, the implication you drew from this on page 48

22 was that the condition of these larvae was due to mechanical

23 damage.

24 Is that right?

25 A. Yes, that is what I would call mechanical damage,

mm3

1 actually abrasion, torn tissues, contusions, and this.

2 Q So the probable cause of death was mechanical

3 damage, not temperature, isn't that correct?

4 A I would be reluctant to agree to that because the

5 suggestion from the other larvae is the higher the

6 temperature goes, the more die. If you look at the other

7 results he had, you see there is some kind of effect,

8 synergistic effect of temperature and these other things

9 apparently involved.

10 Q You indicated a little bit ago that subjection to

11 lethal temperature doesn't cause a larvae to be mangled.

12 A That temperature alone does not mangle fish, that

13 is right, I agreed tothat.

14 Q Now you stated earlier the lengths of white

15 perch --

16 CHAIRMAN JENSCH: Excuse me. Before you leave that,

17 I wonder if I could ask, is it your thought that temperature

18 could have killed the fish, but after it got killed, it got

19 mangled going the rest of the way -- some combination going

20 through the plant?

21 I am trying to understand your answer. You said

22 temperature might have killed them, and temperatures

23 alone don't mangle. But could they get mangled after they

24 were killed?

25 THE WITNESS: Yes.

mm4

I am not prepared to say exactly, you know, what the pathway of death would be, because of the variety of experience that the fish have as they go through the plant, between turbulence, pressure, abrasion, impact and the heat and so on.

However, I believe that the death, the conditions that bring on the death of the fish are enhanced by increased temperature to the point that under the same conditions if you had a higher discharge temperature, including a higher ambient and a higher delta T, that you would have a higher rate of visible direct death.

CHAIRMAN JENSCH: How does the mangling occur?

THE WITNESS: Well, here since he said that the majority of the fish were mangled and that it appeared to be greatest in the larger specimens, I would assume that this is aproblem of impact, and this is an assumption -- a problem of impact on condenser tubes and so forth through the water box, this kind of thing, where if a large fish were being thrust through the ends of that condenser ensemble, the chance, just the statistical probability of that fish hitting some part of it, say the edge of a condenser tube as it starts through there would be higher in a bigger fish than it would be in a smaller fish.

Just the statistical probability of being impacted or hit against something.

DR. GEYER: The smallest passage the fish has to

mm5

make its way through is the screen, I judge.

The condenser tubes are usually an inch or more.

Is there any data on what happens when they pass through the screen itself?

THE WITNESS: My understanding is that the flow would be much higher --

DR. GEYER: The velocity would be higher in the condenser tube, there is no question about that. But the opening would be much smaller inthe screen.

THE WITNESS: Yes.

My recollection of those tubes is, they were around a half inch.

Does someone know the size of those tubes, condenser tubes?

CHAIRMAN JENSCH: What did Marcy say?

Did he tell us what the tubes are?

MR. TROSTEN: No.

THE WITNESS: I don't think so.

CHAIRMAN JENSCH: We may not know unless we know what Marcy's study included. The problem I had was that as I understood the interrogation, you assumed that the mangling came from some mechanical process.

I wondered whether that mangling occurred before or after death caused by temperature. I take it you really can't tell from what has been presented when the mangling

mm6

occurred, whether it was before or after the death from temperature, if that was the cause?

THE WITNESS: Well, what would seem to suggest itself to me is that the most likely place for that damage might be ahead of it, before they pass out through the condenser and get that heat shock.

I have tried to trace through the system in the plant, and it would seem to me that the place where there would be a great deal of shock would be where the water passes into the condenser tubes, and I would think that if that is the case then the damage would have been done, considerable of it, before they went through the tubes and out the other end.

CHAIRMAN JENSCH: The greatest place of contact with temperatures would be in the tubes?

THE WITNESS: In the tubes.

CHAIRMAN JENSCH: Thank you.

BY MR. TROSTEN:

Q. Marcy says the majority of dead specimens were mangled. This condition was more apparent in larger specimens.

Marcy doesn't rule out the possibility that all of the deaths were caused by pressure changes, for example, does he?

A. I don't remember that he discussed what particular

mm7

1 factors were the ones that were the most dominant in
2 mortality.
3 Q So you can't tell from Marcy's report, you, yourself,
4 are not able to tell whether the deaths of these larvae was
5 caused by pressure changes, for example, or mechanical
6 abrasion.
7 A. He does say in the second column under the
8 paragraph marked "discussion" page 1058, "mortalities that
9 occurred in the canal were attributed to heat shock and
10 prolonged exposure to elevated temperatures."
11 Q Mortalities that occurred in the canal?
12 A. Yes.
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Q Yes, I see.

And this is that over-one-mile-long canal that Connecticut Yankee has, is that right?

A Yes. Except that I think in relation to the white perch that were all dead before they got to the weir, by Station B, I would assume any effect of that heat shock or prolonged exposure or whatever would be over at that point where they are all dead.

Q Yes.

But you can't really tell whether the mortalities that were observed by Marcy at the first discharge canal sampling point were due to temperature or due to pressure or due to mechanical abrasion; this is something you just can't tell from his report.

Is that right?

A Just one minute. Let me study this a little more carefully.

I would think the statement that he made saying that mortalities in the canal were caused by heat shock and prolonged exposure to temperature relate to their passage from one sampling point to another down the canal.

Q In other words, the passage below sampling Point B, or sampling Point B down through sampling Point E? Wouldn't you think so?

A I think that is the suggestion, yes.

Q Now, getting back to Kerr for just a second, do you have a copy of that report?

A Yes.

Q I don't know if your copy is any better than mine --

A It is, it is an original.

Q I have something called Section 7, Screen Mesh Size Studies, Section 8, Temperature Studies, rather. Do you see that?

It is under Part 4, Section 8, page 36. Do you see that?

A Yes.

Q Upon what must be page 37 -- do you see the sentence, "The experiments were conducted in two species of flume and later in an actual operating condenser."

A Yes.

Q Does that suggest to you that these experiments were conducted with just a tube run through the plant?

A Let me just read to you, please: "A condenser tube was brought out on each end through the water box walls."

Q Where are you reading from?

A I am sorry. The fourth sentence in the fourth --

Q I see it.

MR. MACBETH: Could we have the page?

THE WITNESS: Page 37. "A condenser tube was

brought out on each end through the water box walls and it was connected to hoses. The hoses in turn were connected to dispersing and receiving tanks for the fish."

So they had a tank of fish on each end and a little hose to connect to the ends of the condenser tube that they brought out through the ends of the water box, and just gave them a ride down through the pipe.

That's doesn't have anything to do with the turbulence in the water boxes, the pressure of the pumps, any of the rest ofit.

BY MR. TROSTEN:

Q But it actually went through the condenser, isn't that correct?

A The hot water tube they used happened to have been heated by steam in the power plant. But it shouldn't be interpreted to be analagous to an actual operating plant such as Marcy's work was.

It just happened to be a convenient tube for them to use.

Q So these larvae experienced thermal conditions in the power plant?

A Yes.

Q That ~~whas~~ was what you indicated before?

A Yes, I would be quite contended it would express the thermal influence.

1 Q Now you stated earlier that the length of white
2 perch larvae, or you agreed earlier the length of white perch
3 larvae collected by Marcy were 2.0 to 3.0 millimeters
4 long; is that correct? Roughly?
5 A I don't think I agreed to that. Did you say 2.0
6 to 3.0?
7 3.9, is it?
8 Q Excuse me.
9 2.0 to 3.9, yes. I am sorry.
10 Now, you would call these "early larvae," would
11 you not?
12 A YEs.
13 Q So Marcy collected no later larvae or
14 pre-screenable juvenile stages of white perch; isn't that
15 true?
16 A That is true.
17 Q When you concluded on page 48 that later larval
18 and pre-screenable juvenile stages can be expected to suffer
19 heavy mechanical damage and death, this was based not on
20 observations of white perch of these stages, but rather on
21 other species not close relatives of the striped bass; isn't
22 that correct?
23 Do you see where you make that statement on page
24 48?
25 A Yes. May I read it back to you?

Q Sure.

A "Thus, for the species Marcy studies, the damage apparently was even greater for stages following the yolk larvae, thus later larval and pre-screenable juvenile stages can be expected to suffer heavy mechanical damage."

Q So you were not intending that that sentence refer to striped bass then, but to something else?

A At thispoint I am talking about the species Marcy studied, right, white perch.

Q The later larval and pre-screenable and juvenile stages were not white perch, isn't that correct?

A I am sorry?

Q The later larval and pre-screenable size fishes that Marcy studied werenot white perch, which are close relatives of the striped bass?

A They were other species.

Q Considering that Kerr reported 95 percent survival of striped bass 0.8 to 1.8 inches long passed through the Contra Costa steam plant, based on observations five days after passage, apparently Kerr didn't find the larvae to be mangled during passage, did he?

A I can't imagine that they would be mangled, no. I don't know that he states in the paper that that was or wasn't the case. But I would see no reason why they would be mechanically damaged.

Q Do you have any information to indicate that the majority of larvae emerged from Indian Point 1 in a mangled condition?

A I am sorry, would you repeat the question.

MR. TROSTEN: I am sorry, would the reporter read the question, please.

(The reporter read the record as requested.)

THE WITNESS: No, I have no such information.

BY MR. TROSTEN:

Q Mr. Clark, isn't it true that the results of the studies by ~~Keiran and Chadwich~~ Kerrand Chadwick on striped bass would lead one to conclude that the majority of striped bass larvae might survive passage through Indian Point 2?

A Certainly not.

CHAIRMAN JENSCH: In reference to the Indian Point 1 situation, were there studies or accurate counts made to show anything about the larvae coming through Indian Point No. 1?

MR. TROSTEN: I am sorry, Mr. Chairman --

CHAIRMAN JENSCH: Your last previous question to the witness was did he have any data to show whether the larvae from Indian Point No. 1 was mangled.

MR. TROSTEN: Yes.

CHAIRMAN JENSCH: Are there some studies and data that show the condition of the larvae that do come through?

1 MR. TROSTEN: That is correct. That is contained in
2 the NYU studies, Mr. Chairman.
3 CHAIRMAN JENSCH: Thank you, proceed.
4 MR. MACBETH: Would Mr. Trosten indicate precisely
5 which NYU study?
6 MR. TROSTEN: The October 30 testimony.
7 MR. MACBETH: Dr. Lauer's testimony?
8 CHAIRMAN JENSCH: You mean both Dr. Lauer and Mr.
9 Clark put their testimony out at the same time. Of course,
10 he hadn't received Dr. Lauer's testimony when he drew his own.
11 So, I was wondering if you bore that in mind. I take it he hadn't
12 seen your evidence about it, and the inference is not
13 having seen his evidence, he assumed there was no data about the
14 condition of the larvae. You kept that in mind, did you?
15 MR. TROSTEN: Yes, I was keeping this in mind. Mr.
16 Clark, of course, as of this point in time, has available
17 to him both the written testimony of Dr. Lauer and also
18 the cross-examination conducted by Mr. Macbeth of Dr. Lauer
19 and it was in that context that I asked him the question.
20 CHAIRMAN JENSCH: Very well, thank you.
21 THE WITNESS: Oh, excuse me. Were you asking me to
22 draw on my review of the NYU data in response to your question?
23 BY MR. TROSTEN:
24 Q Yes, I was asking you the question, do you have any
25 information to indicate that the majority of larvae emerged from

1 Indian Point No. 1 in a mangled condition. I was asking you
2 for information of any sort.
3 A Oh, would you wait just a minute?
4 Q Certainly.
5 CHAIRMAN JENSCH: Excuse me, I am not too familiar with
6 Dr. Lauer's testimony in that regard. I wonder, do the data
7 collected by Dr. Lauer in this NYU study indicate that the larvae
8 were chopped up coming through the screen, or did you make
9 any separate determintion of where things happened as they
10 went through the completion of equipment.
11 DR. LAUER: Yes, sir, we did. We haven't seen any
12 evidence of a mangled condition at any location where we have
13 sampled, intake or discharge. So forturnately in that case
14 we don't have to try to explain where the mangling takes place.
15 DR. GEYER: You don't have any.
16 DR. LAUER: No.
17 CHAIRMAN JENSCH: Thank you.
18 THE WITNESS: That saves me the problem of looking
19 it up to see what your comments were in your testiomny. I saw
20 in there that a number of them were stunned and otherwise
21 damaged, and I had assumed some of that was mangling, but I guess
22 not.
23 CHAIRMAN JENSCH: What do you mean by mangling.
24 MR. TRSOTEN: What did Marcy mean by mangling?
25 CHAIRMAN JENSCH: What did Dr. Lauer mean by mangling.

DR. LAUER: By mangling I mean the bodies of the fish, either alive or dead, are in an intact condition, not frayed or pulled apart into pieces. They are intact, whole, and have no apparent gouges and gigs and fragments sticking out.

CHAIRMAN JENSCH: No scratches, bars, or bruises, is that your thought.

DR. LAUER: I couldn't go as far as to say there were no bruises. It is pretty hard to see a bruise on a three millimeter fish. But that is what I mean by mangling, that they were intact.

CHAIRMAN JENSCH: Mangled assumed two parts?

DR. LAUER: Not necessarily. You could have one squashed flat, still in one mass, not two pieces, and I would consider that mangling. I am talking about intact bodies that are recognizable as fish larvae, and, of course, the live ones are still alive and swimming and viable and feeding and so forth. As far as the dead ones are concerned, they are intact corpses in that case that are recognizable with their eyes in the right place, their jaw in the right place, their tail in the right place, their fins in the right place, not in a squashed or otherwise disfigured type of condition physically. I am not getting into the bruise business.

CHAIRMAN JENSCH: Thank you.

BY MR. TROSTEN:

Q Mr. Clark, I would like to refer you back to page 47 of your testimony. You say on page 47, "This work done at the Connecticut Yankee PLant at Haddam Neck on the Connecticut River shows clearly that white perch yolk larvae are all killed by passage through the plant, at least when temperatures are elevated to be three degrees Fahrenhei or higher at the discharge. This temperature condition wouldbe reached in the cooling water of Indian Point No. 2 in early June and remain until early October, the period when Hudson ambient temperatures exceed 68 degrees Fahrenheit."

What is the source of data that indicates to you that Hudson River temperatures reach 68 degrees Fahrenheit by early June.

A As I recall, the temperatures -- I think the temperatures were from Carlson-McCann. I can't be sure.

Q Wouldyou look into this at the break and we will get back to this again? Would you look into it and tell us what the basis was for that statement?

A Yes, surely.

MR. TROSTEN: Mr. Chairman, I have no further questions of Mr. Clark with regard to the matter of the mortality of removals of striped bass. I would like to move to another subject, if I may.

CHAIRMAN JENSCH: Proceed.

MR. TROSTEN: May I have just a brief recess?

BY MR. TROSTEN:

Q Mr. Clark, let us return to the subject of your July 14 testimony. I have a few additional questions I would like to put to you. On page 13 of your testimony of July 14, you refer to trophic effects. Would you provide the data which you possess that indicate to you that gammarus will be harmed by entrainments in Indian Point No. 1 or No. 2?

A Neomysis is covered in the draft statement.

Q No, gammarus.

A Yes, neomysis on April 13 and gammarus, pages V-51 and 52.

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Q. Are you aware of the testimony of Dr. Lauer in this proceeding on pages 38 and 39, which indicates that there will not be -- the level of mortalities of gammarus ~~is~~ was observed during chlorination of Indian Point No. 1, and likely to occur during chlorination of Number 2, will not significantly affect the population in the river.

MR. MACBETH: That is Dr. Lauer's October 30 testimony?

MR. TROSTEN: Correct.

THE WITNESS: Are you asking me if I changed my mind now?

BY MR. TROSTEN:

Q. I am asking on the basis of the testimony you have seen in this proceeding, or on the basis of the data that is available to you, I want to know if there are data which support your conclusion that gammarus will be harmed by entrainment?

I refer to your statement here which says:

"Unfortunately, the loss will be greatest for certain zooplankton species that make up the primary diet of juvenile striped bass, white perch, and other Hudson River fish."

You do agree gammarus is the primary diet of the striped bass, is that correct?

A. I would agree that is the prevailing thought, but I would really like to have time to review the later testimony,

if you are going to ask me questions about that in relation to the earlier testimony of mine.

Q. All right.

Would you look at that and then we will return to this subject after you have had a chance to review the later testimony.

A. Yes, I would be happy to.

MR. MACBETH: I might point out, Mr. Chairman, that when we had the hearings in June, one of the aims, as I remember it, was to try and cover entirely some of the more minor issues in the case and that is one reason we didn't submit further testimony in October on gammarus and Neomysis, for instance.

It had been our understanding we had tried to cover those issues and put them behind us in June, so that is one reason why some of the July material has not been rehashed in October.

MR. TROSTEN: I understand that, but the problem is in the hearing in June, there was available to Mr. Clark Dr. Lauer's April 5 testimony, which also indicated no significant harm to gammarus.

And following the June hearings, Mr. Clark presented his July 14 document, and this is the first opportunity since that time which we have had to review this.

Now, it is correct that Dr. Lauer in his October 30 testimony has somewhat expanded upon the experimental data that support his conclusion that gammarus was not harmed, that populations of gammarus were not harmed by entrainment.

But you know this is a relatively minor amount of additional data that was presented on this subject.

MR. MACBETH: I didn't want to cut off the cross examination, I just wanted to make it clear to the Board that the various dates these papers were handed in leads to a certain amount of confusion in responding to everyone else in a precise manner.

CHAIRMAN JENSCH: I think,as applicant's counsel indicated,that the witness has had time to review these papers.

Let us proceed.

BY MR. TROSTEN:

Q. In the same vein, and if you wish to study the October 30 testimony, this would be fine with me, would you provide the data which you possess which indicate that other zooplankton or phytoplankton populations will be harmed as a result of entrainment in Indian Point 2?

A. I can quote two sources of information. One has to do with -- well, three.

I can get back to the exact numbers, at Northport,

1 experiments run there, similar to what Dr. Lauer did, of
2 actual entrainments through the plant, have shown death of
3 copapods up to 36 percent.
4 At Oyster Creek Plant in New Jersey, the
5 entrainment losses were, of the zooplankton, were up to, as
6 I remember it, 15.7 percent on passage and this work was
7 done in the winter and therefore was the lowest that you
8 would expect.
9 At Millstone Point, Carpenter has found that the
10 copapods go through the plant, they get shocked, sink to the
11 bottom, and don't live past the weir.
12 Now, those are several instances I can give you
13 off the top of my head.
14 Q. Now, Mr. Clark, are you familiar with the delta
15 Ts, and the maximum temperatures to which these plankton
16 organisms were subjected in these other plants, as compared
17 with the temperatures to which they are subjected in the
18 Indian Point 1, would be in Indian Point 2?
19 A. Yes.
20 Oyster Creek -- I better check that out.
21 One of them is 10 degrees delta T and the other is
22 higher. Would you like me to do that now?
23 Q. No, I suggest that what you do is you reserve
24 this until you have had a chance to look at the more recent
25 testimony and we can discuss it all at once.

dor 5

1 Now, what sampling of aquatic organisms -- and I
2 refer to phytoplankton and zooplankton -- have you made
3 in the vicinity of Indian Point?
4 A. Of zooplankton?
5 Q. Yes.
6 A. None.
7 Q. Or phytoplankton?
8 A. None.
9 Q. What experimental work have you done with regard
10 to temperature tolerance or sensitivity, other sensitivity
11 to entrainment of zooplankton or phytoplankton?
12 A. Zooplankton, other than fish?
13 Q. Yes.
14 A. Talking about invertebrates?
15 Q. Yes.
16 A. None.
17 Q. Phytoplankton?
18 A. None.
19 Q. So you are relying on surveys and published
20 works by others in the field?
21 A. I have had the experience I described to you this
22 morning in addition, where I was responsibile for, in my
23 laboratory, for the conduct of some of this phytoplankton
24 culture work and zooplankton culture work.
25 Down at Sandy Hook, we had a number of people, six

or eight or ten, during the various times I was down there, who were involved in that.

Although my experience is secondhand, because I wasn't the one that was actually operating the experiments, only administering the laboratory, nevertheless, I feel that I am well enough equipped by that experience to be able to appreciate the value of data and to evaluate research designs.

Q. Did these experiments that were conducted at Sandy Hook involve the analysis of entrainment effects on zooplankton, invertebrates, or phytoplankton invertebrates?

A. No.

Some of them were thermal, but not entrainment.

end 27

Q. You refer on page 13 to adverse neurologic effects on plankton. Do you see that in the middle of the page? It is down ten lines from the top of the page.

Could you tell me what kind of adverse neurologic effect can occur to a plankton?

A. Heat shock.

Q. By a plankton,do you mean a one-cell, or maybe a multi-cell --

A. Oh, I am thinking of -- this doesn't say phytoplankton. That is a plant. No, these are zooplankton.

Q. You are referring to --

A. Animals.

Invertebrate animals.

Q. Multi-cell small animals.

A. Talking about invertebrate animals, crustaceans mostly.

Q. Now, on page 14 you have a review of effects on critical functions. I would like to discuss a few points about this with you just to see the specific bases for the conclusions that you draw about the adverse impacts that Indian Points 1 and 2 will have on the critical functions of Hudson fish.

You say the operation of the Indian Point plants with once-through cooling will have an adverse impact on each of the critical functions of Hudson fish.

By this do you mean all of the fish listed in

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Table 1?

A. I think not.

But let me just check and make sure.

Q. Sure.

A. No, I don't mean on every fish. I can tell you that without referring to the table.

Q. In other words, you would say that those fish which have an "O" standing for oceaneanic areas next to the particular critical area would not be adversely affected by the Indian Point -- that critical area as you define it, would not be adversely affected by the Indian Point plants, is that correct?

A. It is not likely that it would, no.

Q. And there are quite a number of "Os" in the first column, most of the third column, about half of the fourth column?

A. Yes.

Q. And none in the fifth column that I can see.

A. Yes.

Q. Now, now many of the 13 fish that are listed in Table 1 breed in the HE, that is the Hudson estuarine areas?

A. Well, there are only 12 listings in the table.

Q. I am sorry. I thought there were two sturgeons, American and short-nosed.

A. But they are listed together.

mm3

Q. Okay.

A. Now you would like me to count how many --

Q. How many of the 12 fish breed in HE portions of the Hudson?

A. Three.

Q. Now, is that a majority of the 12 fish?

A. No, it certainly is not. It is 25 percent of it.

Q. So therefore you would say that the statement that the Indian Point plants are located in such a way as to do significant damage to breeding activities of the majority of these species is not a correct statement, is that correct?

A. I would have to refer back now.

Where were you reading from?

Q. I was quoting from the last sentence of the subheading called "breeding" on page 14. I was referring back to Table 1.

A. On rereading it, I think that is an error of statement on my part.

Q. Now, on page 14, isn't it true that the major nursery area of striped bass is below Indian Point, contrary to what you say here on page 14?

I refer here to your statement that the Indian Point plant is located in the nursery areas of many of the important Hudson species, including the striped bass.

A. Well, that is true.

mm4

1 Q So therefore that statement is not a correct
2 statement, is that right?
3 A No, that statement is true.
4 You see, the nursery grounds of the stiped bass
5 go on up the river above Haverstraw Bay, including the area
6 around Indian Point. But there are so little flats up in
7 there that percentagewise it is just a small proportion.
8 Q Isn't it true that although there are nursery
9 areas, I understand, up and down the Hudson River, that the
10 major nursery area of the Hudson River is below Indian Point?
11 In the Haverstraw Tappan Zee area?
12 A Yes. There are more nursery area fish down there
13 than there are up the river.
14 Q So the statement, "The Indian Point plant is located
15 in the nursery areas of many of the important Hudson species,
16 including striped bass," while I say it is wrong, you say
17 it is subject to interpretation.
18 A No, it is a nursery area. It extends way up the
19 river, wherever they can find some available flats, or
20 whatever they want.
21 Q All right.
22 Now, what data supports your statement on page 15
23 that the Indian Point area is one of the greatest wintering
24 areas for fish along the Northeast coast?
25 A Well, there are just a lot of fish up there in the

mm5

1 winter.

2 Q. Is that the basis for your statement that the

3 Indian Point area is one of the greatest wintering areas for

4 fish along the Northeast coast?

5 A. Yes, it has a very great concentration of stiped

6 bass, for one thing; white perch and these others that we

7 know about. The migratory fish like blue fish don't spend the

8 winter there. They have to go south to warmer temperatures.

9 But it is very well populated with striped bass.

10 Q. Are there data which support this statement?

11 A. Well, there are fishing catches, the Dolphin work,

12 there is enough to show that there is a very high abundance

13 of striped bass in that river in the winter.

14 We don't have really good sampling data for the

15 winter, because it is iced in and most of the guys that go

16 out and study most of the fishermen are not able to operate.

17 Q. And that is the basis for your statement that this

18 is one of the greatest wintering areas for fish along the

19 Northeast coast?

20 A. Yes.

21 We could get up there with the Dolphin, because it

22 was a big steel ship and it could break through the ice and

23 we could trawl the bottom and they were very abundant.

24 Q. This is that three-day trip in March 1968?

25 A. Yes.

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Q. Were there data that were made in other places of the river by the Dolphin or by other research vessels to specifically compare the abundance in the wintertime of fish at Indian Point with other locations in the river, or in other rivers on the East coast?

A. We trawled all over the place out there and other than early in the winter, December and into the early part of January, you don't find any striped bass along that ocean coast. They all take refuge.

Q. Are all of these reported in the Dolphin reports you were going to try to locate for us?

A. Yes, it gives the average catch of striped bass per 15-minute haul and that.

Q. But the basis for this statement you would say is the Dolphin data?

A. And also the catches of commercial fishermen that put gill nets down under the ice.

Q. And you say that these data demonstrate the Indian Point area is one of the greatest wintering areas for fish along the Northeast coast?

A. Yes.

Q. All right.

Mr. Clark, I think we can move to another subject now.

MR. TROSTEN: May we have a very brief recess,

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1 Mr. Chairman?

2 BY MR. TROSTEN:

3 Q. Mr. Clark, before we move on to the next subject,

4 which I would like to cover with you, which would be impinge-

5 ments, when you provide us with the data on the cruise of

6 the research vessel Dolphin, will you please also provide us

7 with the data on commercial fishing which you indicate support

8 your contention that the Indian Point area is one of the

9 greatest overwintering areas on the Northeast coast, including

10 any comparative data which you are relying on for that

11 statement?

12 A. Yes.

13 Q. Mr. Clark, on pages 33 to 38 you discuss your

14 estimates of impingement losses which will occur at Indian

15 Points 1 and 2 when Indian Point 2 goes into operation.

16 Do you have those pages there before you?

17 A. Yes, I am looking at page 33.

18 Q. Pages 33 to 38.

19 Now, havethe numbers of fish impinged at Indian

20 Point 1 been reduced following reduction of flow, Mr. Clark?

21 A. Are you speaking of those flow reduction experi-

22 ments that were done some several years ago?

23 Q. No, I am not speaking of the flow reduction

24 experiments, I am speaking of the fact that Indian Point

25 1 has for sometime now been operated at reduced flow. I believe

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since December of 1970, Indian Point 1 has been operated at reduced flow during the wintertime.

I wanted to ask you whether, on the basis of your review of the data made available to you by Applicant, much of which is contained in the fish impingement stipulation executed by HFRA and the Applicant, in your opinion have these data indicated that the numbers of fish impinged at Indian Point 1 have been reduced following this reduction in flow?

A. No, I didn't reach an opinion on that.

I tried to analyze those data, interpret them, in light of the plant variables and so on. And I just failed to reach a conclusion on that and decided to go back and work with your 1966 and '67.

Q. I am not asking you whether in your opinion the reduction in flow -- at this point I am not asking you whether in your opinion the reduction in flow caused the reduction in number.

I am simply asking you whether the number of fish impinged was reduced following the reduction in flow?

A. Since December --

Q. Since December 1970?

A. Until the current time.

I know that the records collected by ConEd have shown less fish throughout part of that time than they had

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shown in previous years.

Q So --

A. That much I know.

As far as cause and effect of anything like that --

Q I was not asking you that at the moment.

I was simply asking you whether the number of fish impinged at Indian Point 1 have been reduced following reduction in flow?

A. Yes, but I think you are trying to get me to --

CHAIRMAN JENSCH: Excuse me.

He can't give the cause and effect. He said a lesser number, so can't you start from there?

end 28
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BY MR. TROSTEN:

Q. Do the figures show a reduced number in deaths?

A. I am willing to say that during part of this time there have been less fish impinged on the screens than in previous years.

Q. Have you made any calculations as to how much the reduction has been compared with previous years?

A. I intended to compare it with the decline of white perch in the river and I haven't had a chance to do that yet.

Q. In your opinion, would a reduction of fish impinged generally be in proportion to a reduction in flow?

Now, I am asking for your opinion.

A. I can't say.

Q. You just don't know whether it would or not?

A. I have gone on the basis that that is the best approximation to the present knowledge, but I don't know that it is the actual relationship, whether that is linear between flow and probability of entrainment or not.

It is the simplest case you can think of to use. I have used it myself in that fashion.. In lack of specific knowledge, I have used that.

Q. I have been told you used the word "entrainment" a moment ago. Did you mean to say "impingement"?

A. I suppose I did.

Q. Did you mean impingement?

We are talking about impingement, right?

In other words, I am asking you --

A. I am sure we are talking about impingement; I mean to be talking about impingement.

Q. So would you repeat your answer?

Apparently you used the word "entrainment" somewhere.

A. And confused it all?

I could not answer whether there is a direct proportional reduction of impingements with flow, but I added that since that was the simplest proposition you could advance, in the lack of specific data, it is the one I have used myself in these calculations.

Q. So you, yourself, have used as a reasonable working assumption the concept that impingements would be reduced by direct relation to reduction in flow; is that right?

A. Yes.

Q. Now, have the number of fish impinged on the screens at Indian Point 1 varied significantly from day to day within each month?

A. Yes, the records I have looked at have shown some variation, trends, but then variation.

Q. Significant variations from day to day within each

dor 3

1 month?

2 A. I think you could say they were significant at

3 times.

4 Q. Have they varied from year to hear when comparing

5 the same month, significantly?

6 A. Yes, they have varied substantially.

7 Q. Mr. Clark, how far away from the Indian Point Unit

8 Number 1 intake screens are the Indian Point Unit Number 2

9 intake screens?

10 Do you have a rough idea as to how far away

11 they are?

12 CHAIRMAN JENSCH: If you have something you can

13 give him, whatever your figures show, and start out from

14 there, is that significant or whatever the next question is.

15 BY MR. TROSTEN:

16 Q. It is in the Environmental Statement and I believe

17 it indicates in the realm of 500 feet.

18 CHAIRMAN JENSCH: Starting from there, accepting

19 that subject to check, what is the question?

20 BY MR. TROSTEN:

21 Q. Accepting that premise, are you aware of any

22 evidence that demonstrates that density of fish in front of the

23 Unit No. 2 intake screens is the same as the density of fish in

24 front of the Unit No. 1 screens?

25 A. My impression is it must be considerably higher

in front of 2, judging from those tests where those high concentrations of fish were impacted on the screen.

Q. Is your impression based upon the 10 days or so of tests at Unit No. 2?

A. Well, I am thinking of that and also thinking of this year when there were very high numbers taken on Indian Point 2, much higher than you would expect from Indian Point 1.

MR. MACBETH: Did you in fact mean last year?

THE WITNESS: Excuse me, 1972.

BY MR. TROSTEN:

Q. Which numbers were you referring to, when you say those numbers give you this impression?

A. The 160,000 or 175,000 that were killed in a period of three or four days.

Q. That were cited in your testimony? You are referring now to the fish kills when?

I am just trying to get a feel for what you are talking about.

A. In the winter of 1972.

Q. Are you referring to the second full paragraph on the bottom of page 36, where you refer to the 1972 tests of ten days?

A. Yes. I think, let me check a minute. Well, yes, that would be an example.

Q. That would be the basis for your opinion, is that correct?

A. That is not all of it, no.

Q. Is there some other basis?

A. My recollection -- I would have to study this again, I haven't thought about the data in terms of the question you are asking me, as far as indicating whether more fish, whether fish seem to be vulnerable in larger in front of Indian Point 2 or 1. I need to kind of cycle it through.

Q. Well, you think about that. I want to ask you -- the question pending before you is whether there is evidence that demonstrates that the density of fish in front of Unit Number 2 intake screens is the same as in front of the Unit Number 1 screens.

A. I would say not.

Q. So there is no evidence that demonstrates that?

A. That it is the same.

Q. That it is the same. [illegible]

A. That is the question you asked me

Q. There is no evidence that demonstrates to you that it is different, is that correct?

A. Yes, this information.

Q. This information in the second paragraph on page 36, which involves 10 days of testing, demonstrates to you

1 that, in your opinion, the density is greater in front of
2 Indian Point 2 than it is in front of Indian Point 1; is that
3 correct?
4 A. Well, it is 11 times the Indian Point Number 1
5 kill, and the plant only uses four times as much water.
6 Q. And these are for ten days of tests, right?
7 A. Yes. I don't have any other.
8 Q. When the plant was being started up, is that
9 right?
10 A. Yes, tests. The same kind of thing was going
11 on in '71.
12 Q. Now, is it possible, Mr. Clark, that the density
13 of the fish in front of the screens relates directly to the
14 number of fish impinged on the screens?
15 A. You mean if there are more fish in front of the
16 screens, more will be impinged?
17 Q. Right.
18 A. Probably, sure.
19 Q. So if you were to study this for a period of time
20 to determine the relative densities, you might have a greater
21 understanding of whether fish were likely or more or less
22 likely to be impinged at Indian Point 2 than Indian Point 1,
23 because you might be able to determine the density?
24 A. You mean keep killing the fish up there to find
25 out what is going to happen?

1 Q. I beg your pardon?

2 A. Are you talking about continuing to kill fish

3 there as an experiment over the years?

4 Q. No, I was thinking of a different kind of

5 experiment.

6 A. What kind of experiment; I don't understand the

7 question.

8 Q. An experiment to determine the density of fish

9 in front of the screen.

10 A. How would you do that without killing them on

11 the screens?

12 Q. Would you answer my question first and then discuss

13 it?

14 A. I am sorry, I just don't understand it.

15 CHAIRMAN JENSCH: What is the question?

16 Are you considering changing the velocity of the

17 intake or the size of the intake, that that would affect

18 it?

19 MR. TROSTEN: I asked Mr. Clark whether it is

20 possible the density of the fish in front of the screens

21 might relate directly to the number of fish impinged on the

22 screens and he said, yes, he thought it would.

23 My next question is, well, if you studied the

24 relative density of the fish in front of the screens of

25 one plant versus another plant --

CHAIRMAN JENSCH: How would you do that?

MR. TROSTEN: Are you asking me how you might do that?

CHAIRMAN JENSCH: Yes.

You assume you can do it.

MR. TROSTEN: One way I think you might be able to do it, Mr. Chairman, although I am not a fishery biologist, would be to use a Fathometer. YOu might get a feeling in this way, but I am sure a specialist or expert could suggest a way in which this could be done.

I understand this is one way.

CHAIRMAN JENSCH: In other words, you are not seeking to determine density solely by kill.

MR. TROSTEN: That is correct.

CHAIRMAN JENSCH: Excuse me.

I didn't understand the question. Thank you.

Do you understand the question, Mr. Witness?

THE WITNESS: Yes; I don't know what is left for me to answer: whether I think going after it with a Fathometer and seeing if there is more fish in front of one or the other might be helpful in understanding the magnitude of the problem?

BY MR. TROSTEN:

Q. Do you think conducting an experiment to determine the relative density of fishes in front of the

1 Indian Point 1 screens might give you a better understanding
2 of the nature of the problem and the cause of fish impinge-
3 ments and perhaps means of alleviating this problem?
4 A. I think that has already been done.
5 I agree that would be, that was a useful thing,
6 but I think that work has been done, hasn't it? Something
7 has been out with a Fathometer from ConEd doing that.
8 Q. My question is do you think if you were able
9 to get a good understanding of the relative density of
10 fish in front of these screens, that this would help you
11 to understand the nature of this problem?
12 A. Yes, I think so, if you compared it with the
13 environmental variables and got suitable detection
14 measurements of species and all of this stuff, yes.
15 CHAIRMAN JENSCH: Is this a convenient place
16 to recess?
17 We have been at this pretty steadily since 9:00
18 o'clock this morning.
19 I think a witness can take so much concentration.
20 Is this a convenient place to interrupt?
21 MR. TROSTEN: Yes, Mr. Chairman.
22 CHAIRMAN JENSCH: Very well.
23 Is there any other matter we should take up
24 before we recess this evening?
25 (No response.)

dor 10

CHAIRMAN JENSCH: At this time let us recess to reconvene in this room tomorrow morning at 9:00 o'clock.

(Whereupon, at 5:05 p.m., the hearing was recessed, to reconvene at 9:00 a.m., on Thursday, January 11, 1973, in the same room.)

end 29

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