ENERGY COMMISSION

IN THE MATTER OF:

THE TOLEDO EDISON COMPANY and the CLEVELAND ELECTRIC ILLUMINATING COMPANY

(Davis-Besse Nuclear Power Station)

Docket No. 50-346

Place - Cleveland, Ohio

Date - 26 July 1973

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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(Davis-Besse Nuclear Power Station)

Docket No. 50-346

Auditorium, Cuyahoga Building
2079 East Ninth Street
Cleveland, Ohio

Thursday, 26 July 1973

Pursuant to the above-entitled matter, the

prehearing, pursuant to adjournment, at 10:00 a.m.

BEFORE:

JOHN B. FARMAKIDES, Esq., Chairman,
Atomic Safety & Licensing Board.

DR. CHARLES A. LEE, JR., Member

FREDERICK J. SHON, Member

Appearances:

(As heretofore noted, with the following additions:)

Glen Walker, Esq., and James Bourveliotte, Esq.,
Federal Power Commission, Washington, D.C.

P R O C E E D I N G S

CHAIRMAN FOSTER: It is 10:00 o'clock, so we will call the hearing to order and proceed. Again, please, no eating in the room. We will appreciate it very much.

The Board has given a lot of thought and attention to the issue that we raised initially flowing from the testimony of Dr. Sternglass. We considered the comments of the Applicant and the Staff and we have decided that we will hear the issue. Tentatively we can see the issue raised does not hinge on the methodology of Dr. Sternglass. The issue relates to an apparent discrepancy between measured radiation levels and the amounts of radioactivity release. We will get together with the parties later and discuss schedules. We are hoping as we ended at a bench conference yesterday, that we can proceed with dispatch and the preliminary indication is that we can proceed to hear the issue on August 6. I trust we can maintain that schedule, or at least I would hope that we would, and I will try as best I can to meet that schedule.

Let's proceed now with the issues. I think yesterday we still had the Staff's testimony on Issue 1. We have the Applicant's and Intervenor's testimony on Issue 2. We have the Staff's testimony on Issue 4 and I think we can proceed with the Staff's testimony first on Issue 8. If that is convenient to you. We can then conclude Issue 8

WITNESS FRIGERIO: Yes, I have.

MR. DAVIS: Are the contents of that document true and correct to the best of your knowledge?

WITNESS FRIGERIO: Yes, they are.

MR. DAVIS: I would now move, Mr. Chairman, that this document be issued in the transcript as if read.

CHAIRMAN FENWICK: Any objection?

MR. CHURCH: No, sir.

CHAIRMAN FENWICK: It will be received and so bound. I trust I heard no objection from Mr. Baron, too.

MR. BARON: No.

(The document follows.)

PROFESSIONAL QUALIFICATIONS

Norman A. Frigerio

Argonne National Laboratory

I am a Senior Consultant to the Environmental Statement Project, on loan from the Division of Biology and Medicine of Argonne National Laboratory. I am a Radiological Assessment Specialists and Team Leader of the Davis-Besse team of the Environmental Statement Projects.

I received a Bachelor of Science degree in biophysics and chemistry from the Massachusetts Institute of Technology in 1953, and the Ph.D. degree in biophysical chemistry from Yale University in 1957.

I joined the Argonne National Laboratory in 1956 and have been continuously involved since then in the use of nuclear reactors as radiation sources for determining biological effects, and the converse case, determining biological effects of nuclear reactors and their products. I have done research in chemistry, biology, mathematics, physics, engineering, and medicine. I have been involved with a number of research and production reactors at the Laboratory and at the National Reactor Testing Station, with respect to their effluents, their radiation, and the biological effects thereof. I have conducted experiments with animals ranging from micro-organisms up to, in the case of certain therapies, man.

I have held teaching positions at the University of Chicago, St. Procopius College, National College, DuPage College, American University at Beirut, Yale University, and others. The subjects I have taught include engineering, medicine, chemistry, and biology.

PROFESSIONAL QUALIFICATIONS -

Norman A. Frigerio

I have published about 150 papers and 8 books in the field of radio-biology.

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MR. DAVIS: Dr. Frigerio, did you also assist in the preparation of the Final Environmental Statement?

WITNESS FRIGERIO: Yes, I did.

MR. DAVIS: Are the contents of the Final Environment Statement true and correct to the best of your knowledge and belief?

WITNESS FRIGERIO: Yes, with the amendments and corrections that were entered yesterday.

MR. DAVIS: Gentlemen, have you prepared a document entitled, "Supplemental Testimony to Final Environmental Statement Related to Construction of Davis-Besse Nuclear Power Station on Issue 9" for this proceeding?

WITNESS FRIGERIO: Yes.

WITNESS THOMPSON: Yes.

MR. DAVIS: Are the contents of this document true and correct to the best of your knowledge and belief?

WITNESS THOMPSON: Yes, they are.

WITNESS FRIGERIO: Yes, they are.

MR. DAVIS: I have previously given all parties and the Board members this supplemental testimony. I would now move that it be bound into the transcript as if read.

CHAIRMAN FARKHUHAR: Any objection?

MR. CHAUVET: No, sir.

MR. BARON

[illegible] to have none.

CHAIRMAN FARKHUHAR: It will be received into

SUPPLEMENTAL TESTIMONY

TO FINAL ENVIRONMENTAL STATEMENT
related to construction of
DAVIS-BESSE NUCLEAR POWER STATION
TOLEDO EDISON COMPANY and
CLEVELAND ELECTRIC ILLUMINATING COMPANY

Docket No. 50-346

Issue 8

THERMAL PLUME EFFECTS

Fish will probably be attracted to the thermal plume when plume temperatures are nearer the fishes' preferred temperatures. This will occur primarily during the winter. Little is known about the distributions of fish during the winter as the western basin of Lake Erie is usually ice-covered, thereby making sampling difficult. The plume area where fish could be expected to congregate is that area within the 3°F isotherm. In the area near the discharge slots, water velocities will be too great for fish to become resident, thus, the thermal plume area in Lake Erie of interest is less than 0.7 acres. Therefore, any discussion of direct or indirect thermal effects (reduced reproductive success, decreased resistance to disease, depletion of local food supplies, etc.) would pertain to fish moving in and out of the warmer water. The staff is not able to quantify these effects, to determine the number of fish likely to be involved, or to determine the exact impact on whole populations of fish. It is the staff's judgement, however, that it is unlikely that whole populations will be adversely affected. The monitoring program should detect any impact on fish populations. During winters when conditions permit, monitoring studies should include investigation of fish in the plume.

CHEMICAL EFFECTS

The existing total dissolved solids concentration (TDS) of the inshore lake water is slightly greater than the 200 mg/l objective for Lake Erie. Operation of the Station will result in a concentration of dissolved solids by a factor slightly less than 2 through loss of water by evaporation in the cooling tower. A small zone of higher TDS will therefore exist close to the discharge, but no significant effects on human use or on aquatic life from this cause are expected (FES Sections 5.2.7 and 5.5.3). Some of the evaporated water will return to the lake through precipitation over tributary watersheds, but even if the water loss is considered irretrievable, the effect on TDS of the lake as a whole will be undetectable.

The TDS of the Station effluent will be entirely dependent on the TDS of the intake water which controls not only the blowdown concentration but also the amounts of impurities to be removed by the demineralizers. Operation of the Station will not have a detectable effect on the total mass of dissolved solids present in the lake. The quoted mass of chemicals discharged, 8700 tons annually, is actually the total dissolved solids content of the effluent under average conditions (blowdown rate 9225 gpm, TDS 427 ppm). The dissolved solids taken into the Station under the same average conditions will be about 9100 tons annually (make-up rate 18,450 gpm, TDS 225 ppm). In addition, a relatively small quantity of sodium sulfate (estimated as 58.4 tons in Table 3.6) will be added to the lake annually from demineralizer regeneration.

If the small reduction in solids is ignored, the only effect of the Station on the average TDS concentration in Lake Erie will be due to the evaporation of water in the cooling tower at an approximate rate of about 21 cfs. In considering the water balance in Section 5.2.2 it was stated that this represents only about 0.1% of the natural evaporation rate of the lake (225,000 cfs). Since this evaporation is approximately replaced by precipitation over the lake, the rate of flow into and out of the lake is the important factor in considering the effect of the Station on the TDS concentration. The average flow is approximately 200,000 cfs, and it is clear that the effect of the 21cfs loss will be quite negligible compared to normal fluctuations and analytical precision.

Apart from the increased TDS, the only important change in composition produced by the Station will be the addition of sulfate ion. Most of the added sulfate will be the result of neutralizing the cooling system water with sulfuric acid to avoid scaling in the condenser. Under average conditions the mass of sulfate added will be about 4.5 tons per day. Demineralizer regeneration will add a further ~ 320 lbs per day. If the water flowing into Lake Erie (principally from the Detroit River) contains a sulfate concentration similar to that observed at the site (37 ppm) the mass of sulfate ion entering Lake Erie daily is about 19,000 tons. By comparison, the effect of the Station on the lake as a whole will be negligible.

In spite of the above, it is still appropriate to consider whether the chemical effects of the Station could be reduced by reasonable and practicable measures. The major chemical effects are the discharging

of concentrated blowdown with the addition of sulfate, and the concentration of salts in the cooling water making it necessary to add sulfuric acid to avoid scaling. The cooling tower evaporates 9225 gpm (average), and if the solids contained in this volume of water (~12.5 tons per day) were not returned to the lake, they would have to be separated in some way and disposed of on land. The separation of dissolved salts from large quantities of water presents a desalination problem similar to that involved in obtaining potable water from saline or brackish water supplies, except that in these latter cases there is generally no objection to returning the separated salts to the original low quality water. Reverse osmosis, a process which has received much attention in recent years, appears promising for these purposes, and commercial units are available for providing up to several hundred thousand gallons of treated water per day. This is still considerable less than the requirements of a cooling system such as that of the Davis-Besse Station where the quantity of water required to replace evaporation is about 13 million gallons per day. Further, the concentrated effluent from the reverse osmosis plant would have to be disposed of, perhaps by evaporation to dryness for storage on land. At the present time, such methods appear impractical on the scale required.

Reverse osmosis is being used successfully as a first stage in the production of high purity water, to remove a large fraction of the dissolved salts before demineralization by ion exchange, thus reducing the ion exchange capacity required and the quantities of

chemicals used for regeneration. This method would probably be applied to the demineralizing system of a power plant, and would greatly reduce the quantities of waste chemicals and resins to be disposed of. In the Davis-Besse Station, however, the regenerated wastes represent only small fraction of the total chemical discharge, so little advantage would be gained.

Chlorine will be added to the condenser cooling water periodically in amounts sufficient to "shock" defoul the system of slime growths. There is no known way to determine the minimum effective quantity of chlorine other than by direct experiments on site.

At the point of discharge of circulating water into Lake Erie all or nearly all of the free chlorine added will have been converted to harmless chloride ion or to combined chlorine ("chloramines"; Section III.D). The concentration of these chloramines will quickly be reduced by dilution. In addition, natural decay of the chloramines will occur due to reaction with reducing substances in the lake water and due to evaporation to the atmosphere of volatile chloramine species such as dichloramine($NHCl_2$) from the floating heated plume. The rates of decay cannot be predicted accurately due to lack of data and dependence on variable water quality parameters (concentrations of fast-acting reducing species and of ammonia nitrogen, and the pH).

There have been a number of studies of the effect of chlorine on aquatic organisms. The most thorough review has been carried out by Brungs, of the Environmental Protection Agency's Duluth, Minnesota Laboratory.

On the basis of the available knowledge, he has developed interim criteria which, if not consistently exceeded, will protect fresh-water aquatic life. In the absence of significant free chlorine, the appropriate criteria for receiving waters containing only "warm water" fish species (i.e., the western basin of Lake Erie) is that, for a period of 2 hours a day, total residual chlorine may be up to but not exceed 0.2 mg/l.

In view of the fact that the Davis-Besse Nuclear Power Station is designed for closed cycle operation, it is the staff's evaluation that Davis-Besse has been designed using the best existing technology for chemical effluents, and thermal effluents.

With regard to the non-degradation aspects of water quality, the Staff concludes that the Applicant has taken all reasonable and practicable measures (Subject to meeting the Staff's restriction on total residual chlorine) to maintain existing water quality levels.

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MR. DAVIS: One other area of direct on this matter that does not appear in the prepared testimony, and I would like to delve into it for one minute with Dr. Frigerio.

Doctor, are you able to indicate the effects of low levels of radiation on biota, particularly fishes?

WITNESS FRIGERIO: Yes.

MR. DAVIS: Would you please do so?

WITNESS FRIGERIO: To the extent that Issue 8 involves potential hazard to wildlife, fish and other biota, it was necessary to make an estimation of the two parameters which enter into this. One is the dose level and the other is the hazard that a living creature will expect at a certain dose level. This was partly done in the Final Environmental Statement that is contained therein.

More recently in order to check the models that we employed for this, we have utilized some of the data available for reactor sites on Lake Erie.

The Fermi site, when it was in operation with the monitoring stations at Charlevoix and Monroe, Michigan, and the Plumbrook station not far from here.

This was an attempt to verify the dose calculations given in the Final Environmental Statement. The data is available in Ohio EPA monitoring reports. For the maximum releases at Plumbrook registered by the Ohio ~~EPA~~ EPA 1970 some 2000 picocuries per liter at the outfall of Plumbrook, we

CALCULATED THE VALUE OF ABOUT 2 PICOCURIES PER LITER, VERSUS THE 15 PICOCURIES PER LITER GIVEN, SO THAT O MODELS

were considered to be somewhat conservative, which is an advantage, in that it leads us not underestimating the dose of the biota.

On the basis, then, of those calculations and their agreement with those measured values, we could calculate that the doses to biota were certainly no larger than those given in the Final Environmental Statement for Navarre Marsh and in fact the Plumbrook doses are something of the order of .4 millirem in a month of maximum release or an annual average of something less than 1 millirem to the biota in that area.

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Is that sufficient from the standpoint of dosimetry? So that in general one can expect that the range of doses to biota in the entire Lake Erie will range from a maximum of perhaps 58 millirems per year at Navarre Marsh to a minimum of essentially zero. Therefore, if we take this value -- and it does include a factor for biological effectiveness which we discussed yesterday with Dr. Sternglass -- of about 2, the maximum factor for which there is a consensus. Thus the hazard value will be of the order of 58 millirem or ~~thereabouts~~ at maximum. This is about half of the natural background in this area, or about one-sixth of the natural background in maximum areas in the United States such as the Colorado plateau.

We made examination not only of all the literature but also of surveys made of organisms that live in such high background areas.

As Dr. Donaldson pointed out yesterday, a fairly classic Arndt Schultz effect is observed in that low levels of radiation in this area are seldom, if ever, found to have any deleterious effects and most commonly tend to stimulate organisms.

So we concluded that with the dose levels at this level, if you will pardon the roundaway, that one would certainly not expect deleterious effects to organisms in Lake Erie or on its shores, that one might even expect some

stimulation.

MR. DAVIS: Thank you.

Doctor, have you had occasion to read and study the prepared testimony of Dr. Stumpglass entitled "Contention 9, Effects on Fish, Wildlife and Water Quality," and also had occasion to read and study the transcript of Dr. Stumpglass' other direct testimony from yesterday's session?

WITNESS RACCHIO: Yes, we have.

MR. DAVIS: Do you have any comments on the substantive evidence that Dr. Stumpglass did submit on that issue?

WITNESS RACCHIO: Well, we did utilize the methodology of Dr. Stumpglass to examine this question specifically with respect to Lake Erie. Utilizing that methodology as carefully as we were able, we discovered that when an increase in fallout and radioactivity in Lake Erie the fish catch rose from some 37 million pounds to some 42 million pounds in the decade 1960 to 1970.

We chose these years because they encompass the start-up of the Pilgrim Reactor and, on the other hand, the latest year for which we had available data.

CHAIRMAN PAPAZIAN: Am I understanding you correctly? You are saying that you have duplicated the calculations of Dr. Stumpglass insofar as you could?

WITNESS FRIGERIO: Yes.

CHAIRMAN PANAGIDES: And you are saying, too, that your results were contrary?

WITNESS FRIGERIO: Not precisely. The indication seems to be contrary. The results were actually in some sense in excellent agreement with respect to the doses, for example, that one would calculate at the Sandusky water intake.

Our calculations agreed quite well with the measurements. The doses are very low, 30 picocuries per liter or something like 3 percent of the drinking water standard.

MR. SHON: Dr. Frigerio, you are, however, telling us that you used Dr. Sternglass' methodology -- the word bothers me a bit -- and by using at least his system of calculations, you found a relationship between fish catch and radioactive fallout which was in a sense, positive, that is, the higher the fallout, the more the catch of fish through a certain period of time?

WITNESS FRIGERIO: Yes.

MR. SHON: Contrary to what Dr. Sternglass showed us yesterday, which was that the higher the fallout, the lower the catch of fish?

WITNESS FRIGERIO: Yes, that's right. The situations are quite comparable. They refer to different

populations, in one case the Norwegian and in one case Lake Erie.

MR. SHON: Can I ask you what it was that methodology counted?

WITNESS PRIGNANO: We counted of choosing years more or less arbitrarily. In our case, we took five years. We took them, as I say, because first of all they were annual years so that we had good data for human populations as well as other biota. And then comparing the values at those two years and figuring all the values in between.

MR. SHON: What I wanted to establish was you are still talking in terms of contaminant analyses of populations?

WITNESS PRIGNANO: In the case of the fish, not in the case of the deer calculations.

MR. SHON: In what way did you apply his methodology to deer calculations?

WITNESS PRIGNANO: We did not. We applied our own methodology to deer calculations.

MR. SHON: Is there a scientific Stringfellow methodology which applies to deer calculations?

WITNESS PRIGNANO: We were unable to determine any. In fact, he gives no deer in his presentation.

MR. SHON: Dr. Prignano, the two years you picked

for the fish populations, they weren't the same two years that Strangland picked, is that right?

WITNESS FRIGERIO: That Strangland picked for the Norwegian population?

MR. SHON: Yes.

WITNESS FRIGERIO: They were included.

MR. SHON: You simply picked two years for those Lake Erie populations that it happened to bridge across the years that Strangland used to study the Norwegian fish?

WITNESS FRIGERIO: Yes.

MR. SHON: It is important to the Board, I think, to note that you have just said that you knew of no specific Strangland methodology for calculating dose.

WITNESS FRIGERIO: No. In fact, he gives no doses, but he makes the only statement we could refer which is that the doses were a thousand to 100,000 times greater. On the contrary, we found that the doses were somewhat less as measured than we calculated using the same methodology we used for Davis-Besse.

MR. SHON: Thank you.

CHAIRMAN FARKAS: I am sorry, Mr. Davis. Proceed, sir.

MR. DAVIS: That is the extent of my direct questioning of Dr. Frigerio and Mr. Thompson on Issue 8.

CHAIRMAN FARKAS: Cross?

MR. CRAMER: May I have a moment?

CHAIRMAN HARRINGTON: Yes, sir.

(Pause.)

Cross-Examination

MR. CRAMER: You indicated, Dr. Teigland, that you are not aware of a Strangleas methodology for calculating dose. Are you aware of a Strangleas methodology of calculating dose?

WITNESS TEIGLAND: Yes.

MR. CRAMER: How would you characterize that?

WITNESS TEIGLAND: One would say that it was just such, a process of a location of several points which, generally speaking, will be found to agree with Dr. Strangleas' hypothesis. When one examines the entire body of available data, one almost invariably discovers that selection of all points tends to go in one opposite direction and that in general they do not support Dr. Strangleas' hypothesis.

MR. CRAMER: Dr. Teigland, possibly you could face the reporter. It might make it easier.

MR. CRAMER: Have you found many in examining Dr. Strangleas' papers where he has tried to show statistical correlations between mortality and morbidity data surrounding nuclear power plants?

WITNESS TEIGLAND: Yes, we have. We had occasion to re-tabulate but have also not been presented with adequate

to the area about this plant. Is that in order?

CHAIRMAN FARMAKIDES: You are talking to Issue 8 right now?

WITNESS FRIGERIO: Yes.

CHAIRMAN FARMAKIDES: You are talking about data on Issue 8?

WITNESS FRIGERIO: I am not certain.

CHAIRMAN FARMAKIDES: So long as you are addressing Issue 8, fine.

MR. CHARNOFF: The question has been raised concerning Sternglass' methodology as applied to Issue 8 and as applied in general to the Sternglass methodology. Please go on,Dr. Frigerio.

CHAIRMAN FARMAKIDES: Wait a minute, hold on. You can go on, sir, insofar as you wish to address Issue 8 and the methodology used on Issue 8. In that sense you can answer the question posed.

MR. CHARNOFF: Does the methodology employed by Dr. Sternglass in connection with Issue 8 appear in any way to be different than the Sternglass methodology that has been used in the last decade in every paper he has produced on any subject that he has offered, that you know of?

WITNESS FRIGERIO: No --

CHAIRMAN FARMAKIDES: Can you answer that?

WITNESS FRIGERIO: I can answer it. The methodology is marvelously similar. The novelty seems to be that it has been applied to physical rather than merely epidemiological parameters which was a characteristic in the past. Selection of physical measurements has now been employed in particular with respect to dose to biota, to wildlife and so forth. Dr. Sternglass raised two questions, the question of water concentrations of radioactivity and the question of ambient gamma dose as measured with thermal luminescence dosimetry.

In the case of the water dose, I believe we have already answered that, that far from contradicting our methods to Plumbrook, results agree excellently and in fact represent very low doses.

With respect to the thermal luminescent dosimetry, when we examined available data we discovered that Dr. Sternglass had selected the single highest, most anomalous reading available in the entire table --

DR. MAND: What is a table in the EPA report?

WITNESS FRIGERIO: No, this is thermal luminescent dosimetry and there is a typeno in the Bio-Test Laboratories. We moved from water quality, which is in the Ohio report, to the analogs gamma dose to organisms and biota which is in the Bio-Test thermal luminescent data.

MR. CHAIKOFF: Dr. Petigorsky, would you address

yourself to Appendix S-1 to Dr. Sternglass' testimony with regard to the correspondence he attempts to show between fallout and the Norwegian fish and Alaskan fish catches? Would you characterize the nature of that data selection as to whether it appears to be consistent with the Sternglass selection of data technique?

WITNESS PRIGERIO: Yes, it is highly consistent. It is, as Dr. Shon has already remarked, in the nature of an epidemiological examination and in this case the Norwegian fish catch is certainly one of the most minor components of the world fish catch so that it is a selected and very small sample of the total.

MR. CHARNOFF: Now, you testified, I believe, in response to a question from Mr. Davis this morning that in connection with looking at fish in Lake Erie, you did, using Plumbrook as an example, check your methodology for calculating dose and you found that, if anything, your methodology is conservative, is that correct?

WITNESS PRIGERIO: That's correct.

MR. CHARNOFF: And you are reasonably confident, then, that to the extent one would now attempt to show that there might have been occasional measuring of higher points of radioactivity elsewhere in and around Plumbrook that that would not in any way challenge the validity of your model of calculating dose?

WITNESS FRIGERIO: I am afraid I will have to enter into a moment's technicalia. Our method of calculating the anticipated ambient gamma dose in the neighborhood of Plumbrook yielded a result which was the order of .04 millirem per year. This was quite incompatible with the values given by Dr. Strangelass of approximately 40 millirem per year. We normally recheck all our models every time new data becomes available as a way of being certain that they are valid or they are at least conservative.

This was a discrepancy of the order of a factor of a thousand. That being so, it behooved us to examine the data base on which the higher number had been obtained. We discovered that it was obtained from a single value of one quarter reading for which the other quarter had been stolen and which was at extreme variance with the two single monthly readings taken at the same place and in the same quarter.

CHAIRMAN FARKARIDES: What do you mean by stolen?

WITNESS FRIGERIO: There are three quarters for which we have these measurements. July, '72; September, '72; and January to March of '73.

At the Sandusky site, S-24, the quarterly dosimeters and the monthly dosimeters for the July -- actually through October -- dosimeters were stolen or damaged. Some were stolen and others were reported as being damaged.

So there were two readily available examples, November and December of '72. This is where we got both quarterly and monthly readings in '73.

The quarterly reading at T-74 for the last quarter of 1972 was anomalously high and in strong disagreement with the two monthly ones taken parallel and at the same time. If you were to take the difference between the last quarter of '72 and the first quarter of '73 -- and Riverbend with inserting in that period -- you obtain a value of approximately 40 millirem per year. If you take the difference between the two monthly ones averaged and the quarterly or monthly ones, you get a minus 4.5 millirem per year. We concluded tentatively what we were again in the problem of highly unreliable data. We examined this in another context in that we took all the dosimeters for all 19 measuring stations and discovered that in fact T-24 did not show the largest differences. Larger differences were reported 26 to 27 miles from Riverbreck with smaller ones in between.

There was, in fact, no pattern at all except the pattern of some sort of instrumental error. As a final check we noted that the average for the quarter, the last quarter of 1972, was 7 millirem per year above the average for the first quarter of 1973 over all sites roughly as far away as Toledo. We had to conclude this was an example of

something that the eastern regional facility has also found, which is that certain handlings will increase the FLD apparent dose by something of the order of 50 to 100 percent.

DR. HSND: What are you suggesting when you say certain handlings?

WITNESS FRIEDMAN: Apparently one of the major problems is that the dosimeters are seldom read on site. They are removed from the site and transported generally across the country. In the process, the emblem batch can easily become exposed, either because of cosmic radiation of high altitude flights or because of some local radioactive condition either in the airport or in transit, and the eastern regional facility has recommended that this has caused so much trouble in the past that from now on, all of these be read in situ, where they have been resting.

MR. SHON: I just wanted to try to corroborate what you have said for my own mind quickly.

As I understand it, what you are saying is that in the case of high gamma levels, at least, the thermal luminescent dosimeters which were used to measure this are read both quarterly and monthly, that the figures quoted by Dr. Sternglass involve the use of a single quarterly dosimeter. The dosimeter which was meant to check that or other quarterly dosimeters having been stolen, and that dosimeters exposed in the same place at the same time as monthly dosimeters showed no such high reading?

WITNESS FRIEDMAN: That's correct.

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CHAIRMAN FARNSWORTH: Having heard no objection, we are going to receive this evidence in the way it was given.

Then now on, however, we would like to limit any further cross-examination to Issue 5 and to would appreciate it if you would confine your remarks to Issue 5.

Proceed, Mr. Chumbris.

MR. CHUMBRIS: I would point out, Mr. Chairman, that the testimony that was given was in connection with Issue 6 because it had to do with what it we knew about radioactivity levels in Lake Erie.

CHAIRMAN FARNSWORTH: We might, we will accept that. It is Issue 6 we are talking about.

MR. CHUMBRIS: I have no further questions of this witness.

CHAIRMAN FARNSWORTH: Mr. Brown?

MR. BROWN: I would like to make this observation. Because of the scheduling of Dr. Sternglass yesterday and the lateness of the hour at which we finally did adjourn, he was obviously not able to exhibit me in cross-examination. So what I propose to this is to where when Dr. Vulgaris's testimony -- on the basis of, I'm sure, of what he has testified to this morning with respect to Dr. Sternglass' testimony -- when that is available, we can supply Dr. Sternglass with a copy of that, since we anticipate his

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returning here around the 6th. Could we reserve him a few minutes' time at that time to, shall we say, offer some rebuttal to these remarks?

CHAIRMAN HARTMANIONS: Offer rebuttal? Yes, sir, you may. You may rebut the remarks.

We understand, too, Mr. Baron, and let the record be very clear, that we scheduled Dr. Scarsglone yesterday for his convenience. All the parties had scheduling problems with their witnesses and the schedules that we finally adopted were done in order to accommodate all three parties.

However, understanding the situation and understanding, as you have indicated earlier, that when lawyers are not experts in these fields, and there is no doubt about it, we will permit you to do just that. You may have an opportunity to rebut the testimony.

Now, let's have some parameters on there. There is no need to take time on the parameters now. But think in terms of a definitive parameter. I just don't want a 500-page book in rebuttal, nor do I want a 10-page rebuttal. I want something reasonable and directly to the point.

We will discuss this later in a bench conference and we will come to some agreement as to how much rebuttal is necessary.

MR. BARON: I have only one or two questions which as a lay person I could bring up with regard to what he said.

Was individual mobility, in fact, a relevant to that fact?

[illegible] Yes, it would. I don't suppose we can effect exist in the literature. It would not be. There is no necessity for it.

MR. CRAIG. Would it eliminate the fact, actually what is it eliminating the result [illegible] as well?

[illegible] Probably, as I pointed yesterday, what is the number of total individuals that we have. We say between the size of the population. It may actually increase the size of the individual and in some cases it increases child mortality for certain areas so that they live longer. It may be a population effect. That is to say, something you can by counting cold numbers, but it has also been reported as an individual life, regardless one cannot speak of a certain individual.

MR. CRAIG. One of the last; would it appear to be that the reproductive capacity of the individual did increase.

[illegible] Yes, and also it could also be shown that this was happening.

MR. CRAIG. So with the [illegible] is considered to some of the other effects of the [illegible]?

[illegible] It is [illegible] probably too

4mil

been the most prevalent effect, at low doses and low dose rates, if you will pardon my being technically correct.

MR. BARON: So the fish which have been irradiated are the ones which become more reproductive?

WITNESS FRIGERIO: Yes.

MR. BARON: Have any studies been made of their progeny as to what has happened to them?

WITNESS FRIGERIO: In some cases ordinarily for 100 generations the fecundity increased and leveled and the organism had apparently adapted itself well to the increased radiation and became, if anything, more successful and certainly not a less successful species.

MR. BARON: So there was no effect on reproduction?

WITNESS FRIGERIO: No deleterious effect.

MR. BARON: It would seem to me that is something the fishing industry would look into.

WITNESS FRIGERIO: It might be moderately expensive to bring this about in practice. I believe that --

MR. BARON: Let me ask you this: The reason I asked you the question, it seemed to me yesterday there was some testimony -- I don't know if it was Dr. Hartman -- with regard to the fish growing up too soon, being caught by the fisherman, but being found to be immature fish. I believe that was the nature of his testimony.

I am wondering how that relates to what you have

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

6mil

MR. BARON: Are you familiar with any of Dr. Inglis' work?

WITNESS FRIGERIO: Some of his papers and literature, yes.

MR. BARON: Do you have any opinion as to his position in the scientific community?

WITNESS FRIGERIO: Quite respectable, certainly. I would hesitate to pass judgment on his physics.

MR. BARON: May I read to you a paragraph from his book which I just mentioned at page 133, and ask you if you have any comment on the statement.

This book is published by the Addison-Wesley Publishing Company, Reading, Massachusetts. It is copyrighted 1973.

MR. DAVIS: Mr. Baron, would you have two copies of that so that Dr. Frigerio could follow along?

MR. BARON: I have only one and I will read it very slowly and very articulately.

CHAIRMAN WAMMARDES: Why don't you show the document to the witness, please, and tell him what you want to read and then you can quote from it.

MR. DAVIS: Mr. Baron, I do assume this is within the ambit of the direct examination that Dr. Frigerio has just given?

MR. BARON: It is with respect to his observations

with regard to Dr. Hastings' work previously, and as an
x which is a well-known, you know, Professor Morton
Dr. Baumgartner thought

Since this is probably going to be the last
witness we will have on Dr. Baumgartner's testimony, unless --
Counsel consulting. Anybody, Mr. Evans. If
there is an opportunity, Mr. Davis, please address your minds
and we will recognize an objection if you have it. I will decide
it at that time. Mr. Evans, please continue.

MR. EVANS: When paragraph on page 100 ends as
follows. "The established fact that Baumgartner's
conclusion had not been proved. There is a tendency for it
to be believed as now seeming to be probable." If we
stable. Even if his claim, scrupulously free of efforts
most unclear point clearly, are found to most rare fallible
theoretical than evidence was ever really sought to disprove. It is
impossible that this important subject be further work
independently studied by an unbiased investigator. In the
meantime, it can reasonably be said that his general
conclusion cannot be disputed and that the
performed a valuable service in pointing out the fallacy of our
then knowledge of these matters. If a true only which one that
broken wand, we have broken our brain for. If lack of regularity
and malformations as a result of published experience does appear
point - please might be if we did show that combined by

Cmil

Cofman and Tamplin, as Sternglass further concludes, this casts further doubt on the advisability of such a program."

That is the paragraph and I assume you can make a comment on that.

WITNESS FAIRHURST: There is an essential point here which is almost necessarily missed, I am afraid, by a physicist and it is apropos of what we are calling Issue 9, but which is in effect the general issue of damage to living things, specifically biota in this case. That is the question of dose rate. All of us are familiar with this, but neither Dr. Sternglass, who is a physicist, nor Dr. Inglis, who is also a physicist, are aware of this almost by the nature of their training.

To a physicist's mind, the application of a force to a body will result in a predictable motion. To a biologist has same application of force is very likely to result in a bitten finger. I say that slightly in humor, but it is essential to the point.

A radiation insult which would affect a static object does not necessarily and in fact biologically almost anti-necessarily have a deleterious effect on a living object. It will depend very much on the relationship between the living object and what occurs.

As a consequence, it is possible to adduce evidence of damage in some cases from data, as Dr. Sternglass

Drill

does, and to extend it to other areas quite inappropriately because of the question of [illegible] If I threw an open pin at you each day [illegible] it will do you no harm. If I threw all the open pins at once, it will remove you from consideration.

OPEN PIN

OPEN PINS

The same thing applies to radiation. Rule has been shown in innumerable studies, but is apparently doesn't get out to the generality pointed out by Dr. Brumgloss and Dr. Raglin. So that -- what shall I say? I hate to use the legal term ab initio. But that is important to the question of not only would dose, but the speed at which it is given. Is it given so slowly that the organism has no difficulty in repairing the damage and perhaps even making some use of it? Apropos of that, then, is it quite logical that Dr. Brumgloss' mechanisms might agree with other facts in some cases, but not be low level and low rates. It has recently been shown in great detail that populations in the United States, not merely human, but animal as well, at high background levels do not suffer deleterious effects as a consequence because the background dose rate is very low.

The trace populations exposed to high rate x-rays show very definite dose [illegible].

MR. DANOH: Thank you! That is all the questions I have.

CHAIRMAN VANDERVEN: Thank you, Mr. Danoh.

10mil

May redirect, Mr. Davis?

MR. DAVIS: No, thank you, Mr. Chairman.

CHAIRMAN FARRANDS: The Board has no questions, gentlemen. Thank you very much. You are excused.

(Witness excused.)

MR. CHARNOFF: Mr. Chairman?

CHAIRMAN FARRANDS: Yes.

MR. CHARNOFF: Mr. Chairman, I would like to move that the Licensing Board reconsider the ruling it has made with respect to Contention 9. I believe the thrust of the Licensing Board ruling was that in some way the methodology employed or the so-called Sternglass methodology used in his testimony offered in connection with Contentions 6 and 7, which apparently gave rise to the Board's idea that there ought to be a Contention 9 was in some way different. The Board could not explain in which way that methodology is different.

I think we have just heard testimony that makes it very clear that the methodology which was the thrust of what I was arguing yesterday is the methodology of arbitrary and discriminatory selection of data and that the same methodology was used in connection with Dr. Sternglass' testimony with respect to fish. The same methodology was employed by Dr. Sternglass in interpreting or misinterpreting the so-called Pinsbrook and environs material, and that it is

10mil

Any redirect, Mr. Davis?

MR. DAVIS: No, thank you, Mr. Chairman.

CHAIRMAN FARMAKIDES: The Board has no questions, gentlemen. Thank you very much. You are excused.

(Witnesses excused.)

MR. CHARNOFF: Mr. Chairman?

CHAIRMAN FARMAKIDES: Yes.

MR. CHARNOFF: Mr. Chairman, I would like to move that the Licensing Board reconsider the ruling it has made with respect to Contention 9. I believe the thrust of the Licensing Board ruling was that in some way the methodology employed or the so-called Sternglass methodology used in his testimony offered in connection with Contentions 6 and 7, which apparently gave rise to the Board's idea that there ought to be a Contention 9 was in some way different. The Board could not explain in which way that methodology is different.

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where that the Stevenson model study is precisely the same. Now, it may be that there is some subtle difference in one model automobile that I don't know that would account for the unfortunate ways of refuting my evidence, but no particular scientific method behind it. It is fair to say, however, that the Stevenson methodology has been endorsed by many groups in addition to Dr. Fitzgerald.

The Pennsylvania Department of Environmental Resources, after performing Mr. Stevenson's calculations with respect to the Bonne Terre plume, has said that he selected data and had no support for it.

The American Academy of Pediatrics, similarly his data, said the same thing.

The American Council of Public Health, the U. S. Public Health Service, the Missouri State Department of Health, and United States Judge Stephen Limbaugh, after carefully his charges with respect to the Times Beach plume.

And I'm sure we need to supplement that statement by the Welch Foundation.

MR. SMITH: I want to object to these statements unless there are proof --

CHAIRMAN WOLFENBARGER: Mrs. Chamoff, Mr. Chamoff. What is your objection?

MR. SMITH: I don't have time to be reading this and I am unwilling to be putting in statements

12mtl 1 accuracy of the statement. I don't know what this document
2 is.
3 MR. CHARNOFF: This is our collection of papers from
4 all of these reports that we have been compiling and I will
5 be glad to make them available to Mr. Baron or his friends
6 at any time, a notebook full of papers criticizing Dr.
7 Sternglass' methods.
8 CHAIRMAN PAHLAVIDIS: You have made your point,
9 sir.
10 Mr. Chandler?
11 MR. CHANDLER: I think I have, and I simply want
12 to say that if the Board rules once again to consider
13 Contention 9, we will be there because maybe there is a
14 public interest in doing it. I would appreciate, however,
15 if the Board does entertain my request for reconsideration,
16 that the Board clarify what it means when it says that the
17 methodology used here is six and seven is different or
18 appears to be different than the families Sternglass
19 methodology.
20 That would help us in approaching the problem.
21 CHAIRMAN PAHLAVIDIS: Mr.Baron, do you have
22 anything in response?
23 MR. BARON: I have no comment, sir.
24 CHAIRMAN PAHLAVIDIS: Mr. Davi.
25 MR. DAVIS: Mr. Chairman, on the original motion,
if you will, to alter Issue 9 as a contention, the State

have the thought and be stuck by our thoughts of yesterday.

CHAIRMAN MANSFIELD. Mr. Chairman, I think this will be the last time that this issue is raised until we have heard it. We may go to Guam ourselves, however, on your orders. We will hear the above. We will also accept the rebuttal testimony of Dr. Steengrave and we will clarify whether, sir, what we had in mind. I think the best person for that is Dr. Shon.

MR. STOCKS. Very Mr. Chairman. The word "seismology" has been bruised about and bleated about throughout several days now. What we wish to emphasize in Exhibit 9 is the matter of currently or presently higher dose rates and contamination levels than would have been predicted from a knowledge of the volumes from the plumes in question.

We specifically asked -- I specifically asked Dr. Feigenbaum whether there was a Rasmussen methodology for making those predictions and he had knowledge to said there was not. So that the fact that Dr. Steengrave's methodology may have been different in providing a dose rate that was to the board to preclude our examination of these supposedly higher radiation levels. Dr. Steengrave didn't contest them. All he did was repeat them.

Now, I must admit Dr. Feigenbaum was given some testimony about here upon this Monday. And so far, he has been unchallenged and he was certainly not explained all of

14mil

the discrepancies. I think even he would agree to that.

CHAIRMAN FARMAKIDES: And the testimony that he gave, of course, flowed from Issue 8, the first paragraph of Issue 9, but it does have bearing on the new matter that we discussed.

Mr. Chernoff, we do want to be as clear as we can to all three parties and we understand that there might be a problem here in fully grasping the issue that we think is very apparent. We think, as we said earlier, it is a very serious issue.

So far, perhaps the word "methodology" is bothering people. If we can be more specific as to the clarification that Dr. Chen stated yesterday on page 343 of the transcript and today again, I would appreciate it.

So let's not necessarily focus on the word "methodology" as being the key to this issue.

Is there anything further before we proceed?

MR. CHERNOFF: I just want to make one point clear.

CHAIRMAN FARMAKIDES: I think, sir, we have heard you and I think we have ruled and I think we can proceed. We have nothing more on Issue 8 so far as we can see.

We can proceed, then, to Issue 1 except for the fact that the witness will be in this afternoon, the PPC witness, and we have agreed to that.

Our next issue is Issue 5. The Applicant and the

ISmall

Intervenor both have given on Issue 2. I understand, too, there was a stipulation to be worked out between the Applicants and the Intervenors with respect to introduction. What has happened? Could you clarify it, Mr. Chamoff or Mr. Brun?

MR. BRUN: Mr. Chairman, with respect to Issue 2 Mrs. Stebbins has been working as diligently as she could to complete a draft --

MR. CHAMOFF: Pardon me, Mr. Brun. We are confused.

Are you and Mr. Brun, Mr. Chairman, talking about a stipulation in connection with Contention 17

CHAIRMAN WOLFE-CREEK: Yes.

MR. CHAMOFF: Then you are both advocating yourselves to Issue 2 so I am confused.

MR. BRUN: That's right.

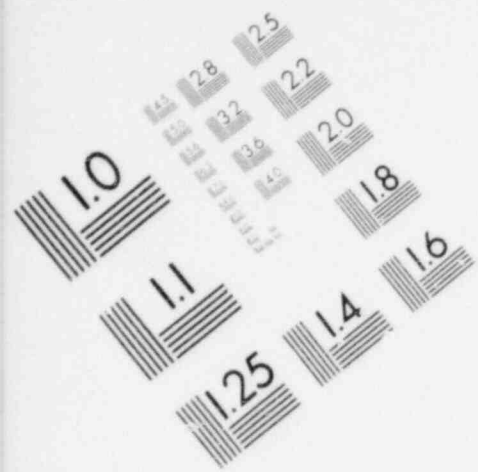
(Discussion off the record.)

CHAIRMAN FARRAR: Let's go back on the record.

The stipulation with respect to Issue 2 hopefully will be prepared and presented to the Board sometime around noontime. We will now proceed to Issue 3.

Who shall the spokesman be for the Applicants, Mr. Chamoff or Mr. Brun?

MR. CHAMOFF: Mr. Brun, I would like to have Mr. Rau



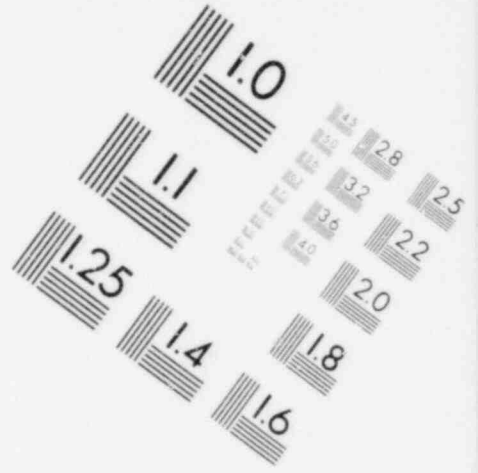
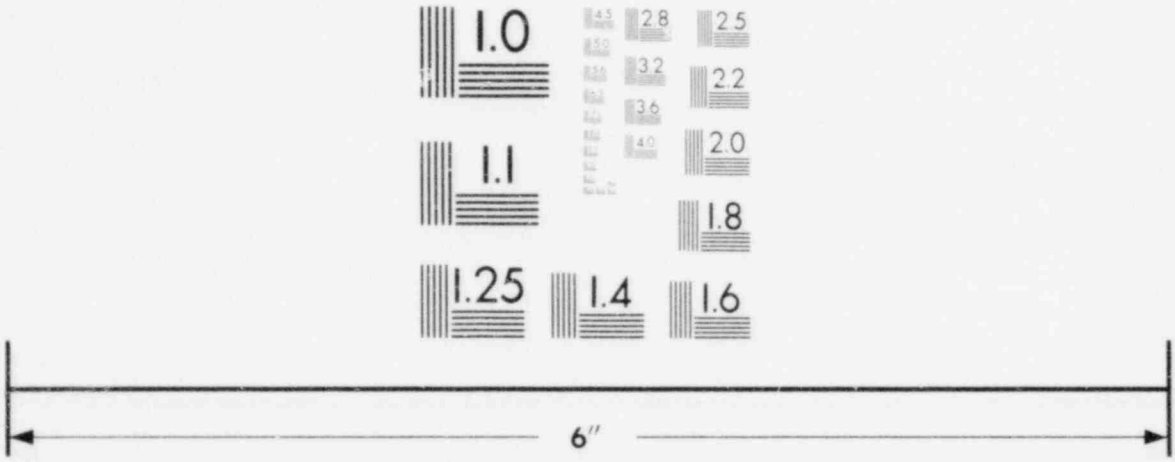


IMAGE EVALUATION
TEST TARGET (MT-3)



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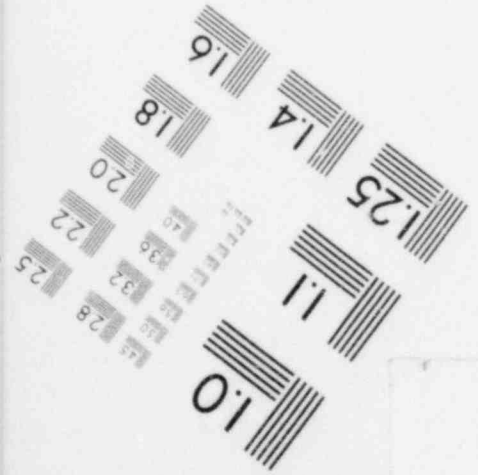
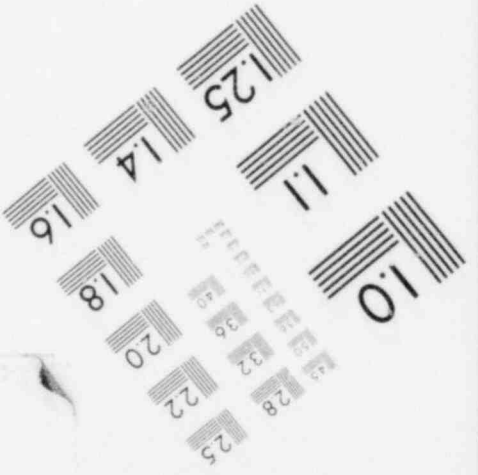
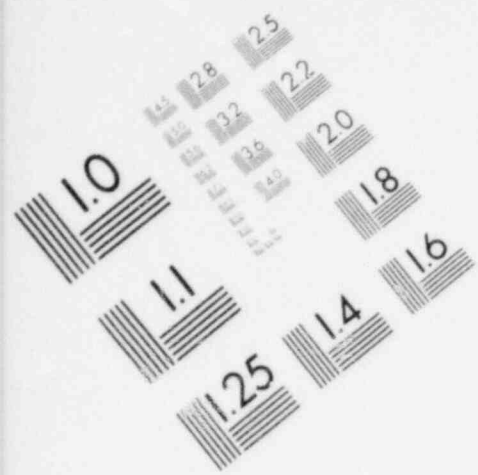






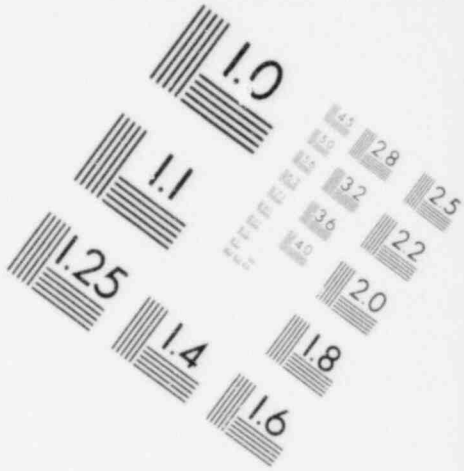
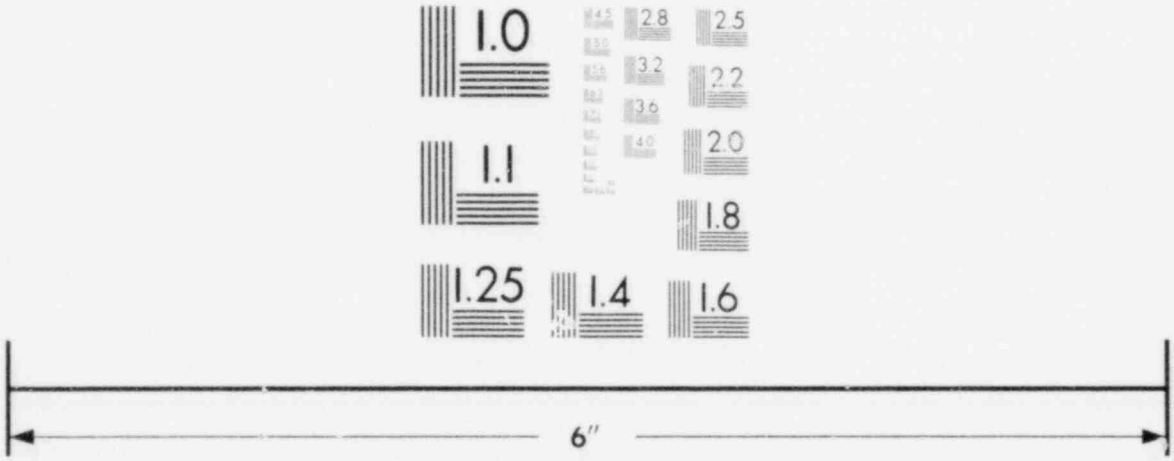


IMAGE EVALUATION
TEST TARGET (MT-3)



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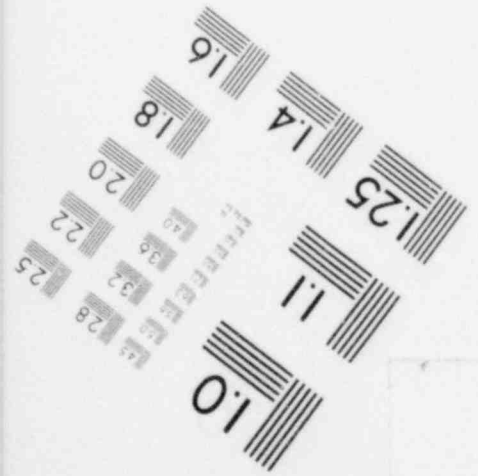
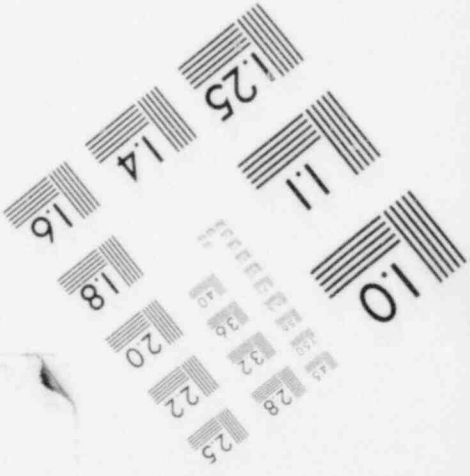




resume the stand.

16mll Thereupon,

LOWELL ROE

was recalled to the stand as a witness on behalf of the Applicant, and, having been previously duly sworn, was examined and testified further as follows:

(Discussion off the record.)

CHAIRMAN HARSHBARGER: Let's go back on the record.

MR. CHRISTOFF: I would like to formally move the introduction into evidence to be incorporated into the record as if read, the testimony of Lowell E. Roe relating to Issue No. 2 dated July, 1973, which has been submitted to the parties and the Licensing Board about 10 days ago. If there is no objection, Mr. Chairman.

CHAIRMAN HARSHBARGER: Hearing no objections, it will be so received.

MR. CHRISTOFF: We are giving the reporter additional copies of that document.

(The document follows.)

UNITED STATES OF AMERICA
ATOMIC ENERGY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
THE TOLEDO EDISON COMPANY	)	
and THE CLEVELAND ELECTRIC	)	Docket No. 50-346
ILLUMINATING COMPANY	)	
	)	
(Davis-Besse Nuclear Power	)	
Station)	)	

TESTIMONY OF

LOWELL E. ROE

RELATING TO

ISSUE NO. 2

JULY 1973

FLOOD AND STORM CONSIDERATIONS FOR THE DAVIS-BESSE NUCLEAR POWER STATION

A. General

The Davis-Besse Station design considerations have fully taken into account all historical flood and storm conditions that have been experienced in the site locality and the design criteria on which the station is designed makes the safety related structures of the Davis-Besse Station capable of withstanding floods and storms that have never been experienced and which are the maximum that could be postulated to occur in the site area.

These design considerations, design criteria and postulated maximum probable events were fully covered in the Preliminary Safety Analysis Report (PSAR) and are fully covered in the Final Safety Analysis Report (FSAR) for the Davis-Besse Nuclear Power Station. An index for these PSAR and FSAR sections is given in Table 1.

A.1 Site and Station Arrangement

The Davis-Besse Station site is a 954 acre tract which borders on Lake Erie. Approximately 600 acres of the site are low lying marsh areas principally in the easterly and northerly portions of the site. There is a substantial beach ridge at the shoreline which separates the low marsh areas to the west of the beach from Lake Erie. At the northerly and southerly site boundry, dikes have been built to prevent direct communication of the marsh water with the normal fluctuation of the lake levels.

To the west of the marsh areas, the original topography of the site rises to high ground which is 2 to 6 feet above the mean lake level of 570.5 feet IGLD. The station structures are located on this high ground approximately in the center of the site on an area of approximately 56 acres which has been raised in elevation from 6 to 14 feet above the existing grade to provide a station area that will be above any possible flood water elevation of Lake Erie. The site and station arrangement is shown on Figure 1.

A.2 General Station Design

There are two general classes of design criteria for station structures. One class which is for all structures that house safety related equipment or serve a safety related function. These structures include the shield building, auxiliary building and portions of the intake structure. The non-safety related structures include the turbine building, office building, water treatment building, portions of the intake structure, and the cooling tower.

The safety related design criteria requires that structures built under this criteria maintain their integrity and function under the most severe conditions of earthquake, flood and wind that can credibly be postulated to occur at the site. The flood and wind design criteria for these structures are given in Sections B.2 and C.3.

Structures which serve no safety related function are designed to withstand naturally occurring events such as earthquake, flood and wind that can reasonably be expected to occur at the site following accepted practice, codes and regulations. Flood design criteria for these structures are the same as for the safety related structures due to all structures being built in the same area which has been raised in elevation above the original grade. The wind design criteria for structures other than the cooling tower are given in Section C.2.

The cooling tower due to its shape and size has design criteria based on the same low level wind criteria that apply to other non-safety related structures, but special considerations for high level winds and wind forces are applied. The wind design criteria for the cooling tower is given in Section C.4.

The cooling tower foundation ring rests on compacted granular rock material which is placed on top of undisturbed till which overlies the bedrock. This compacted granular rock material is sealed off from any potential water seepage flow from the cooling tower basin by means of a compacted impervious clay water cutoff and bentonite board seal as detailed in Section D. This foundation design assures structural integrity of the support system for the cooling tower for all conditions of operation and water levels. The earth fill around the perimeter of the cooling tower which is graded up to station grade elevation of 584 feet, protects the cooling tower from any conditions of normal or storm induced water levels present in the surrounding area.

The water intake system structures are designed to withstand normal conditions of storms, floods, ice and other naturally occuring events that can be expected to occur. In addition, the service water supply system which is critical to safety, is designed to remain functional under the most adverse conditions of storms, floods and ice which can be credibly postulated to occur including complete blockage of the water intake from the lake. A description of the water intake system is given in Section E.

The central site area on which the building complex is located, is protected by a wave protection dike to prevent this area from experiencing wave run ups during the extreme maximum probable design water level conditions as detailed in section B.4. This wave protection dike does not extend to the cooling tower since this structure is not safety related. In any case, the cooling tower shell structure can withstand the wave action associated with this condition.

The wave protection dike and pumphouse intake structure in addition to being designed and constructed to withstand high water effects including the forces of wind generated waves which would be present during the maximum credible water level condition, are also designed to withstand the forces of wind driven ice which could be present.

The marsh dikes serve only to isolate the areas that are leased to the U.S. Government as wildlife refuge areas, from normal fluctuations of Lake Erie and to control water level in the marsh areas for optimum waterfowl habitat as determined by the Ottawa National Wildlife Refuge manager. A description of these dikes and marsh areas including their design is given in Section F.

B. Flood History and Design Considerations

B.1 Lake Level History

The original topography of the site is relatively flat and rises only six feet above the mean low lake level. As a result, it is expected that the site areas that have not been raised above the original grade may be flooded by high waters in Lake Erie. The highest monthly mean lake level (no wind tide or wave effect) for the period of record 1860 to 1972 recorded by the U.S. Department of Commerce, National Ocean Survey was 572.76 feet IGLD Internation Great Lakes Datum (IGLD 1955). In June 1973 a new period of record high mean lake level for Lake Erie of 573.51 feet IGLD was recorded.

Water levels at Toledo are recorded by the U.S. Department of Commerce, NOAA-National Ocean Survey (previously by the U.S. Army Corps of Engineers). However, prior to 1940, the gaging station was located on the Maumee River in Toledo where levels are affected by ice jam conditions which caused locally high water in the river but did not represent Lake Erie water levels under these conditions. Such an ice condition caused a high water level of 577.1 feet IGLD on February 29, 1936 when the monthly mean elevation was 567.5 feet IGLD.

In 1940, the gaging station was relocated to its present location at the mouth of the Maumee River where the gage readings are truly representative of the levels in Lake Erie at the throat of Maumee Bay. The U.S. Corps of Engineers considers only the records from 1940 to date in determining the wind set up and blowdown values for Toledo during storm conditions.

The highest recorded level at Toledo prior to November 1972 with no ice jam effects occurred on April 27, 1966 with an elevation of 575.67 feet IGLD. This occurred at a time when the monthly mean lake level was 570.34 feet IGLD and the rise due to the wind tide effect was 5.33 feet. Higher lake levels as recorded at Toledo, occurred on November 14, 1972 and April 9, 1973 but the wind tide effect was less than that which was experienced on April 27, 1966. The table below gives Toledo lake level data for these dates and other dates where the wind tide effect was greater than that for November 14, 1972.

Date	Maximum Elevation (feet IGLD)	Monthly Mean Elev. (feet IGLD)	Wind Tide Effect (feet)
April 27, 1966	575.67	570.34	5.33*
January 1, 1948	574.83	570.45	4.38
January 30, 1947	573.78	569.48	4.30
April 9, 1942	574.07	570.03	4.04
November 14, 1972	575.98	572.13	3.85
April 9, 1973	576.67 *	573.36	3.31
June 17, 1973	575.36	573.51 *	1.85
July 6, 1943	573.68	572.19	1.49
May 30, 1946	574.07	571.05	3.02
March 22, 1955	575.08	572.29	2.79
July 6, 1969	574.61	572.65	1.96

* Period of Record Maximums

B.2 Flood Design Considerations

The static water levels in the western basin of Lake Erie are affected by long term and annual cyclic variations in the mean monthly level from the mean low water level, and short period variations in the daily level from the monthly mean level due to wind tides and seiches. To establish the flood design criteria for the Davis-Besse Station, the subject of lake levels was investigated and the results of this investigation are summarized in this section.

The low water datum of Lake Erie is 568.6 feet IGLD. The maximum variation in the mean monthly level was 4.16 feet above datum from the 110 year period of record that data had been collected. A probable maximum variation of 4.8 feet above datum was used for design consideration at Davis-Besse.

Short period variations in the daily level from the monthly mean level are experienced and which are due to both a lengthwise wind tide which produces the greatest disturbance of water level and a transverse seiche in the west end of Lake Erie which can oscillate between the northern and southern shores. The recorded maximum transverse seiche was 0.8 feet and a probable maximum value of 1.0 feet at Davis-Besse was used for design considerations. A uninodal lengthwise seiche on Lake Erie can contribute some increment to the wind tide but the maximum amplitude of the uninodal seiche cannot coincide with the maximum wind tide.

A probable maximum meteorological event (PMME) was postulated to determine the maximum rise in lake level due to wind tides. This meteorological event would have a maximum ENE wind at any one location of 100 miles per hour for a ten minute period and the wind speed would exceed 70 miles per hour during the six hour period both before and after the maximum wind speed. The procedure developed by Platzman in reference (1) was applied to this storm to determine the maximum wind tide rise in Toledo. Since the Davis-Besse site is located about 80% of the way from the wind tide node (point in the lake where no wind tide change in lake level occurs) to Toledo, wind tide variations at Davis-Besse were reduced by 20% from Toledo wind tides. This procedure gave a maximum wind tide rise with ENE winds of 9.3 feet.

For the probable maximum high water level condition at the site the 9.3 foot wind tide was postulated to occur at the time of the 4.8 foot long term high monthly mean lake level, and under conditions where the transverse seiche would be adding one foot of lake elevation. The total would be 15.1 feet above the low water datum or a probable maximum high static water level of 583.7 feet IGLD.

Wind-generated waves are limited in their dimensions by wind velocity, by fetch (open-water distance available for wind action), by water depth, and by duration of the wind. Higher wind velocities, longer fetches, deeper water, and longer wind durations all increase the heights, lengths, and velocities of the waves. Neither wind velocity nor duration of wind are subject to control by the lake basin, but fetch and depth are a physical characteristic of the lake basin. At Davis-Besse the available fetch plays an important part in the height of the maximum wave that might arrive at the station, on top of the maximum static high water level from other causes.

The probable maximum high water that could occur at Davis-Besse is predominantly the result of wind tide under prolonged strong wind from the ENE. The station site is in the western basin of Lake Erie, and wind-waves generated by ENE winds over the rest of the lake find their access to the western basin almost completely blocked by the islands that separate the western basin from the central basin. Those parts of waves from the eastern parts of the lake that succeed in passing through the islands are damped, refracted, and reflected into a confused sea around the western sides of the islands. From here the ENE winds must construct the maximum wave that will bear upon the Davis-Besse site. Toward ENE from the station's site, the maximum fetch is 12.5 statute miles.

Using the equations and curves developed in reference (2), the ENE 100-miles-per-hour winds associated with the probable maximum meteorological event would produce a maximum wave height (difference between wave crest and trough) of 11 feet at the lake's normal shoreline. Other equations and curves in reference (2) indicate that these waves would break in 15 feet of water. These larger waves generating in the lake will break when they meet the normal shoreline, as the ground rises to elevation of about 575 feet IGLD and higher along the shoreline. However, smaller waves generated in the lake up to a height of 6.5 feet would pass over the beach without breaking at the maximum probable static water level. These smaller waves will build up to a height of about 8.7 feet in the marsh area and will break when they reach the elevated area around the station. The finished grade and roadways around the station is built-up to about elevation 584 feet IGLD for a distance of 250 feet to the east and north of the building. This elevated area around the station is protected along the north and east sides by an earthfill breakwall built up to an elevation of 591.0 feet IGLD to provide protection to all buildings against the wave and wave runup. This breakwall is about 15 feet wide at the top. The lakeward side of the breakwall and the banks of the built up area have a three to one slope and is protected against wave action with riprap. The maximum wave runup on this breakwall

will be 5.8 feet above the probable maximum static water level of 583.7 feet IGLD. This will give a maximum water level on the breakwall of 590.5 feet IGLD. As a result, no large unbroken waves will reach the station's buildings and none will overtop the wave protection dike.

The station's ground floor elevation of 585 feet IGLD will protect the station against the maximum probable static water level of 583.7 feet IGLD. Its location about 3,000 feet from the shoreline, the elevated land along the shoreline and the breakwater at the station will protect the station against wave action at the maximum probable water level.

The intake structure is designed to accept the wave action directly. The cooling tower is located outside the diked area, and could be subjected to wave action which might require it to be taken out of service. In this event, the station can be brought to a safe and orderly shutdown condition and maintained in this condition since all other systems are fully protected.

The cooling tower is not required for a safe and orderly shutdown of the station or to maintain the station in a safe shutdown condition. The station cannot generate electricity without the cooling tower in service but its loss or inoperability has no environmental significance.

The site arrangement is shown on Figure 1 and the arrangement of the station structures and wave protection dike is shown on Figure 2.

B.3 Analysis of November, 1972, Storm

On November 13, 1972, a storm moved into the Lake Erie drainage basin. This storm was classified as being of moderate intensity by the National Weather Service (Snider oral communication). However, the total effect of the storm was greatly increased by the existing high water level of Lake Erie. In November the lake was 3.5 feet above the Low Water Datum of 568.6 feet IGLD. The combination of the higher lake level and moderate winds initiated wide-spread flooding, and subsequent local evacuation within the low-lying areas along the western and southwestern shore after the storm winds shifted from south to northeast.

The maximum surge on Lake Erie occurred at Toledo, Ohio where water level rose to very nearly elevation 576.0 feet IGLD, or a total of 7.4 feet above Low Water Datum. This surge was driven by northeast winds with a directional duration of approximately 12 hours and a maximum velocity of 30 knots.

For most of November 12, winds were light (4 knots) and out of the southwest. Very late on the 12th and throughout the 13th, winds shifted gradually to northwest then to northeast. By mid-day on November 13, the northeast winds were established and velocity increased to 20 knots. Water level began rising at Toledo at 0400 hours on November 13.

Maximum wind speed was reached early November 14, with gusts of up to 30 knots. By noon on November 14, while wind direction was changing to north, the water level at Toledo had reached its maximum of 576.67 feet IGLD and began falling off rapidly reaching a minimum level of elevation 572.0 feet IGLD by 1900 hours on the 14th. Wind direction remained northerly throughout the 15th of November while velocity varied from 5 to 14 knots. Secondary and tertiary seiches were experienced on the 15th. Because of their rapid decay, caused by bottom friction, their average maximum elevation was recorded as 572.9 feet IGLD. By November 16, 1972, water level stabilized at approximately elevation 572.4.

Moving away from Toledo, along both the Michigan and Ohio shorlines, water level gages recorded proportionally lower maximum surges. At the Fermi power plant north of Monroe, Michigan, the maximum surge was recorded at elevation 574.9 feet IGLD, while surge elevations of 575.12 and 574.3 feet IGLD were measured at Marblehead and Cleveland, Ohio, respectively.

Waves during this storm were not measured, but sufficient data is available to calculate the maximum waves possible by using the guidelines established by the U.S. Army Corps of Engineers, Shore protection, planning and design, Technical Report #4, 1966. In computing maximum waves for the November 14, 1972, storm several conservative assumptions were made:

1) Steady state wind velocity over Lake Erie (U) is equal to 1.43 times the maximum land wind speed recorded at Toledo, U = 1.43 (30) = 43 knots = 49.5 mph.

2) At maximum surge elevation 576.0 feet IGLD the average water depth (d) is set at 25 feet.

3) Fetch length (F) is set at 70,000 feet (13.25 miles) and is not influenced by offshore island chains.

4) The slope (m) of the lake bottom within the vicinity of the power plant is established as 1:10.

Using these assumptions, the calculations yield the following values:

H = 5.8 feet (Significant wave height)

H_{max} = 10.4 feet (Maximum wave height)

H_b = 12.4 feet (Breaking wave height)

d_b = 12.4 feet (Water depth at H_b)

These values indicate that the maximum wave approaching the shoreline during the storm could not have exceeded 10.4 feet. As the wave approached a water depth of approximately 12.5 feet it could have built up to 12.4 feet before it collapsed. Similar calculations show that smaller waves which could have formed between dry land and depth d_b (12.4 feet) could have reached a maximum height of 8.36 feet. These waves would have broken in about 8.4 feet of water, and could not have runup above elevation 579.5 feet IGLD.

Therefore, the maximum elevation which waves could have reached during the November 14, storm was 579.5 feet IGLD. Finished plant grade and roadway elevations at the Davis-Besse site have been established at 584.0 feet IGLD. The storm level observations and wave calculations are compared to water levels and waves determined from the PMME.

B.4 Comparison of November, 1972, Storm with PMME

Flood design considerations for the Davis-Besse site require that the PMME will occur during the design maximum monthly mean lake level of 573.4 feet IGLD. The November 14, 1972, storm occurred during a time when the Toledo mean lake level was at elevation 572.1 feet IGLD.

The PMME requires that the maximum wind speed reach 100 mph for at least 10 minutes and be preceeded and followed by 6 hours of 70 mph average winds. During this 12 hour period, winds must be from the ENE. The wind speed during the fall 1972 storm is calculated to have reached a maximum over-water velocity of 49.5 mph. This wind was preceeded and followed by winds of variable velocity which ranged from 15 to 20 mph. During this time wind direction was also variable and ranged from N to ENE.

The maximum surge associated with the PMME would produce a rise of approximately 11.6 feet at Toledo above the mean lake level and a rise of 9.3 feet at the Davis-Besse site with an additional one foot rise due to a transverse seiche. For the maximum design considerations, these surge rises were assumed to occur at a time when the monthly mean lake level was 4.8 feet above datum. The November storm produced a storm surge at Toledo of 3.8 feet above the November 1972 Toledo mean lake level or 9.0 feet below that associated with the PMME at Toledo. The November 1972 storm occurred at a time when the mean lake level was at a record high for November but 1.3 feet below that postulated for the PMME event.

B.5 March 1973 Storm

On March 15 and continuing into March 16, 1973 a storm moved into the area with northeast winds which produced high water conditions in the westerly portion of Lake Erie. The maximum water level at Toledo was 574.79 feet IGLD at 8 A.M. on March 17. At this time, the mean lake level at Toledo was 572.9 feet IGLD which was 0.9 feet higher than November 1972 and the wind tide effect was 1.9 feet which was 1.9 feet lower than the wind tide effect in November 1972.

B.6 April 1973 Storm

During the day of April 9, 1973 a storm with easterly winds was experienced in the area which produced water level conditions higher than that experienced in November 1972 and which measured 567.67 feet IGLD at Toledo. At this time the mean lake level at Toledo was at an all time high of 573.36 feet IGLD and 1.23 feet higher than in November 1973. The wind tide effect was 3.3 feet which was 0.5 foot lower than the wind tide effect in November 1972.

Figure 3 illustrates the historical record levels for Toledo, Toledo maximum water levels on November 14, 1972, March 17, 1973 and April 9, 1973, and the projected water levels at Toledo and the Davis-Besse site for the PMME.

C. Station Wind Design Criteria

C.1 General

All station structures are designed to withstand the forces which strong winds generate. The basis which resulted in selection of the design condition winds and forces are given in Section C.2.

All structures which house equipment and station components which are critical from radiological safety considerations are also designed to withstand the effects of a tornado including the barometric pressure drop and airborne objects or missiles that are associated with a tornado. These structures are designated as Class I and the design criteria for tornadoes is given in Section C.3.

The cooling tower due to its size and shape has a specialized design criteria which is given in Section C.4.

C.2 Wind Criteria

All Class I structures are designed for tornado forces. Wind loads did not control the design of Class I structures due to the very low wind stresses in comparison with the tornado loads.

High winds, when they occur, are usually associated with summer thunderstorms or winter time cyclonic storms. While tornadoes are rather common in Ohio, the probability of one striking a point within the one-degree square in which the site is located is 6.3×10^{-4}. The associated recurrence interval is once in approximately 1,590 years.

The highest winds are usually associated with thunderstorms (tornadoes excepted) during the passage of a line squall or cold front.

The Task Committee on Wind Forces of the American Society of Civil Engineers (3) has estimated for the area a "fastest mile" of wind, at 30 feet above ground, of approximately 90 mph, once in 100 years.

H.C.S. Thom (4) has estimated the extreme fastest mile of wind, at 30 feet above the ground, for the following mean recurrence intervals:

Interval (Years)	Annual Extreme-mile (mph)
2	50
10	60
25	80
50	84
100	90

The following minimum wind pressures were used in the design of the Station's structures, and these wind loads are based on Figure 1(b) of reference (3) for a wind velocity of 90 miles per hour, 30 feet above the ground with a 100 years recurrence:

PRESSURE lbs/sq feet

HEIGHT ABOVE GROUND (ft)	WINDWARD SIDE RECTANGULAR STRUCTURES	LEEWARD SIDE RECTANGULAR STRUCTURES
	P	0.68 P
0 - 30	22	15
31 - 50	25	17
51 - 100	35	24
101 - 300	50	34
301 - 500	60	41
501 - 1,200	85	58

For any other height (H), the $V = 90 (H)0.2$, $P = 0.00256\ V^2$ was used.

Where: V = Wind Velocity (mph)
P = Pressure (lbs/sq ft)

For all other structures of shapes other than rectangular, the shape factors recommended in reference (3) were applied.

C.3 Tornado Criteria

C.3.A General

There are few reliable measurements of the pressure drop associated with a tornado funnel. The greatest reliably measured pressure drops have been on the order of 1.5 psi or less.

The design pressure drop is assumed to be 3 psi in 3 seconds. This is 100% greater than the greatest pressure drop ever reliably measured, which is conservative.

Because of the complexity of the airflow in a tornado, it has not been possible to calculate the velocity or trajectory of missiles that would truly represent tornado conditions. It is assumed that objects of low cross-sectional density, such as boards, metal siding and similar items are picked up and carried at the maximum wind velocity of 300 mph.

The behavior of heavier, oddly shaped objects, such as an automobile, is less predictable. The design values of 50 mph for a 4000 lb automobile lifted 25 ft in the air is considered to be representative of what could happen in a 300 mph wind as the automobile is lifted, tumbled along the ground, and ejected from the tornado funnel by centrifugal force. These missile velocities are consistent with reported behavior of such items in previous tornadoes. (5)

Structures were analyzed for tornado loading on the following bases:

1. Differential pressure between the inside and outside is assumed to be 3 psi positive pressure for the shield building and 1.5 psi positive pressure for the auxiliary building with the provision of venting the structure in order to control the differential pressure to within the 1.5 psi limit.

2. Lateral force on the shield building is assumed to be the force caused by a tornado funnel having a peripheral tangential velocity of 300 mph and a forward progression of 60 mph. The applicable portions of wind design methods described in ASCE Paper 3269 are used, particularly for shape factors. The provisions for gust factors and variation of wind velocity with height do not apply.

3. A tornado driven missile equivalent to a 12 foot long piece of wood 8 inches in diameter traveling end on at a speed of 250 mph is assumed.

4. A tornado driven missile equivalent to a 4000 lb automobile traveling through the air at 50 mph and at not more than 25 feet above the ground, is assumed.

5. A tornado driven missile equivalent to a 10 foot long piece of pipe 3.5 inches O.D. traveling end on at a speed of 100 mph is assumed. Pipe type is 3 inches I.D. Schedule 40.

C.3.B Conversion of Tornado Loads Into Forces

The tornado wind velocity of 300 mph is used uniformly on Class I structures such as the shield building and auxiliary building. The equation

$$q=0.002558V^2 \quad \text{(Reference 3)}$$

is used to compute the wind forces. The shape factors of 0.8 and 0.5 for windward and leeward [illegible] respectively, are used.

The differential pressures of 3 psi and 1.5 psi for the shield building and auxiliary building, respectively, are assumed to act concurrently with the force exerted by a 300 mph wind.

The load combination used for the Tornado Accident is

$$U = 1.0\ D + 1.0\ L + 1.0\ W + 1.0\ T_o + 1.25\ H_o$$

where –

D	=	Dead Load
L	=	Live Load
W	=	Tornado Load
T_o	=	Thermal Loads
H_o	=	Thermal Force

C.4 Cooling Tower Wind Design Criteria

The cooling tower design is based on wind velocities at the 30 foot level of 90 mph which is the same design for the other non Class I station structures. Due to its height, however, the design velocities vary at other elevations such that at the 500 foot level, the wind design velocity is 175 mph.

The wind design distribution is in accordance with ASCE paper 3269 "Wind Forces on Structures" which is a recognized standard for this type of a structure and location.

The general structural design criteria for the cooling tower is given in Appendix A.

D Cooling Tower Foundation Design and Construction

D.1 General

The cooling tower foundation which supports the shell is a circular reinforced concrete ring which spreads and transmits the forces from the static and wind load of the shell to the bedrock through an interposing layer of natural undisturbed glacial till and a compacted layer of granular rock fill material.

The cooling tower basin area which serves as a receiving and surge basin for the water flowing through the cooling tower is paved with reinforced concrete with water stops at construction joints to provide a water tight floor for the contained water. The fill material under this basin floor and inside the foundation ring has an impervious clay fill cutoff over the granular material at the foundation ring area and a bentonite sealing board at the side of the foundation ring.

The basin concrete floor provides a watertight bottom for the basin and in the unlikely event of a crack in this floor, the cutoff and sealing board provide a positive seal to prevent any seepage flow out of the basin and through the granular fill.

The earth fill around the perimeter of the cooling tower is glaciolacustrine clay material and is graded up to station grade elevation of 584 feet. This prevents any normal or storm induced water levels in the site from reaching any portion of the cooling tower or foundation.

D.2 Foundation and Basin Arrangement

The static weight of the cooling tower shell and additional forces from wind loading is transmitted through columns to a large circular reinforced concrete foundation ring which provides a means to spread these loads over a considerable area to the fill material beneath the foundation ring and through the fill to the underlying bedrock. The details of this foundation arrangement are shown on Figure 9.

The top of the foundation ring, reinforced concrete paving within the foundation ring area and a vertical concrete wall resting on the foundation ring form a water retention basin to receive the water flowing through the tower and to provide a surge basin for the condenser cooling water system. These details are shown on Figure 9. All construction joints between the foundation ring, paving and basin wall have water stops to provide a completely sealed basin.

At one side of the cooling tower, an opening through the basin wall permits the flow of water through a transition piece to an open return canal. The return canal which is paved with concrete, carries the water to the circulating pump intake structure adjacent to the turbine building.

D.3 Foundation Support and Fill

The top of bedrock in the area of the cooling tower varies in elevation from about 560 feet to 564 feet. This bedrock is dolomitic bedrock which is jointed in the upper portions and is banded with gypsum.

In some areas fissures and solution cavities are present. The areas of the site where major structures are located have been extensively investigated to determine the condition of the bedrock which sup . these structures. This investigation included borings, excavations, gravity surv smic surveys, resestivity surveys and geologic mapping all of which are completely .ported in Appendix 2C of the Final Safety Analysis Report.

Solution cavities were found in a portion of the cooling tower area and a grouting program was used to fill these cavities to assure competent bedrock integrity.

Above the bedrock, there is a layer of glacial till deposit which is dense and very stiff silty clay about 6 to 10 feet in thickness which is overlain with a glaciolacustrine deposit which is a dense stiff silty clay.

Since the till deposit has a very low compressibility, and is suitable for foundation support the area under the cooling tower foundation was excavated to the till deposit an anular crushed rock fill, densely compacted, was placed in the excavation up to the vation of the bottom of the cooling tower foundation ring as shown in Figure 10.

The granular crushed rock used was obtained from the on-site quarry operation and contains gypsum which is soluable in water containing medium to low dissolved solids. Even though tests had shown that large settlement of this compacted material would not occur even with considerable amount of weight loss due to the fine gypsum particles being dissolved by a flow of distilled water, a backup means to the basin paving design and construction was felt to be desirable to prevent any potential seepage flow from the basin and through the granular fill material.

This arrangement is shown on Figure 10 and consists of a compacted layer of clay which is impervious to water flow placed over the granular fill from the cooling tower foundation ring to existing glaciolacustrine material inside of the cooling tower foundation ring. This gladiolacustrine material being a dense clay material is also impervious to water flow.

In addition a bentonite board ring was placed on the inside face of the foundation ring to prevent seepage of water down the face of the foundation ring.

The area outside of the cooling tower has been partially graded and will be completely graded to station grade of elevation 584 in the configuration shown on Figure 10 following completion of the cooling tower interior work now in progress.

This fill is the clay glaciolcustrine material from on-site which is compacted and is impervious to water flow. This extensive outside fill prevents ground water or high water levels from reaching the cooling tower structure.

E. WATER INTAKE AND DISCHARGE DESIGN

E.1 GENERAL

An electrical generating station installation requires large quantities of water for the condenser cooling system to remove the low temperature heat released from the turbine exhaust steam in the main condensers. A considerably lesser amount of water is also required for miscellaneous auxiliary purposes.

In an arrangement utilizing a once-thru circulating water system, this water is brought into the station through an intake system connecting with the river or lake and this water is then discharged back to the river or lake by a separate, divergent discharge system. The water for auxiliary purposes follows the same route. The water intake is normally an open canal connecting the river or lake with a pump house in or adjacent to the main station structure.

Utilization of a closed cycle, evaporative type cooling tower system provides an arrangement whereby the large qualities of condenser cooling water can be continously recycled with only relatively small quantities of river or lake water needed to provide makeup for evaporation losses and blowdown. The amount of water required from and returned to a river or lake source with a cooling tower system is approximately 2-5% of that required for a once-thru system dependent on specific relative design conditions. The water intake and discharge requirements for auxiliary systems can be approximately equal to the requirements for the cooling tower makeup and in the case of the Davis-Besse facility, the largest auxiliary requirement has been consolidated with, and serves as, the source of cooling tower makeup so that there is only a small quantity of water required for normal station operation beyond that which ultimately serves as cooling tower system makeup.

E.2 WATER USE AND DISCHARGE REQUIREMENTS

A general schematic diagram of the Davis-Besse water use diagram is shown on Figure 3.5 of the Final Environmental Statement and is included herein as Figure 5. A complete description of the various systems involved in this overall water use diagram is given Sections 3.3, 3.4.1, 3.5 and 3.6 of the Final Environmental Statement and Chapter 4 of the Environmental Report Supplement.

The principal quantity of water used by the station is that required for the service water systems which provides cooling through heat exchangers for the turbine area closed cooling system, the nuclear area closed component cooling system and the containment cooling system. This service water, after passing through these heat exchangers, is used for makeup water to the cooling tower system during normal operation or is discharged directly to the lake or is recirculated in the intake canal forebay area if the cooling tower is not in operation.

The service water system is the only portion of the overall station water use diagram shown on Figure 5 which is critical to safety and the design of the water intake and discharge arrangement provides for continued operation of this system, under all conditions of adverse natural events such as storms, high water and ice conditions.

E.3 INTAKE ARRANGEMENT

Water for station use to satisfy the station requirements detailed in Section E.3 above is drawn in from Lake Erie through a submerged intake crib structure about 3000 feet offshore at the lake contour depth of about 11 feet below lake datum. This intake crib is made up of timbers with slots in the top to permit downflow of water into the intake cone located within the crib structure. Rock fill around the crib holds it in place and permits some water flow through the rock and sides of the crib structure.

Surrounding the top of the intake crib is an air bubbler pipe system which will provide an air bubble screen to discourage entry of fish into the crib and intake pipe.

Water entering the crib, flows into an intake cone on top of a 96" diameter intake pipe which is buried below the lake bottom. The water flows through this intake pipe by gravity to, and discharges into the open onsite intake canal.

Located around the outer area of the intake crib is a rock barrier which helps prevent sand from reaching the crib and also provides protection from ice being driven into the crib by wind and wave action. Even if ice should pile on top of the crib and block the slotted openings, enough water to satisfy the station's needs would enter the sides of the crib through the rock fill adjacent to the crib.

The arrangement of the intake crib and intake pipe are shown on Figure 6 and the general arrangement of the intake crib, intake pipe, onsite intake canal and pump house intake structure is shown on Figure 1.

The water entering the onsite open intake canal from the submerged intake pipe, flows the length of the 2800 foot long canal to an intake forebay area adjacent to the area of the main station structures where the pump house intake structure is located. This forebody area is shown on Figure 1 and 7.

The forebay area dikes rise in elevation and transition into the wave protection dike, as shown on Figures 2 and 7. These dikes are faced with heavy stone rip rap material the same as the wave protection dike to provide protection against any errosive action of waves. The pump house intake structure at the end of the forebay has a concrete wall face extending up to elevation 591 and is designed to withstand any direct wave action and high water.

The pump house intake structure has three openings in the lower portion of the face wall, each of which opens into separate pump suction bays as shown on Figure 8. Ahead of these openings, are located trash racks which will prevent large objects such as logs from entering the pump suction bays.

Ahead of the pump suctions, traveling water screens are located which prevent fish or small debris from entering the pump suction area. These traveling water screens have fine

mesh (3/4" openings) panels on a chain and sprocket system so that the front face is continually rising when they are in operation, carrying any material caught on the face, upward where it is automatically washed off above the floor level and sluiced to a catchment basin. The screens can be started manually but are on an automatic starting system which starts them in operation if a differential level exists across the screens indicating some small blockage of flow from fish, leaves or other debris.

There are three separate pump suction bays, each one containing a service water pump. Only one service water pump is required to satisfy all critical station needs for service water.

As stated in Section E.2, under normal station operation; service water after, serving as cooling media for the turbine room area, nuclear component area and containment area is used for cooling tower system makeups. At times when the station is not in normal operation, this service water is discharged directly to the lake through the discharge system.

The service water system is also designed so that in the unlikely event any blockage or loss of the submerged intake crib, intake pipe or intake canal up to the forebay area should occur, the service water discharge would be returned to the forebay area which would serve as a cooling pond for long term, assured supply of service water.

F. Marsh Areas and Dikes

F.1 General

Approximately 580 acres of the site are leased to U. S. Government as a National Wildlife Refuge which is administered as the Navarre Unit of the Ottawa National Wildlife Refuge. This area includes the beach ridge and essentially all of the marsh area. The only construction of any nature associated with the station within this leased area is the intake canal, buried discharge pipe, and minor temporary construction facilities. The site arrangement and marsh areas are shown on Figures 1 and 4.

None of this marsh area has any relation to the Davis-Besse Station construction or operation.

The marsh area in the southeast portion of the site is isolated from communication with the lake by the beach ridge at the shoreline, the intake canal on the northwest, the upland area on the west, and a dike on the south. This dike was existing when the property was acquired but was in a poor state of repair. No work prior to the spring of 1972 was done on this dike except to repair portions so that the marsh water level would be controlled. The top of this dike varied in elevation from 572 feet to 576 feet.

The north marsh area is a portion of a large marsh of which only a part was acquired for the station site. To isolate this on-site area from the remainder and to provide means for water level control, a dike was constructed in 1972 with a top elevation of 574 feet. The intake canal on the southeast, upland area, and the area occupied by station structures on the south, and State Highway 2 on the west complete the boundary of this marsh area.

F.2 Agreements With Bureau of Sport Fisheries and Wildlife

The initial agreement with the U. S. Bureau of Sport Fisheries and Wildlife that resulted in acquisition of the Navarre Tract by Applicants in exchange for the Darby Marsh, provided for a 50-year lease of all but a small portion of this tract to the U. S. Government for management as a National Wildlife Refuge and a similar 25-year lease for all other marshlands acquired for the station site. This agreement also required Applicants to maintain the south dike of the Navarre Tract and to construct and maintain a similar dike on the north side of the site. This agreement also required Applicants to install water level control pumps which would be operated and maintained by the U. S. Government.

In accordance with this agreement, the repairs to the south dike and construction of the north dike discussed in Section F.1 was done. In 1972, two water level control pumps, one for the south marsh area and one for the north marsh area, were installed and are operational.

In September 1972, further agreement was reached with the Bureau of Sport Fisheries and Wildlife to establish the top elevation of the dikes at 575 feet. In accordance with this additional agreement, work on these dikes to raise their elevation commenced in the spring of 1973 and work is still in progress.

F.2 High Water Considerations

During the high water periods in November 1972, March 1973, and Apr. 1973, the major portion of all marsh dikes were completely underwater since the dike elevations were lower than the lake level at these times. During normal lake level periods in early 1973, some portions of the south dike were also underwater. Water action during these periods caused some erosion of the southern dike and the marsh water level remained essentially at lake elevations.

The north marsh area water level was reduced to 571 feet IGLD commencing March 19, 1973 at the direction of the Ottawa National Wildlife Refuge Manager and has remained at a lowered level since that time. Additional pumping has been required since the initial lowering, due to the effect of heavy rains and drainage water from off-site areas to the west of State Highway 2. Raising of the north dike elevation was completed in May 1973.

In early May 1973, the low spots in the south dike were filled and commencing on May 10, 1973 lowering of the water level in the south marsh area started under the direction of the Ottawa Refuge Manager. High lake water conditions on June 17, 1972 caused overtopping of portions of the south dike that have not yet been raised. Raising of the south dike will be completed in July 1973.

During the high water storm periods, the wave action caused extensive erosion to the beach area. In two locations, the barrier beach is quite narrow and the storm erosion resulted in these narrow portions being almost completely washed out. These areas are being built up to an elevation of 579 feet IGLD and the lake side will be faced with large stone rip-rap to provide wave protection.

This work, which is underway, will provide controlled water level conditions for the marsh areas of the site for all normal levels of Lake Erie but will not prevent extreme water levels such as those which occurred in November 1972 and April 1973 from entering the marsh areas.

The marsh areas of the Davis-Besse site which are leased to the U.S. Government as the Navarre Unit of the Ottawa National Wildlife Refuge, upon completion of the dike work now in progress, are better prepared to withstand high water level and storm conditions than any other marsh portions of the Ottawa National Wildlife Refuge.

TABLE 1

Wind, Flood and Related Design Considerations

Preliminary Safety Analysis Report (PSAR)

Section	Title
2.3	Meteorology
2.4	Hydrology
Appendix 2B	Meteorology
5.2	Containment System Structural Design
5.9.2	Auxiliary Building Design
5.9.2	Turbine Building Design
5.9.3	Intake Structure Design
5.9.5	Office Building Design
Appendix 5A	Design Basis for Structures
Appendix 5B	Description of Load Factors

Final Safety Analysis Report (FSAR)

Section	Title
2.3	Meteorology
2.4	Hydrologic Description
3.3	Wind and Tornado Design Criteria
3.4	Water Level (Flood) Design Criteria
3.8	Design of Siesmic Class I Structures
Appendix 3A	Descriptions of Load Factors
Appendix 3D	Conformance With the AEC General Design Criteria

Geology Design Considerations

PSAR

Section	
2.5	Geology
2.7	Subsurface Conditions
Appendix 2C	Geology, Siesmology, Subsurface Conditions, and Preliminary Foundation Design Criteria

FSAR

Section	
2.5	Geology and Siesmology
Appendix 2C	Geology, Siesmology, Subsurface Conditions and Geotechnical Design Criteria

List of References

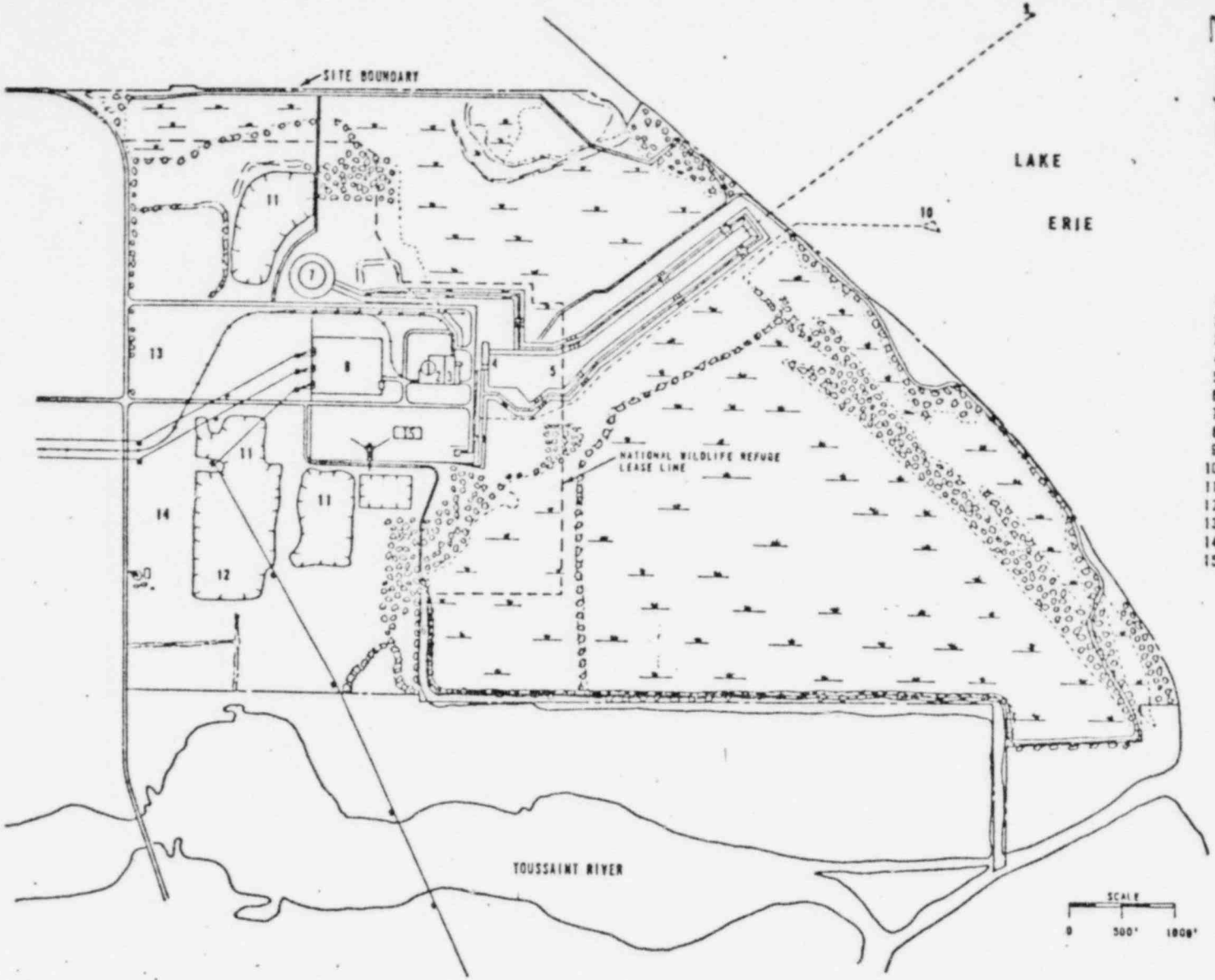
(1) Platzman, G. W. 1967. A Procedure for Operational Prediction of Wind Set-up on Lake Erie, Technical Report Number 11 to the Environmented Science Services Administration Weather Bureau.

(2) Department of the Army, Corps of Engineers, 1966. Shore Protection, Planning and Design, Technical Report Number 4, U. S. Army Coastal Engineering Research Center.

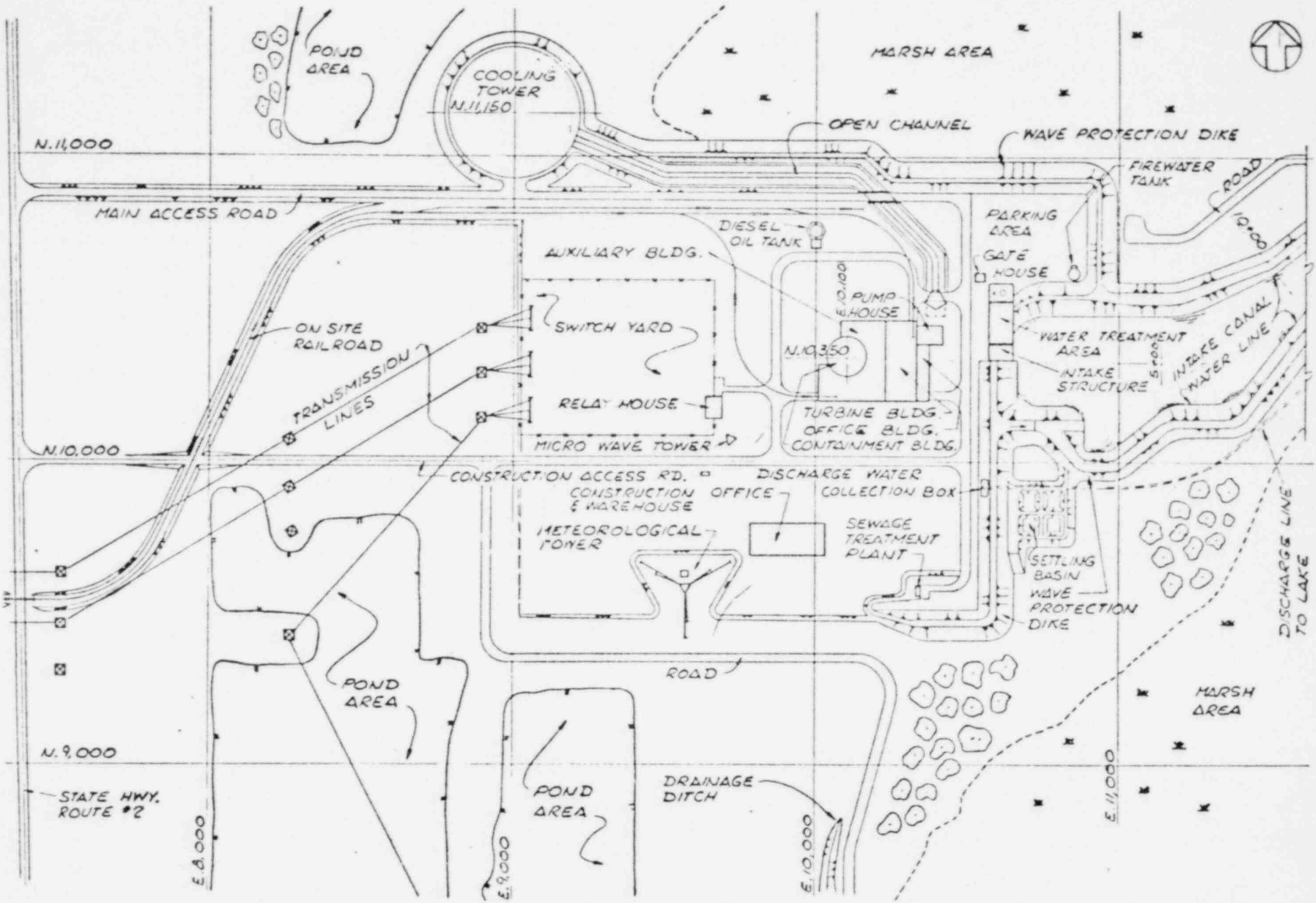
(3) "Wind Forces on Structures" Paper No. 3269, American Society of Civil Engineers.

(4) Thom H.C.S., "New Distributions of Extreme Winds in the United States", Journal of Structural Division Proceedings of the A.S.C.E., July 1968.

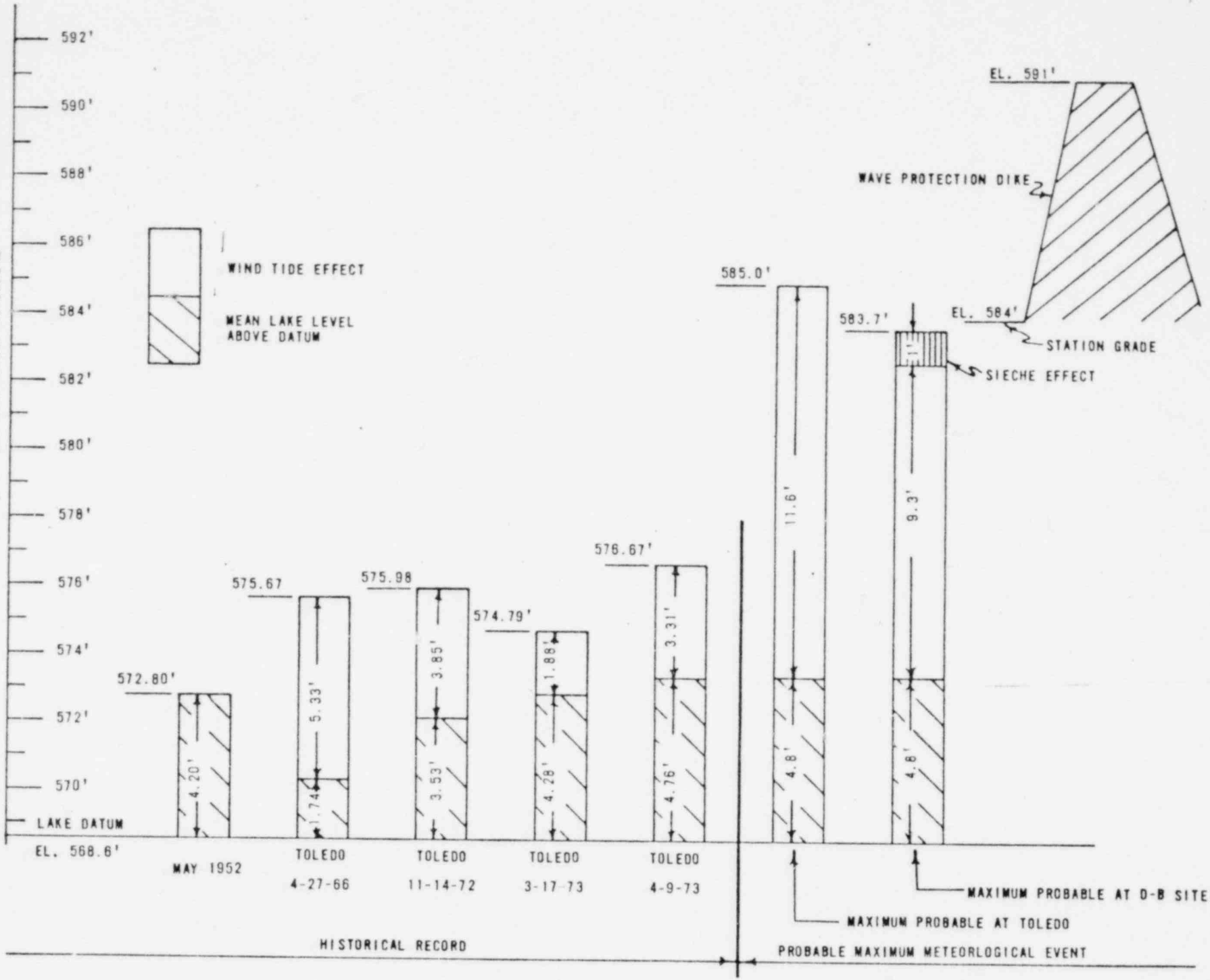
(5) "Design Criteria for Nuclear Power Plants Against Tornadoes", Bechtel Corporation, July, 1969.



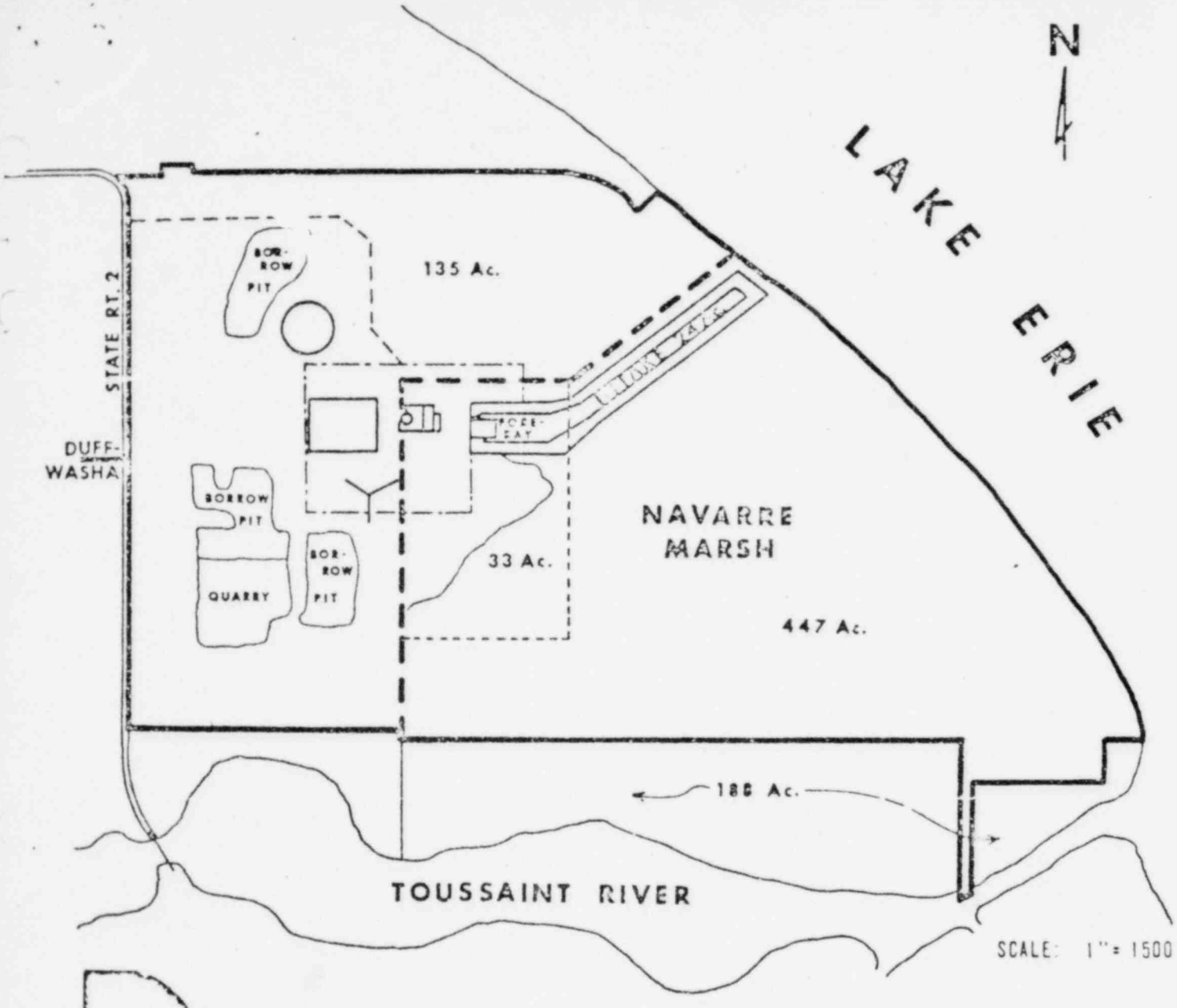
DAVIS-BESSE NUCLEAR POWER STATION
SITE PLAN
FIGURE 1



DAVIS-BESSE NUCLEAR POWER STATION
STATION ARRANGEMENT PLAN
FIGURE 2



DAVIS-BESSE NUCLEAR POWER STATION
WATER LEVEL CONSIDERATIONS
FIGURE 3



TOTAL STATION SITE 954 AC.

NAVARRE TRACT 524 AC.
(532.9 DEED AC.)

50 YR. LEASE TO BUREAU
447 AC.

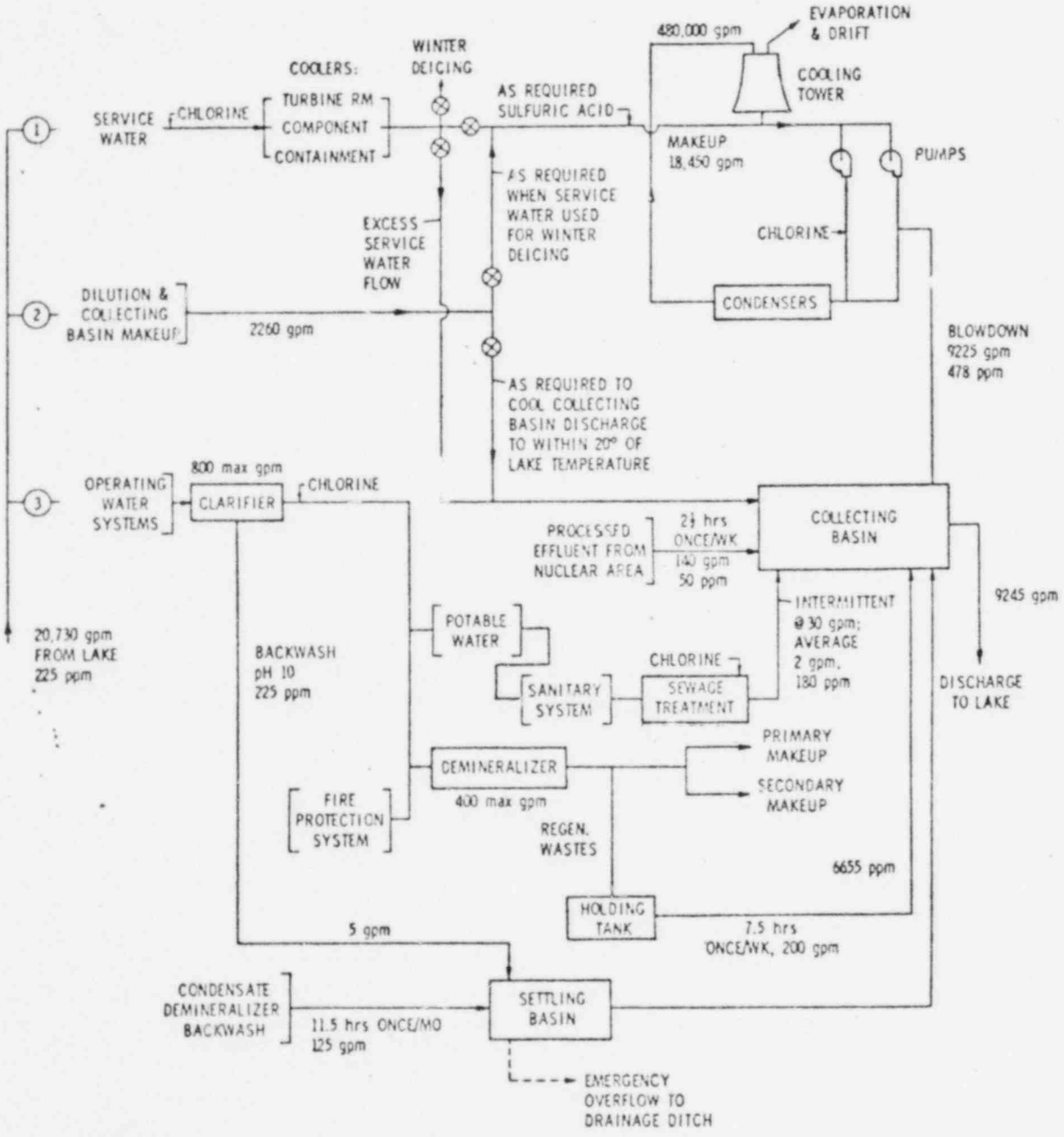
25 YR. LEASE TO BUREAU
135 AC.

MARSH AREAS NOT LEASED BUT
MANAGED BY BUREAU 33 AC.

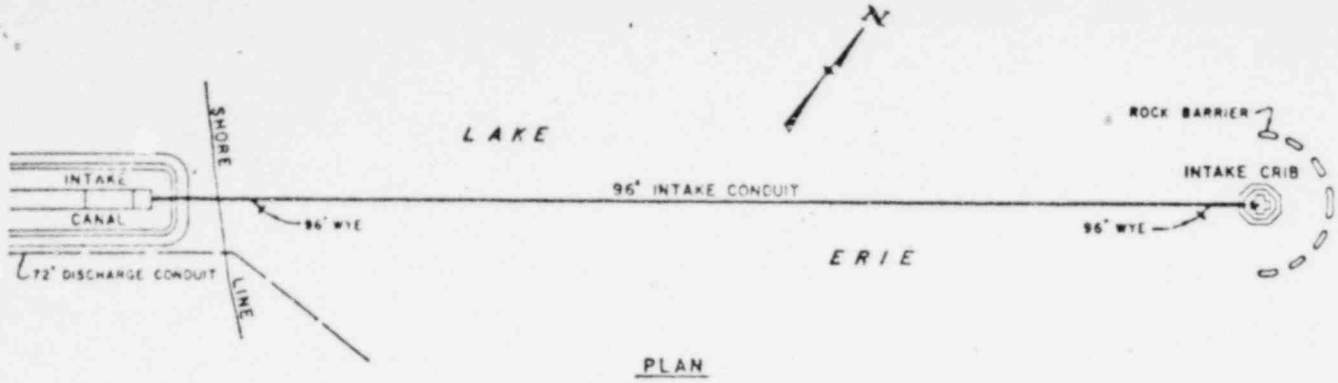
GRADED & FENCED STATION
AREA 56 AC.

BORROW PITS & QUARRY 46 AC.

DAVIS-BESSE NUCLEAR POWER STATION
SITE AREAS
FIGURE 4

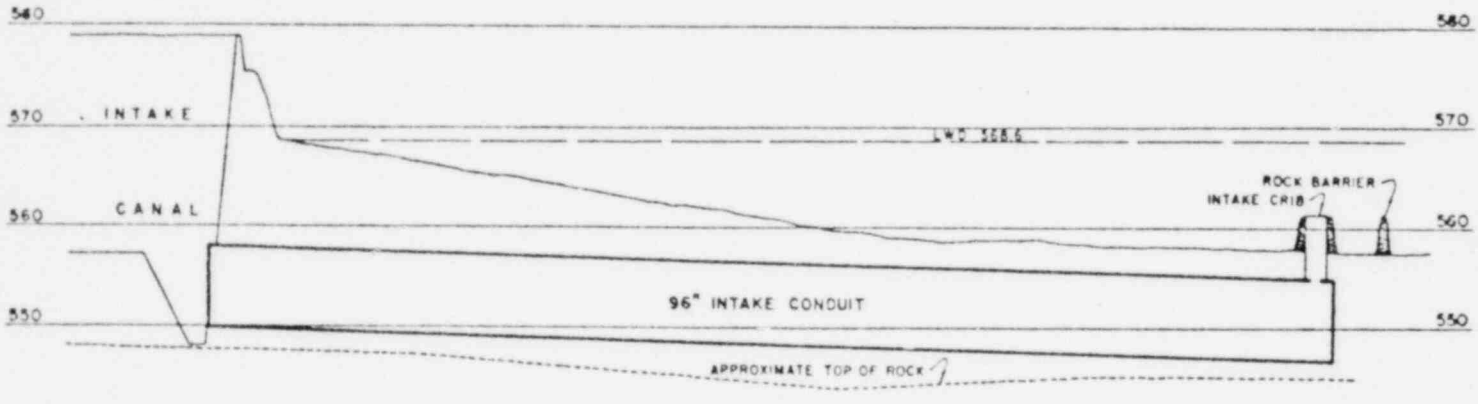


DAVIS-BESSE NUCLEAR POWER STATION
STATION WATER USE DIAGRAM
FIGURE 5



PLAN

0 100 200 300 400 500
SCALE IN FEET



PROFILE

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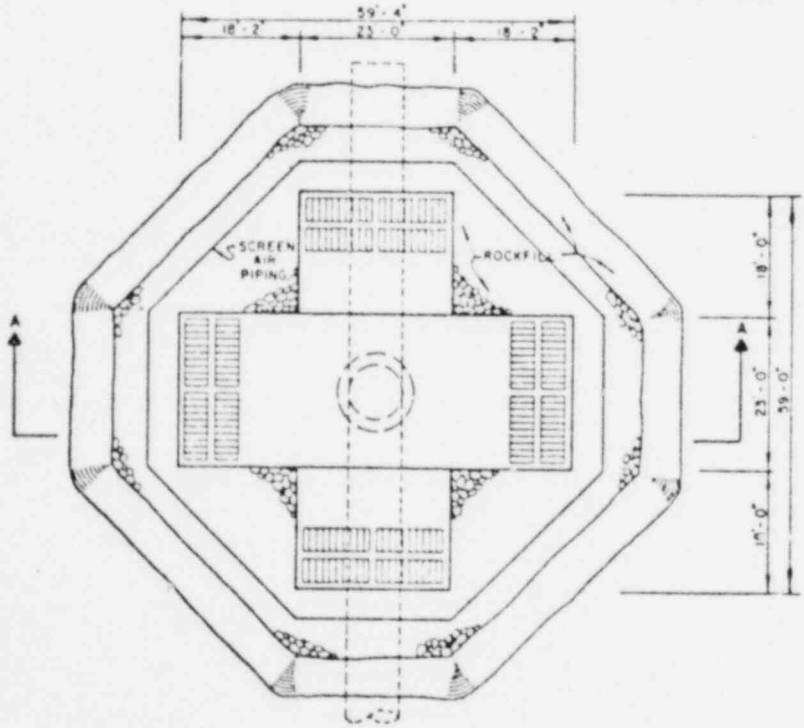
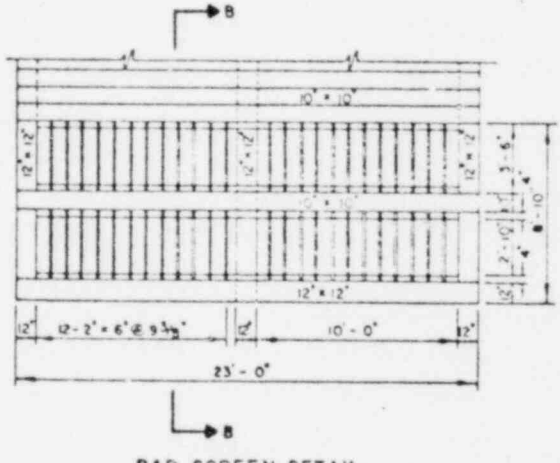
SCALE IN FEET

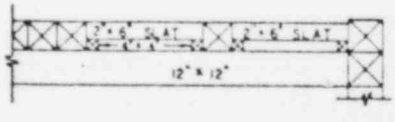


PLAN
INTAKE CRIB

0 1 2
SCALE IN FEET



BAR SCREEN DETAIL
NO SCALE

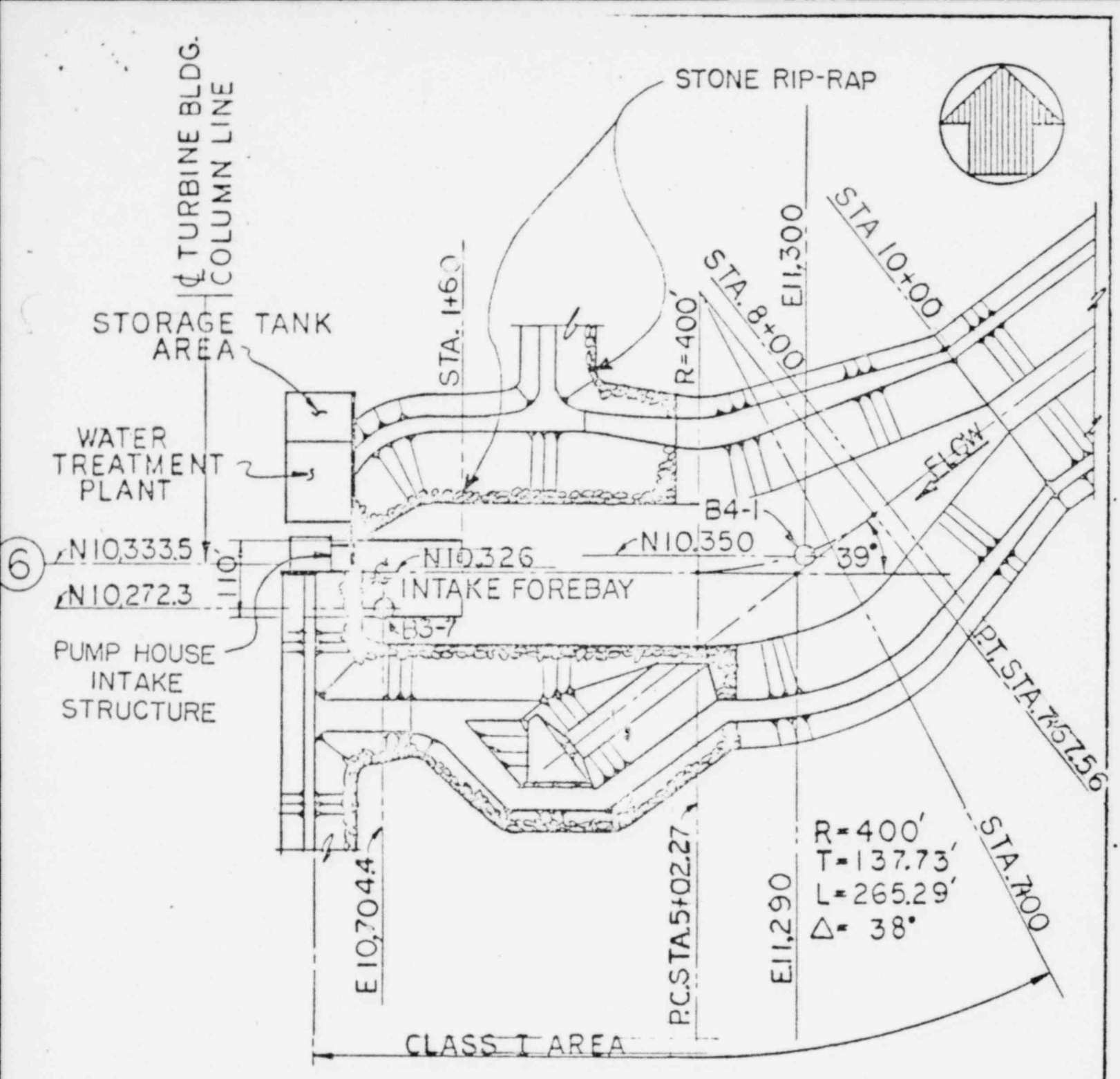


SECTION B-B

SECTION A-A

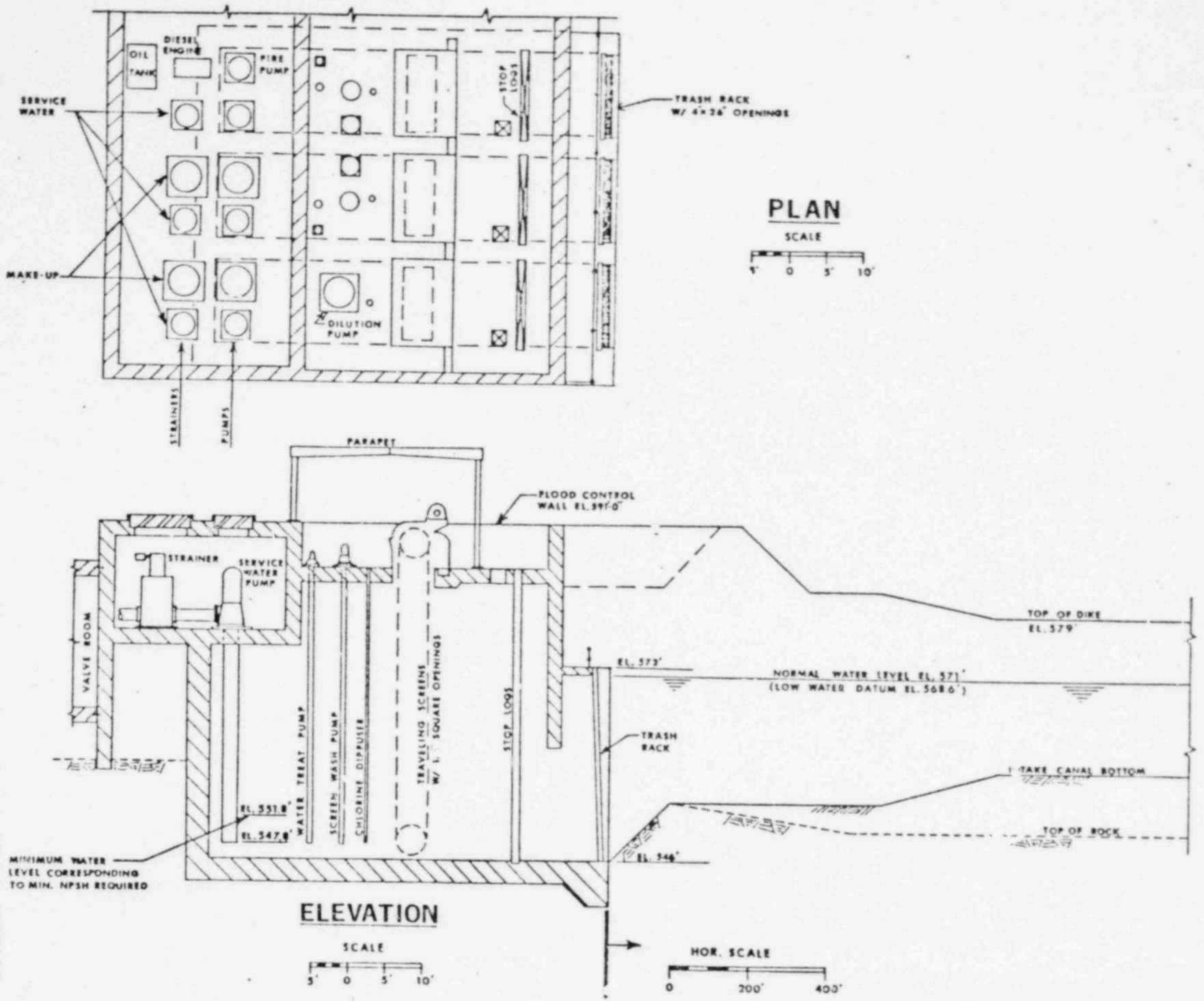
0 1 2

DAVIS-BESSE NUCLEAR POWER STATION
SUBMERGED INTAKE CRIB
FIGURE 6

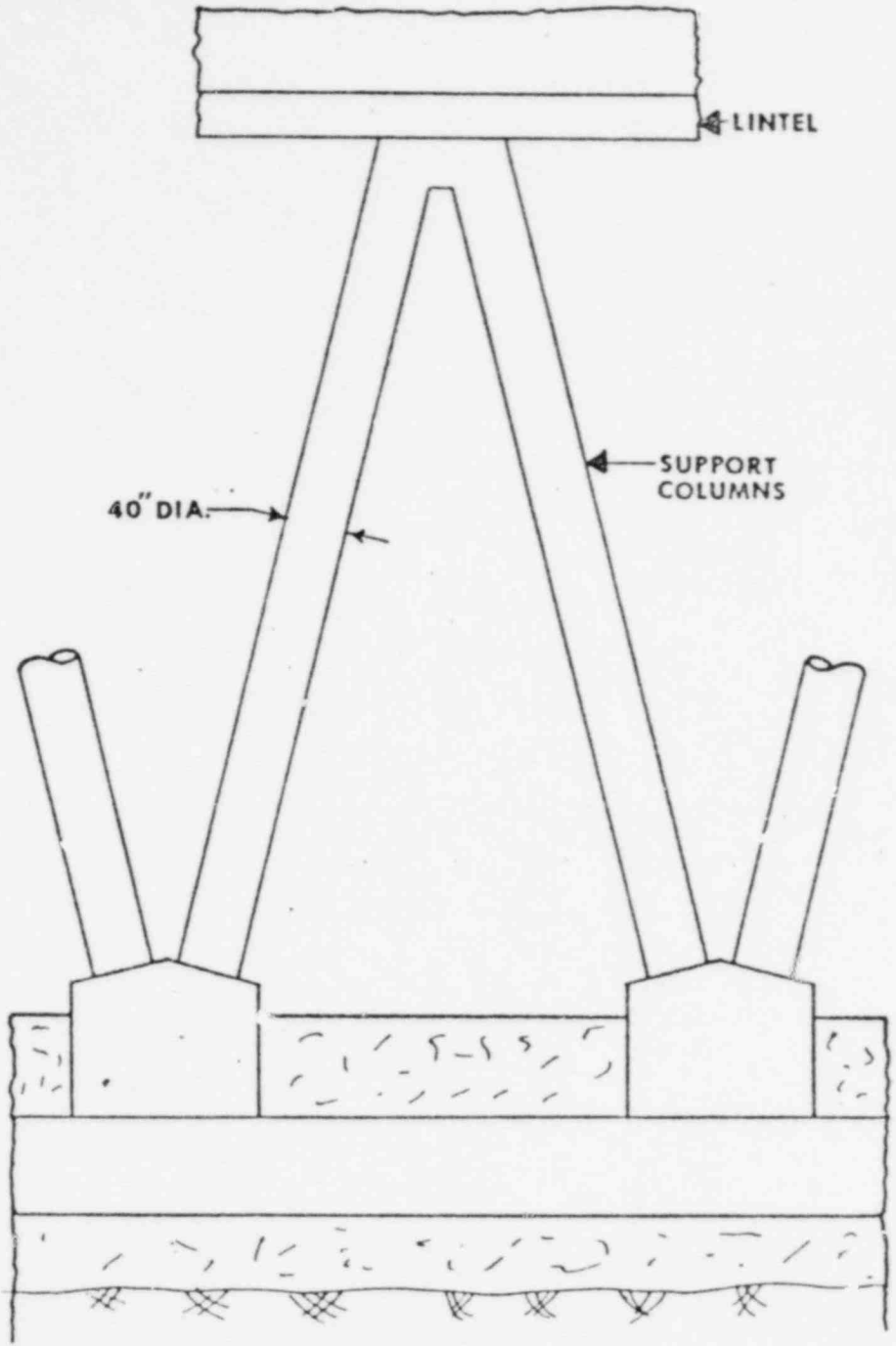


PARTIAL PLAN-INTAKE CANAL

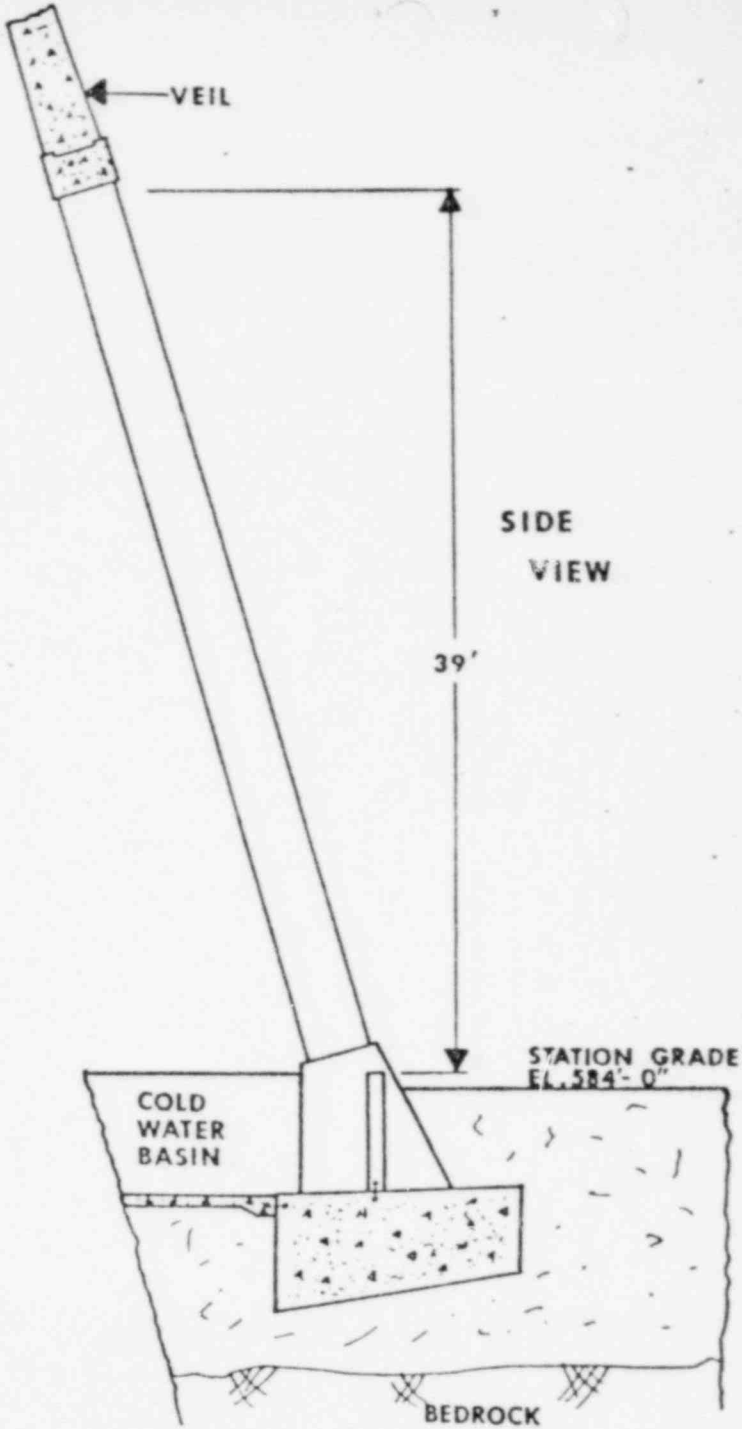
DAVIS-BESSE NUCLEAR POWER STATION
PARTIAL PLAN OF INTAKE CANAL
FIGURE 7



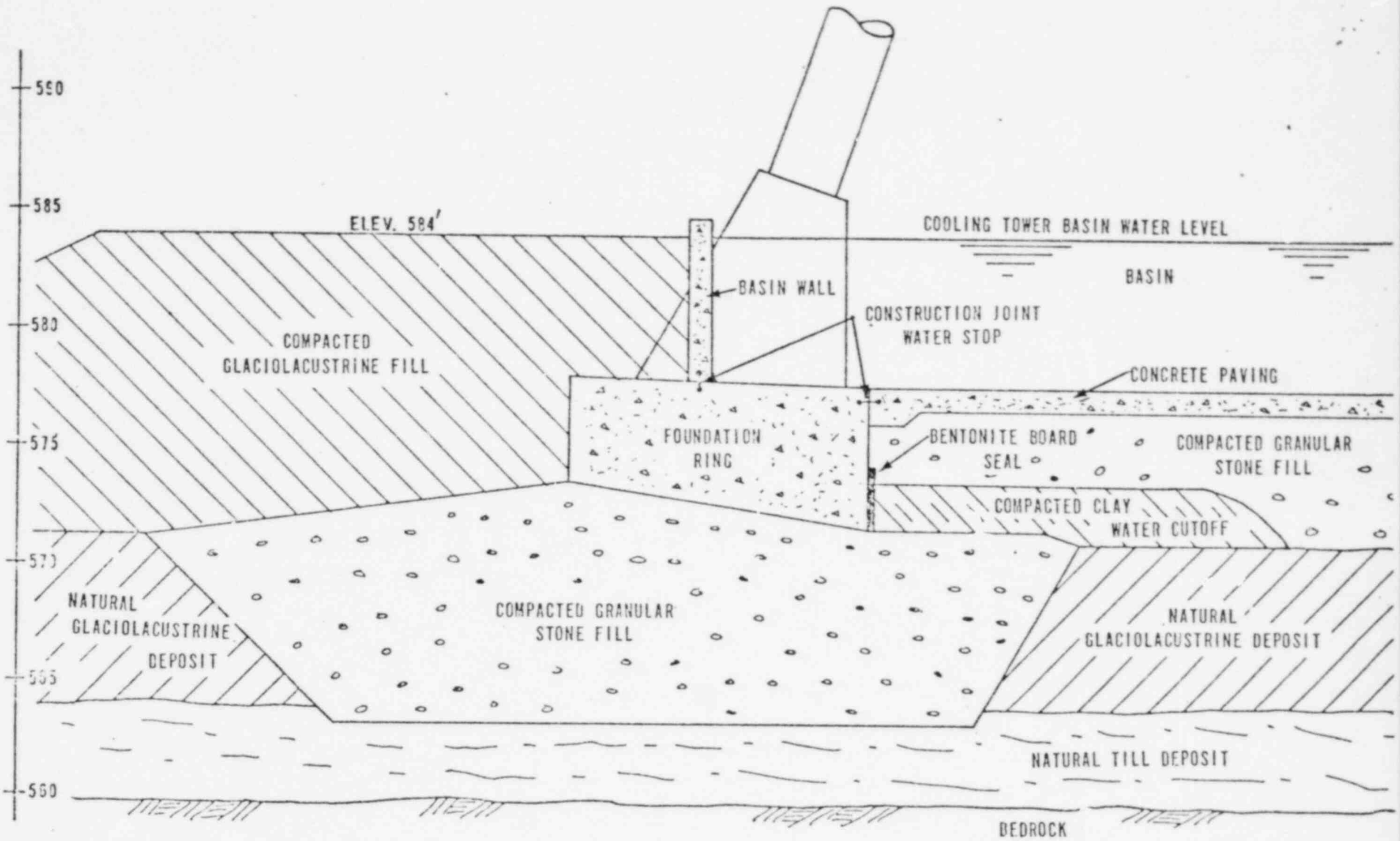
DAVIS-BESSE NUCLEAR POWER STATION
PUMP HOUSE INTAKE STRUCTURE
FIGURE 8



FRONT VIEW



DAVIS-BESSE NUCLEAR POWER STATION
COOLING TOWER
STRUCTURAL SUPPORT DETAILS
FIGURE 8



DAVIS-BESSE NUCLEAR POWER STATION
COOLING TOWER
FOUNDATION SUPPORT ARRANGEMENT
FIGURE 10

SECTION 3

STRUCTURAL DESIGN CRITERIA

A. The profile of the proposed cooling tower, 493 feet high from basin to cornice with a 39 foot air gap, is that of an offset hyperbola.

B. The minimum shell thickness is nine and one-half inches (9½") which provides dead weight to counteract most of tension from design wind load and further provides adequate safety against buckling.

C. The upper part of the shell is gradually thickened up to the top where if forms a stiff ring beam. This top ring serves to increase the natural frequencies of the tower, thereby increasing the safety factor against buckling. Furthermore, the ring reduces edge deflection.

D. The lower part of the shell is gradually thickened down to the lintel ring beam which in turn is supported by diagonal columns. This lower thickening reduces concrete tensile stresses under wind loading, further increases the counteracting dead load, and reduces the danger of buckling where the shell becomes conical.

E. The dead weight loading is analyzed by the membrane theory using two equations of equilibrium:

$$N_{\phi} = - \frac{R}{2 r_o \sin \phi}$$, the meridional stress resultant

$$N_{\phi} = \frac{r_o}{\sin \phi} \left(\frac{N_{\phi}}{r_1} + p_z \right)$$, the circumferential stress resultant

where R is the total weight above the section, r_o is the radius of the parallel circle, r_1 is the principle radius of curvature along the meridian, and p_z the component of the dead load taken normal to the surface. These equations neglect bending which is permissible except at the edges, where bending moments can be larger. For this tower, with shell thickening near the edges, these moments can easily be taken by reinforcement.

F. The Wind Loading

Estimating the live loading from wind required first, the conversion of meteorological wind data into mean hourly wind pressures, second, the establishment of a vertical profile of wind pressure distribution, third, the determination of a gust response factor and fourth, the establishment of a horizontal distribution of wind pressure around the tower cross section.

1. Mean hourly pressures $\bar{q}(z)$ are computed from Basic Wind Velocities defined in ASCE Paper No. 3269 as the fastest mile wind speeds read off of U. S. Weather Bureau Isotach Charts. The wind speeds are taken 30 feet from ground elevation and in open country. Using the chart for a 100 year return (from A. C. S. Thom "New Distributions of Extreme Winds in the United States", ASCE July 1968), i.e., a probability of occurrence of once in 100 years, we find the fastest mile wind speed in Ohio to be about 90 MPH. The specification establishes a speed of 90 MPH which is converted into pressure by

$$q_f = .002558\, V_f^2 = 20.7 \text{ psf.}$$

2. The vertical profile of wind pressure, taken directly proportional to that of wind speed, is dependent upon the exposure when (from Thom, July 1968)

$$\bar{V}(Z) = \bar{V}_G \left(\frac{Z}{Z_G}\right)^{\alpha}$$

where

Exposure A, cities $\alpha = 1/3$, $Z_G = 1500$ feet

Exposure B, rolling country $\alpha = 1/5$, $Z_G = 1150$ feet

Exposure C, open country $\alpha = 1/7$, $Z_G = 950$ feet

$\bar{V}_G$ is the mean gradient velocity, i.e., the mean velocity at the gradient height Z_G, the height above which the wind velocity is assumed constant.

For a coastal area (including the Great Lakes), these fastest mile speeds correspond to a vertical wind profile (following ASCE No. 3269, Table 1b),

$$V(z) = V(30) \left(\frac{z}{30}\right)^{\alpha}$$

where α varies from 0.3 (for V(30) = 60 MPH) to 0.143 (for V(30) = 130 MPH). When V(30) = 90 MPH then α = 0.23 and the profile becomes

V(30)	=	90 MPH	(=20.7 psf)
V(50)	=	101 MPH	(=26 psf)
V(150)	=	130 MPH	(=43.3 psf)
V(400)	=	163 MPH	(=68 psf)
V(600)	=	180 MPH	(=83 psf)

which lead to the average values shown in parentheses compared to those in Table 1b.

		Table 1b	Averaged from Formula Values
V(0-50)	=	90 MPH	(90 MPH)
V(50-150)	=	115 MPH	(115 MPH)
V(150-400)	=	145 MPH	(146 MPH)
V(400-600)	=	175 MPH	(172 MPH)
V(600-1500)	=	180 MPH	(180 MPH)

The resulting pressures, used in the design of this tower:

V(0-50)	=	20.7 psf
V(50-150)	=	33.8 psf
V(150-400)	=	53.8 psf
V(400-600)	=	78.4 psf

3. The gust response factor depends, significantly, upon the size, natural frequency, and damping of the structure, along with the exposure or roughness and obstructions on the terrain. A number of similar methods have recently been proposed for establishing a loading factor G from which to obtain design wind pressures by the formula

$$q(Z) = .00256G\ (\bar{V}\ (Z))^2$$

where q (Z) is the equivalent static velocity pressure at height Z, $\bar{V}(Z)$ the mean hourly velocity at height Z, and G the gust response factor, converting dynamic loading effects into equivalent static pressures, and having the form

$$G = 1 + gr\ \sqrt{B + R}$$

where g = a peak factor, r = a terrain roughness factor, B = a factor reflecting the excitation by background turbulence, and R = a factor reflecting the excitation by turbulence resonant with the structure.

Since V_Z is based on one mile of wind, the total duration of a 90 MPH wind would be 3600/90 = 40 seconds, which can be converted into a mean hourly wind speed by the attached chart (constructed from a statistical analysis of data obtained in strong winds over flat, unobstructed terrain) where F (40 sec) = 1.28 so that $V(30) = V_Z/1.28 = 70$ MPH.

The pressures used in this design, being based upon fastest mile wind speeds, already contain a gust response factor equal to 1.64. This value of G comes directly from the factor of 1.28 used to convert fastest mile wind speeds to mean hourly wind speeds. Since the pressure is directly proportional to the square of the velocity, $G = (1.28)^2 = 1.64$.

4. The horizontal distribution of wind pressure around the tower is obtained from wind tunnel tests and is given in the attached diagram. Integration of this pressure distribution around the tower leads to an equivalent shape factor, which corresponds approximately to the values given for circular cross sections in ASCE Paper No. 3269.

G. Stress resultants from the wind are computed from the membrane theory following the integration scheme introduced by Martin and Scriven in 1961 and later generalized by Kratzig. These results have been shown to be vaid even when bending is included. The attached graphs show the maximums for meridional tension (at θ = 0 degrees) and for meridional compression (at about 0 = 75 degrees) by combining the wind loadings with dead load.

H. Reinforcement is proportioned to take tension in accordance with the specification where the tension force in the shell is computed by combining wind loads with dead loads such that ultimate load capacity of the tower corresponds to an overload tensile force of

$$U = 0.9D + 1.25W$$

where D is N_ϕ for dead load and W is N_ϕ for wind load, the resulting tensile forces are then divided by the steel area obtained from an ultimate steel stress $f_s = \phi f_y$ where $\phi = .9$ and $f_y = 60,000$ psi.

EDUCATIONAL AND PROFESSIONAL QUALIFICATIONS
LOWELL E. ROE
CHIEF MECHANICAL ENGINEER
THE TOLEDO EDISON COMPANY

1. My name is Lowell E. Roe. My residence is 3119 Glenn Street, Toledo, Ohio. I am employed by The Toledo Edison Company, Toledo, Ohio, as Chief Mechanical Engineer.

2. I served in the U.S. Navy from 1943 to 1946 completing the Naval Reserve Officers Training Program at Harvard University in 1945 with the rank of Ensign.

3. I graduated from The Ohio State University in 1948 with a Bachelor of Mechanical Engineering degree. Upon graduation, I commenced employment with The Toledo Edison Company in the Mechanical Engineering Division.

4. In 1951, I was recalled to active duty in the U.S. Navy and released to inactive duty in 1953. I presently hold the rank of Lt. Commander in the U.S. Naval Reserve (Retired).

5. In 1953, I re-commenced employment with The Toledo Edison Company in the Mechanical Engineering Division.

6. In 1956, I was appointed Special Project Engineer and was assigned to the Atomic Power Development Associates in Detroit, Michigan, to work on the Enrico-Fermi Breeder Reactor Project. During this period, I worked on all phases of component test facility design, construction of the reactor system and was head of Test Operations Section for the early non-nuclear testing, including sodium filling and operations.

7. In 1961, I returned to The Toledo Edison Company work in the Mechanical Engineering Division as a Senior Engineer working on the engineering for a major unit addition.

8. In 1962, I was appointed Chief Mechanical Engineer where I am responsible for the mechanical engineering activities relating to the selection, design, and arrangement of power plant equipment. I have also been appointed as Project Engineer for all design and licensing activities associated with the Davis-Besse Nuclear Power Station project.

During the course of this project which commenced in 1967, I have worked with and directed work of consultants in many fields (including radiation safety and environmental protection) and have used material prepared by consultants in preparing or directing the preparation of the necessary design and licensing documents. In this capacity, I have become knowledgeable in many disciplinary areas involved with a project of the scope represented by the Davis-Besse Nuclear Power Station.

9. I am a member of the American Society of Mechanical Engineers, American Nuclear Society, National Society of Professional Engineers, and am a Registered Professional Engineer in the State of Ohio.

DIRECT EXAMINATION

BY MR. CHURCH:

Q Mr. Day, I have just a few additional questions to ask you relating to the evidence which came out during cross-examination by virtue of the Court's ruling on the summary disposition motion yesterday.

In light of the June, 1973, high water level which was above the maximum variation in the monthly level of low water datum of Lake Erie, what practicable or design modifications to this harbor-basin facility are appropriate considering?

A None.

Q Why is that?

A The postulated maximum storm level upon which the petition design is based considers a maximum of three conditions occurring simultaneously to produce this storm level. Those three conditions are, first of all, a maximum monthly long lake level condition being present; when a probable maximum meteorological storm produces a maximum wind HIDE set-up, coupled with a maximum transverse seiche effect which occurs with a wind-tide. As covered in my prepared testimony, the June, 1973, monthly mean elevation was at an all-time record high of 1.81 feet above datum, which was 11/100 foot above the highest mean condition for the station begins.

The wind-tide setup considered for the station design would add 9.3 feet to this elevation and would be caused by a storm with sustained wind exceeding 70 miles an hour during the six-hour period preceding a 10-minute period of winds at 100 miles an hour. Added to this wind-tide setup would be the TRANSVERSE seiche adding one foot in the water elevation coincident with a maximum wind-tide setup.

Q Mr. Boe, assuming that there is a condition of maximum high water resulting from the coincident conditions of maximum monthly mean, maximum wind tide setup and maximum seiche under the maximum meteorological conditions which you have considered for determining the postulated maximum water level for the station design, would you describe what the conditions would be like at Sand Beach, Port Clinton, and in the neighborhood of Toledo, including Toledo, under such conditions?

A Under those conditions there would be a high water elevation in the Davis-Besse site area over seven feet higher than that experienced in November, 1972, April, 1973, while at Toledo it would be over eight feet higher than occurred during these periods. This extreme water elevation with winds between 75 and 100 miles an hour for a period of 12 hours would probably mean that there would be no residential buildings left standing in Sand

If required.

Q Mr. Bain, there have been a number of offered statements which will be introduced by the Intervenors with regard to the erosion events that were experienced this past year in Lake Erie. In one of those statements Mr. Trenchard's testimony is summed, and I quote, "The storms washed large gaping holes in the Toledo Edison dikes along the river. These holes can still be seen." Are there reported holes in the wave protection dikes surrounding the plant or protecting the plant, or were they in the marsh dikes or in some other dikes?

A These holes are in the marsh dikes of the property directly across the Toussaint River from his property. That is Mr. Trenchard's property. This particular property he is referring to is a 100-acre tract of marsh land that runs between our southern site boundary and the Toussaint River, and although owned by the Applicants, is not a part of the site itself. This property was purchased to prevent any development of this property as described in the Final Environmental Statement. There are no holes in the wave protection dike other than areas which have not yet been constructed and there are no holes in the marsh dikes on the site itself.

Q Are the dikes which have the reported holes in them constructed in the same manner as the wave protection dike?

A No, they are not.

Q Will you describe the differences?

A There marsh dikes have been constructed --

Q Which marsh dikes are you talking about, the ones in which the tubes were located, sir?

A This is correct, and the proposed marsh dikes in the area. These marsh dikes have been constructed by using a dragline or clam bucket to pick up soil from alongside the dike and placing it on the dike area. This material is generally dug underneath water levels and is wet and somewhat fluid. After being placed in the dike area, it is generally left to dry out and is then leveled off by a bulldozer or similar equipment. The more productive dike was then actually reconstructed by placing dry earth material, free from organic matter, in layers on top of the undisturbed marsh that has been developed at all top soil. Each layer of material is carefully compacted in accordance with rigid specifications to a specified density. All of this work is subject to extensive quality control and quality assurance requirements. This dike will not be used with a stone filter blanket and large stone riprap as originally with rigid specifications and will be the same level of quality control and quality assurance requirements.

Q Thank you. Now, another gentleman who will be handling testimony for the Intervenors is a gentleman

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named Mr. St. Clair. In his testimony he asserted, and I quote, 'A big field of moving ice could break through dikes in the area; no type of diking would stand up against it.' Is the wave protection dike presently the Davis-Besse site designed to withstand moving ice fields?

A Yes, it is. Ice is present in Lake Erie during the winter months and under strong wind conditions can be blown into the shore area. These ice chunks or floes normally ground themselves in the shallow water and pile up in wind rows out in the lake. Under high water level conditions some ice could conceivably pass over the beach ridge and continue on to the dunbion area over the marsh. The wave protection dike has been analyzed for such conditions and will withstand any effects of wind-drive ice. The ice would in fact ground on the lower portion of the dike, pile up and would serve as further protection for more ice or waves. It is improbable that ice could cross over the intake canal dikes due to the relatively higher elevation of the dikes at the intake canal, being four to five feet above the beach barrier, but in any event, the face of the pump house structure is designed to withstand the full impact force of wind-driven ice.

Q Thank you. Now, a third gentleman whose testimony will be introduced by the Intervenors is a gentleman named Russell Taylor. In his testimony he has stated, and I

feet inland from the beach front and all large waves would be broken in passing over the beach front if the water level is high enough to permit any waves to pass over the beach at all.

CHAIRMAN FARNKOPF: Thank you, Mr. Chernoff. I see a lot of lifted eyebrows, Mr. Rae. Would you kindly explain a little bit more in detail what you mean by riprap design? I know you discussed it a little bit there, but please explain it so people can understand what you are talking about.

WITNESS ROE: The basic dike itself is of clay natural earth material which is on the site and compacted and it makes a very dense and stiff structure, earthen structure in itself. The face is constructed starting out with a wide base and sloping up with a slope of 3 to 1 so that it means that for every foot rise vertically it slopes over horizontally three feet. On the sloping face that faces the lakefront is placed a thin stone filter blanket which permits water to run through it without eroding the material, and on top of that is this riprap material, which are chunks of stone in varying sizes and which, as has been mentioned -- over 75 percent of these stones are from 1000 to -- I forget what I said -- are from 1000 to 6000 pounds in size. That is, the individual chunk of stone which faces the slope and which provides protection to break the wave and to prevent erosion of the wave protec-

when they should.

[illegible] survey, Mr. Chairman, I respectfully should explain and clarify what I maybe did.

MR. CHAIRMAN: I'll apologize in favor of hearing retired [illegible].

We have no further questions.

[illegible] about the retired or tenured [illegible] people that we are in the process of developing a record and how would there arise in the position of helping every single person in developing their best record so long as we can make our best judgment. In the process of developing it there was public member of the public, who didn't understand [illegible] of the procedures, who we can clarify it orally, do there's [illegible] more wise.

MR. SHAPIRO: If counsel will [illegible] questions of the [illegible]. I was just being curious.

CHAIRMAN FRIEDMAN: Thank you, sir.

Does the staff have any [illegible]?

MR. DAVIS: The Secretary would [illegible] questions of Mr. [illegible].

CHAIRMAN FRIEDMAN: Mr. Harris?

EXAMINATION

BY MR. GRAY:

Q Mr. Davis, I did not catch [illegible] what

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respect to the dike. Did you say that it is going to be redesigned and the height of it increased in light of the recent storm?

A No, sir. I said it is not going to be redesigned or increased.

Q So the projections, then, that were mentioned yesterday by the fellow from --

CHAIRMAN RAMSDELL: Mr. Hulman.

BY MR. BARCH:

Q -- Dr. Hulman, the new study and so on, this has no effect on the present dike itself there?

A It is probably 75 percent constructed and now in place. It is not completely constructed, but it is essentially there.

Q As far as height of the dike, has it already been constructed to the presumed height?

A Yes, it has.

Q And that is what figure?

A Elevation 501.

Q Was it at that height during the recent storm?

A Yes.

Q During all of them?

A Yes.

Q The part that is not finished, what is that --

A The dike facing the front of the property. The

Q Or length, if you want to call it length.

A It is the length portion I was talking about where it is not constructed. In other length areas it is constructed to its full height, breadth and with the riprap on it. I would say there would be, judgment, four or 500 feet of it along its length that was not finished.

Q Would you indicate the same amount of flooding would have taken place at the site, had the dike been fully completed at the time of these storms?

A The dike has no relation to the amount of water in the general area of the marsh. The total purpose of the dike, which is raised in elevation from the station grade to its top, is seven feet -- its sole purpose is to provide a protection against the water that would be present during this maximum high water condition for which the station is designed.

Q You provided the Intervenors, I believe, with photographs of the flooding which took place during some of these recent storms?

A We provided all photographs that we had taken since about September of last year. They were not necessarily after any of the storm periods. They were all of the photographs we had occasion to take.

CHAIRMAN FARMAKIDES: Let's take a brief recess of 10 minutes.

(Recess.)

CHAIRMAN DIRKWITCH: We will proceed, please, Mr. Barash.

BY MR. BARASH:

Q Mr. Doe, earlier one of your interrogatories a request was made of the Applicant for photographs to be supplied. I don't know if you were instrumental in having that done.

A Yes.

MR. BIBER: Here's what we've marked Intervenor's Exhibit No. 6-A. Unfortunately, Mr. Chairman, we are going again to run into the same problem. There is only one copy of each one.

CHAIRMAN DIRKWITCH: I'm sure so, I can appreciate the problem and the Board recognizes the problem. Do you have additional copies of these photographs, the Applicant?

THE WITNESS: Yes, with me, sir.

CHAIRMAN DIRKWITCH: Can you get them? Are they available?

THE WITNESS: They are available back in Toledo, yes.

CHAIRMAN DIRKWITCH: Could you kindly, Mr. Charnoff, supply us with an additional ten copies, and send them to me, and I will be sure that the public proceedings

people get a copy and the remaining copy will be for the Appeal Board's record.

MR. CHARNOFF: We may have to make a copy during the lunch break, if you will give us, Mr. Reporter, a record of the numbers of these exhibits that are on the book. Then we will be able to get these.

CHAIRMAN RHINELANDER: All right, fine. Let's proceed, Mr. Baron.

(The documents referred to were marked Intervenor's Exhibits B-A, B, and C, for identification.)

BY MR. BARON:

Q I hand you Intervenor's Exhibits B-A, B, and C, and ask you to examine them and identify them.

A Exhibit B-A is an aerial view of the site and general station area in particular, as is B-B. B-C is an aerial view of the site area itself, more of the surrounding area.

Q These were taken when?

A October 9, B-A and B-B being taken on October 9, 1972; and Exhibit B-C was taken on January 26, 1973.

(The documents referred to were marked Intervenor's Exhibits B-A and B-B, for identification.)

BY MR. BARON:

Q I will ask you to do the same thing with these

view showing portions of this site and surrounding area and it was taken on May 16, 1973.

BY MR. BARON:

Q In preparing the -- let's take Intervenor's Exhibit 8-C, which was the one taken on January 26, 1973, and 8-H which was taken on 5-16-73, and I ask you to take a look in the upper left-hand corner. This is the dike we are talking about, isn't it, the wave protection dike?

A Let's make sure I am oriented. Yes, it is.

MR. CHANLOTT: I am sorry, Mr. Baron. For the record, I think you just said "is this." You are talking about Exhibit 8-C when you are talking about the upper left-hand corner?

MR. BARON: That's correct.

BY MR. BARON:

Q Now, looking at this dike here and comparing it with the dike that appears in Exhibit 8-H, which is a later one in May of this year, it seems obvious that this dike as it appears in 8-C was not completed.

A The portion of the dike you were referring to on 8-C, in particular the area you said that appears not to be completed, you are correct. It is up to final elevation, however, it does not have the stone filter blanket or the large stone riprap on the face of it.

Q Heightwise, though, was it intact?

A It appears that it is up to its full height, yes.

Q So the only thing that was missing from it at that time was, you might say, the barrier earthen which would make it more stable, more durable, more lengthwise?

A Well, it would provide for more and less protection, yes, and protect the foundation dike from any erosion, yes.

Q You mean that although the earthen structure, this riprap, would have been the element that would provide the protection from ice impacts?

A Yes.

Q And what else?

A Large rocks -- massive outlines of large rocks.

Q In D-D, which is a photograph taken January 26, 1972, it appears to this particular dike the dike has been completed?

A You are probably on a totally different portion of the dike.

Q Do you know the date upon which the dike was completed?

A The dike is not complete, as I established earlier.

Q I am sorry. D-D is a photograph taken March 27, 1973, which is straight down.

A Yes.

Q This photograph indicates that the dike is far more complete.

A You are pointing to an entirely different portion of the dike and that one particular portion is complete, yes.

Q There is only one dike that we are talking about, isn't there?

A Yes. We are talking about a dike that surrounds the full fresh face of the excavation area, which is not a full straight line. It does angle back along the intake canal adjacent to the pump house intake structure and then continues on and curves around to the other part of the station.

Q In this photograph which is W-8, taken on January 26, 1973 --

A Yes.

Q It appears that there is water behind the cooling tower.

A There is water beyond the cooling tower from the angle this picture was taken, yes. That is part of the marsh area there. Figures 1 and 2 in my additional testimony -- Figure 1 shows the general site area and Figure 2 shows the wave protection dike and it is labeled several places so that you can get a good idea of the wave protection dike we are talking about. Figure 3 is a partial view of the intake canal and wave protection dike.

(The document was marked Intervenor's Exhibit No. 3-I, for identification.)

Hall

BY MR. MERCU:

Q I don't think this has been shown to you. Do you recognize Exhibit 6-T, marked for identification?

A Yes.

Q Do you recognize what is being the Lotus-Dana, also?

A Yes.

Q Looking at this photograph, does the reference side of the cooling water pipes appear to be rather hard bonded and holded in the white photograph?

A Yes. I did not touch the deposit area of the vessel area that you can actually see here and I might point out to be more specifically that area is also beyond the coolant tubes and that is where it appears to be.

Q So when you are also indicating that these bodies of water which appear in all of these exhibits are mostly permanent bodies of water, water trapping by bodies in the crevice of water chunks?

A They are particulate matter which have a certain level and is quite very by some other factor. They are related to water level temporarily by the presence of species Pleistocene and Holocene. Because it is part of the normal system of the site, it is considered to be important as a natural product. The actual level is rather hard to determine.

Q It appears the photos have been given to have some

Emil

effect upon the levels of these marshes, do they not?

A If the marsh dikes themselves are intact and the water level is below the top of the dikes, they generally have no effect on the water level of the marshes because they are protected from normal water level fluctuations of Lake Erie.

(The document referred to was marked Intervenor's Exhibit No. 3-J for identification.)

BY MR. RAMOS:

Q I am now handing you what is marked as Exhibit 3-J and ask you if you can identify that?

A Yes, this photograph is an aerial photograph of the site area. It is not one of the photographs that was taken by us or presented to the Coalition under request.

Q Do you recognize the marsh that is shown -- the scene that is shown in that photograph?

A Yes, it is the site and general area.

Q Do you recognize it as a fairly accurate depiction of that site?

A Yes, it is.

Q Does the date appear in the upper left-hand corner?

A The date of 11-16-72.

(The document referred to was marked Intervenor's Exhibit 3-K, for identification.)

BY MR. CROSS:

Q I will hand you what has been marked Exhibit 2-H --

MR. CROSS: Also I would like to have identified that are not ours, I think the Defendants will have the burden of calling multiple copies of those exhibits. We don't have additional copies.

COMMISSIONER CLEMENTS: Does it mean that you are going to not object to admitting into the record?

MR. CROSS: Yes.

COMMISSIONER CLEMENTS: All right, so have replied.

MR. WATSON: We will do some work. I assume that the supplying of copies of exhibits that are not literally ours or that they've already identified --

COMMISSIONER CLEMENTS: We will be very liberal on this. We have three days. This is not the beginning and end. We would like to have them identified and then if possible we'll do both.

MR. CROSS: We will make those available.

BY MR. CROSS:

Q I believe I was handing you Exhibit 2-H.

A Yes. Exhibit 2-H is entitled Profit Sharing

amil

principally the immediate area of the building and cooling tower.

Q And again there is a date in the upper --

A Yes, it is dated 11-16-72.

(The document referred to was marked Intervenor's Exhibit 8-L, for identification.)

mmr

BY MR. BARON:

Q How about 8-L?

A 8-L is a general aerial view of portions of the site and surrounding area.

(The document referred to was marked Intervenor's Exhibit 8-M, for identification.)

mmr

BY MR. BARON:

Q And 8-M, which I am now marking? The same question with respect to that.

A Yes, 8-M is another general view showing the marsh areas of the site and surrounding area.

Q Now, those photographs -- the date of these photographs, how does that relate to a storm which occurred in November of 1972?

MR. CHERNOFF: By "these photographs," you are referring to your own photographs?

MR. BARON: Yes, 8-J, K, L, and M.

THE COURT: There was a point that an accompanying high level of water in the area on March 1st, 1972, as there would be this dry bottom.

BY MR. FRED:

Q Now would you indicate the -- the marsh areas in these photographs -- I will withdraw that.

Is appears from Exhibit 1, Photograph 2-1, that the ponds in and surrounded by what you've taken already.

A The areas you were pointing to and the marsh -- part of the marsh right there and the brown pink area which we have previously seen in the other photographs.

Q Now would all of this marsh be more appropriately described as this photograph that we did Exhibit 1-2 by Bunch which is in the record condition, both 1-2?

A Both photographs do somewhat poor quality and I see the marsh areas which I can see on photograph number. There would appear to be water standing in those areas in the general area at which you pointed. The dike pointed in the river, the Intracoastal Waterway that appears one area.

Q And the dike pointed to -- that dike at this land in the upper area of the photograph.

A Yes. See all of that area. The marsh areas of which are here -- all the land area and is known as Bunche Beach Causeway.

Cmil

Q How about in G-N? Is this area immediately to the left of the tower a marsh or is this flooded?

A Yes, that is a marsh area and it has water in it and it is one of the areas that you have pointed to in a number of the other photographs.

Q The wave protection dike, then, is not intended to protect the plant from any of the flooding that might have taken place in November or any of the other storms, is that correct?

A It is not intended to protect the plant from any flooding. The still water elevation associated with the maximum high water conditions which we have postulated -- the November and April high water periods -- some of the site areas which have never been graded up did have water, but that is generally seven or eight feet below the grade of the site itself and the wave protection dike extends up another seven feet in elevation.

So we are talking about wave protection dikes that are 14 feet at the top above the maximum water that was in the area in November and April.

Q You have indicated that this dike was built to withstand the pressure of pack ice?

A I don't believe I used the terminology "pack ice."

Q Well, ice that would accumulate on the lake. Ice that accumulates on the lake in wind ROWS and then might move

Tait

aboveward.

A I said for in the lake it is to be a graveyard will probably spread out in the middle zone, for lack of a density gradient that would prevent circulation of the total volume is submerged. So it will spread in intermediate deep water. So normally it spreads offshore and piles up in wind RWS

If there is extremely high water elevation rise could considerably cause air to the beach edge, but you would probably have to have water elevation approaching one hundred centimeters for this to happen.

It certainly could happen with the triple barrels of November or April.

Q If it did, would the obstructions for dust

A I have --

Q The ingress of the dust

A -- we physically wouldn't have to be equipped to withstand such ice.

Q The above family of questions previously that you have indicated in an answer to one of the interrogatories will withstand the erosive action of the waves.

A Yes.

Q What was the approximate life of structures that would be very heavy? To that end, your considered knowledge as to how long these things will last?

A The general design that is used for the fifty

Omil

is to withstand waves as they occur for an extended period of time. The design criteria is based upon a shore protection criteria which generally is exposed to waves essentially all the time, of course, of varying heights and intensity.

Q What provisions do the applicants have in mind with regard to maintenance of this dike? Is this something that they will do on their own or is it part of the contracted out job?

A I would like to make it clear. This is an earthen structure with stone and large stone segments on it. It is never anticipated that the water level under any normal circumstances, including those of November or April, would ever reach this wave protection dike and therefore there is no maintenance involved with it.

Q What proof is there based upon actual operating experience that such a designed dike will actually perform as expected?

A The design criteria for the dike, as I mentioned, was taken from the Corps of Engineers bulletin, the R-4, which is an extensive design bulletin for structures of this kind, and as I also mentioned, it is for shore protection areas which are exposed continuously to the water action and the Corps of Engineers have established this criteria over a number of years of experience.

So I would say there is extensive proof and

Dwil

experience to prove the design of the dike.

MR. BROWN: Mr. Chairman, I am having to confine myself within very narrow limits with respect to the cross-examination and it is necessary to this line here, so if I step out of this, forgive me, but certainly.

I want to ask a question now with respect to the barge channel.

CHAIRMAN HOLLINGSWORTH: All right, proceed. If we hear an objection, we will rule on it.

BY MR. BROWN:

Q In your evaluation of the November 10 - 11, 1972, storm which appears on page 5 and 6 and 7 and starting at 5, you don't make any mention of the fact that the barge channel was opened to Lake Pontchartrain which here already had access to the west portion of it through the barge channel.

The simple question is: Is there a reason why this was not included in the evaluation of the November, 1972, storm?

A I should point out, however, that the fact that the barge channel, as you refer to it, is open, that the intake channel, which is designed to [illegible] into the lake, is nothing more than what had existed and will be opened to during normal operation. The [illegible] was opened to [illegible] while still we had the levee in its then size.

10:11 Under construction now are submerged pipes from an intake offshore that will terminate within the bench area of the intake canal, but the intake canal will be exposed to the same water level conditions of the lake. So what the intake canal and all the way up to the barge unloading facility and the face of what is not the wave protection dike, but the face of the intake canal dike, which is also riprap, was exposed to in November under normal conditions, it will be exposed to from now on.

At no time was the wave protection dike exposed to it because the water level was never up to the base of the wave protection dike.

MR. BRAUN: I think we will be concluded with this cross-examination if we may have a brief off-the-record conference.

CHAIRMAN FARRINGTON: All right.

(Discussion off the record.)

BY MR. BARR:

Q Mr. Ben, one question.

Is there any similarity in the materials used in any aspect of the construction of the wave protection dike to materials used in any aspect of the foundation of the cooling tower with fill, shall we say?

MR. CHRISTMAN: I am going to object to that on the grounds of relevance, Mr. Chairman.

16mil that would have required outwardly towards you, it would have known.

Q So your knowledge, was anything like that reported to you?

A For the wave protection dike?

Q For the wave protection dike.

A None whatsoever.

MR. BIRCH: That is all the questions.

CHAIRMAN HARRINGTON: Thank you.

Any questions redirect?

MR. CRAWFORD: Yes.

REDIRECT EXAMINATION

BY MR. CRAWFORD:

Q Mr. Roe, there were a number of pictures shown to you with respect to flood levels in the general area during storms of late fall and early spring of 1973. During any of those storms, including the high water reached during June of 1972, did any water ponds rise above through any of the incomplete portions of the dike, and secondly, even if the dike were not there, would any of that water have reached the site of the plant?

A Definitely not. The maximum water level at the site on any of these periods was seven feet lower than the weather grade itself, so even in areas where the dike is not constructed, it would have no effect on additional seven feet

Q So in effect, none of the high water levels recorded in Lake Nale during the last year have even reached the foot of the dike, of the wave protection dike, is that correct?

A Generally correct. On the one side it does extend almost down to the marsh level, but it is 15 or 16 feet down from the top I would say it is not reaching the full height.

Q Thank you.

Would you say that the requirements for a dike of this sort, even given the maximum of the high water levels that we talk about, is illustrative, if you will, of the general conservation of the design for the plant?

A I think it is an excellent illustration of the conservative design of the plant and really of the design requirements that this station or any other station has to abide by to satisfy all the safety requirements. It is a dike that will never see water against it under any normal situation and the storms of the past months have been -- have had some of the most severe water level conditions that we have ever experienced in the area. It is strictly for protection against this one probable maximum event which in fact will never happen, but which is conceivable that it could happen.

Q Now, all of the water bodies that were set forth in the Intervenor's pleadings, the photographic exhibits,

received some questions on it and some of them were pertaining to the storms of November and it was specifically November at that time because we had not had the --

MR. KNOWLES: Pardon me, Mr. Lee. Did you mention your application for an operating license?

THE WITNESS: Yes, I did.

MR. KNOWLES: You said construction permit.

THE WITNESS: Thank you. So that we have had those questions. It is in response to verify the model program for a storm that would produce high wind-tide setup conditions in the lake.

Q Is your consultant preparing answers to the NRC questions?

A Yes, they are. They have been working on this.

Q Have they completed their data production yet, sir?

A No, they have not. They have a good share of the information, including meteorological information which has been most recently received.

Q Have they given you any preliminary indication as to what the likely impact of such additional data is likely to be on the determination of the probable maximum flood?

A Yes, they have said that from their initial work they see nothing that would indicate that there would be any changes in the maximum wind-tide setup.

MR. CHAIRMAN: Thank you very much. I have no further questions.

Counsel opposite? Mr. Fairbairn, Mr. Lamontagne? Mr. Bureau?

Mr. Dunlop?

MR. DAVIS: No.

MR. ORF: Mr. Chairman, I would like to hypothesize a circumstance. Suppose the plaintiff was employed and working during recess in the hall of the school and the fixer came in there through negligence as they were in the last few months. Would that be any different than I hazard to the employee as well to attribute a safe character from liability?

MR. MARTIN: Mr. Chairman, if the plaintiff had been operating normally we would not have received a compensation permit.

MR. CHAIRMAN: An interesting theory, Mr.

MR. ORF: I'm saying that I can't always give you a hypothetical situation.

MR. CHAIRMAN: Sure it is very hypothetical.

MR. ORF: Would there be any liability or any duties to the other pupil to prevent an officer a more serious, any fight or what?

MR. CHAIRMAN: No, that is the question we have to decide. We could not be expected to foresee every move of the

ar5 reach the site area.

CHAIRMAN FARBSTEIN: Thank you.

(Witness excused.)

CHAIRMAN FARBSTEIN: Can we finish Issue No. 2? I think the Intervenor had some direct that he wanted to introduce.

MR. BARON: Mr. Chairman, through the cooperation of the court reporter last evening, we have made copies of the written testimony that was presented by the various people living in the area to which Mr. Chernoff has made some allusion this morning. I haven't been able to put them back together. He gave them back to me this morning and I didn't have a chance to get them all together.

CHAIRMAN FARBSTEIN: What do you intend to do?

MR. BARON: We are going to offer them in evidence.

CHAIRMAN FARBSTEIN: Can we do so now, and during the luncheon recess distribute them?

MR. CHARNOFF: Are those the same letters and documents that we received about two weeks ago? The Applicant has no objection to their introduction into evidence as if read and we have no cross-examination of the witnesses.

MR. BARON: That is what it is.

MR. DAVID: The same proviso, if there are in fact the same letters.

CHAIRMAN FARBSTEIN: Mr. Baron has assured us

[illegible] every way, and I believe that accurate.

MR. [illegible]: We have no [illegible] questions.

CHAIRMAN [illegible]: [illegible]?

MR. [illegible]: I will [illegible].

CHAIRMAN [illegible]: We will assign that material and you can offer it as you will. Mr. Brown.

MR. [illegible]: I wish to refresh my recollection. I think I did have, at my office [illegible], a copy of a letter dated July 10, 1972, from the U.S. Senate Select.

MR. [illegible]: That's right. I have read the documents that you have. Is [illegible]? You will you assume to be --

CHAIRMAN [illegible]: It would [illegible] to Mr. Dorsen?

MR. [illegible]: [illegible] that it also included in this, along with the letter [illegible] of the memo.

MR. [illegible]: Yes. I think those are the documents.

MR. [illegible]: May these [illegible] green booklet, Mrs. Mortenson, [illegible] to them [illegible].

MR. [illegible]: Yes.

MR. [illegible]: That's only [illegible] copy, so we can offer that as an exhibit to [illegible].

MR. [illegible]: [illegible], [illegible] and [illegible]

ar7 to the admission of both of those documents into testimony as well.

CHAIRMAN PARSONS: Mr. Davis, would you also stipulate?

MR.DAVIS: I would like one minute, please.

CHAIRMAN PARSONS: All right.

(Discussion off the record.)

CHAIRMAN PARSONS: Let's go back on the record. Mr. Davis?

MR. DAVIS: Mr. Chairman, the Regulatory Staff has no objection either to the introduction of the Coast Guard document or letter or the booklet that Mr. Baron referred to here earlier as Exhibit 2.

CHAIRMAN PARSONS: All right, Mr. Baron.

MR. BARON: Then I would offer at this time at least into the record two letters from two residents of the area, a letter dated July 10, 1973, from the United States Coast Guard to Dr. --

CHAIRMAN PARSONS: We have that, sir, so there is no need to read that.

MR. BARON: Then we rather than.

CHAIRMAN PARSONS: Fine. The parties have stipulated that the parties have exhibits of this package of letters, consolidating two that we received, or the Intervenor. They will be so received.

(The documents follow.)

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

Address reply to:
COMMANDER(or)
Ninth Coast Guard District
1240 East 9th St.
Cleveland, Ohio 44199

3440
10 July 1973

Dr. Owen Davies
13436 Harlon Ave
Lakewood, Ohio 44107

Dear Dr. Davies:

In response to your letter of 12 June, the following information is provided.

During the storm of 13-15 November 1972, three Coast Guard units were actively involved in the evacuation of personnel in the Sandusky area. Boats from Coast Guard Station Sandusky evacuated 15 persons from Cedar Point upon request from the Sandusky Police. Time from initial notification to completion of all evacuations was one hour and 22 minutes. Station boats continued to patrol the area for an hour and 23 minutes in search of any other stranded persons. At the same time, Coast Guard Station Marblehead received reports that Civil Defense personnel were unable to reach stranded personnel in the Locust Pt/Turtle Creek area with an amphibious DUKW. Upon determination that Coast Guard boats could not safely reach the distressed persons, two Coast Guard helicopters from Coast Guard Air Station Detroit were dispatched to the area, and evacuated 49 persons. Time from notification to arrival on scene was one hour and 16 minutes; total time for the evacuation was 3 hours and 41 minutes.

During the storm of 17 March 1973, numerous Coast Guard forces were alerted or dispatched. At 0930, Coast Guard Station Marblehead was requested by the Ottawa Co. sheriff to assist in the evacuation of stranded persons in the Sand Beach area. Although the Station itself was experiencing flooding, forces were dispatched. Back-up boats and vehicles were dispatched from Coast Guard stations Sandusky and Cleveland Harbor. Coast Guard Air Station Detroit was alerted for possible operations, and a 180' cutter in Detroit was placed on immediate standby status. At 1455, Station Marblehead advised that 14 persons had been evacuated from the Sand Beach/Turtle Creek/Locust Point areas, and that Coast Guard assistance was no longer required; back-up forces were subsequently released to their parent units, having been immediately available but never actually required.

No information is available on Coast Guard participation in Flood Relief efforts consequent to the storm of 8-11 April, 1973 in the Sandusky area.

It should be noted that Coast Guard participation in these operations was a direct result of Coast Guard statutory obligations to take immediate measures to protect endangered life and property whenever possible. These operations were not requested through normal channels for seeking Federal Disaster Relief, and in no way relieve local or State governments from their obligation to take all possible measures to render aid to endangered persons in their area.

Normally, a local government's first source of additional relief should be the State government; only when all resources reasonably available to the State and local governments have been committed to the effort can the Governor request to the Regional OEP Director that his State be declared a Disaster Area; if, on recommendation of the OEP Director, the President delcares a disaster, then Federal forces will be dispatched. In each case cited above, State forces were avialable which had not been brought to bear (e.g.: National Guard helicopters and ground forces); in addition, had the situation been more exigent, extensive additional Coast Guard resources, including aircraft, large cutters, and numerous rescue boats and other small craft would have been immediately available.

The information cited above is certified to be a true and correct summary of information available in our files.

A. C. PEARCE
Captain, U.S. Coast Guard
Chief, Operations Division
By direction of Commander,
Ninth Coast Guard District

ANNEX 1

WEATHER/GEODESY/HYDROGRAPHY

GENERAL

Lake Erie's water level has historically varied in high and low water cycles. The level is primarily dependent upon the rainfall in the Great Lakes Basin. Over a long time period the amount of rainfall in the total Basin causes the high and low variation. (This variation has been recorded since 1860.) Over a short period, the rainfall in Lake Erie Basin itself has the major effect. At the present time, Lake Erie is at an all time high of average water level between 4 and 5' above Low Water Datum (LWD) (568.6). Lake Erie also has an annual variation with the low normally in December and the high in June. It is predicted that the 1973 high in June will be 5 feet above LWD.

Lake Erie lies on a NE-SW axis. When the general wind is from the W, the water is blown to the east end of the lake which rises with a resultant fall around Sandusky. When the winds blow from the E or NE, water is piled up at this end of the lake. The water in the Sandusky Area will rise 3 to 4 feet because of the wind effect. The greatest difference between Buffalo and Toledo has been over 13.5. When the NE winds blow at 40-60 knots over the 250 miles of lake expanse, they can produce 10-13' waves added to the high water level.

SPRING 1973

This spring this area has the highest recorded water level in the lake history. The impact of what is locally known as a 3 day Northeastern will add 3-4' to the present water level plus the damaging wave actior These factors combine to give this area a potential f
and erosion.

All low lying
addition the wa
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Copy

13436 Harlon Avenue
Lakewood, Ohio, 44107
June 12, 1973

Commander (DPI)
9th Coast Guard District
1240 East 9th Street
Cleveland, Ohio, 44199

Dear Sir:

Newspaper accounts indicate major problems resulting from severe Lake Erie storms of Nov. 13 - 15, 1972, March 17, 1973, and April 8 - 11, 1973 in the areas between Fort Clinton, Ohio and Magee Marsh, on Lake Erie. These accounts indicate that major problems were encountered in the evacuation of people from the area, especially from Sand Beach, due to flooding and adverse weather conditions.

We would like official verification of the means employed for these evacuations, and an estimate of the time required to accomplish the evacuations under the adverse weather encountered.

This information is to be used in upcoming hearings on the proposed Davis-Besse Nuclear Power Plant. This information has a bearing on safety of operation of this plant in the light of unpredictable and major Lake Erie storms. It also has bearing on the applicants' ability to evacuate the area in case of a breakdown caused by storm or accident.

Since the information is to be used in hearings, it is necessary that we have certification that the information supplied is a true and correct copy of the information in your files.

Very truly yours,

Dr. Owen Davies

UNITED STATES OF AMERICA
ATOMIC ENERGY COMMISSION

Before the Atomic Safety and Licensing Board

in the Matter of	)	
	)	
THE TOLEDO EDISON COMPANY and	)	Docket No. 50-346
THE CLEVELAND ELECTRIC ILLUMINATING COMPANY	)	
	)	
(Davis-Besse Nuclear Power Station)	)	

STATE OF OHIO	)	
	)	SS
COUNTY OF ERIE	)	

TESTIMONY FOR DAVIS-BESSE HEARING

I, Russell o. Taylor, residing at 2033 Cedar Point Roadway, Sandusky, Ohio, 44870, being first duly sworn on oath, depose and say that the following statements are true and correct to the best of my knowledge and belief:

Observation of Severe Weather Conditions on Lake Erie at Cedar Point and Vicinity

By Russell O. Taylor

A storm struck on November 14th and lasted two full days, the first day the waves reaching a height of eight feet. Lake Shore property owners suffered extensive property damage.

I had a seawall of rip-rap stone on the lake side of my property that was leveled in the first three hours of the storm. Three lombardy poplars approximatly 70 feet in height collapsed because the soil had eroded from the root systems.

The pressure from the water level increase has cracked the floor of my basement and water seeped up on to the floor. The longest of the separations is about 1/8 inches wide and 10 feet long. The thickness of the cement floor is 6 inches. After the storm ceased and the water level went down the seepage drained back out the cracks.

I have a dock on my property extending southwesterly from the Cedar Point pennisula in a cove that is in the lee of northeasterly wind velocities. This dock normally is 3 1/2 feet above the water surface, during the storm it was 1 1/2 feet below water surface.

Describing damage other than personal damage, the waves had accumulated sand on the road 2feet deep in some places. Residents between the 400 and 600 blocks had sand 2 feet deep on their lawns which had to be removed with hydraulic shovels. There were telephone poles that washed up in peoples' yards.

A total of about a half mile of road was partially washed out. Only in a few places was the road totally washed away so that no traffic could pass. In one particular section half the road was caved in for 300 yards. Automobiles were crossing residents' yards to avoid falling off the six foot drop.

There was an incident where the road caved in and broke a natural gas line. It was hours before this problem was corrected.

The far southeast end of the penninsula has always had a seawall of limestone rock. The damage experienced by these residents was that when the waves would strike the wall the tremendous force of the waves cast loose rock from the seawall up into their yards. Many residents had their front lawns covered with limestone 1/2 foot deep.

I remember from November through June, three different stone companies dumping reinforcement limestone along Cedar Point.

The Sandusky Water Department had both of their filtering basins totally clogged. The filtering apparatis consists of two fixed screens. It is set up so that in a normal situation while one screen is clogged and is being cleaned, the other filtering basin can be used. The screens are cleaned by draining the basin, a man removes the solid debris with a shovel

then the basin is refilled. This is a process that is completed in an hour at a hastened rate.

"During this November storm," a water department foreman told me, "there was so much debris that both screens were clogged within 20 minutes." The clogging matter consisted of vines, live fish, and mostly large, heavy textured poplar leaves.

Sandusky was without water for a few hours until the water department switch to a N.A.S.A. water supply refilled the settling basins.

Since the November storm there has not been a great deal of wave damage that I know of, but there has been a considerable amount of flooding. The flooding has made roads impassable, homes uninhabitable, and a great percentage of boat owners have had the catwalks in their boathouses underwater. Being submerged, may cause the wooden catwalks to rot and produce a risk of falling through. Muck settles and moss grows on the catwalks which makes them slippery to walk on and also poses a risk of drowning.

Sworn to before me and subscribed
in my presence the 12th day of
July, 1973

Notary Public

HELEN C. SMITH

UNITED STATES OF AMERICA
ATOMIC ENERGY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
THE TOLEDO EDISON COMPANY and	)	Docket 50-346
THE CLEVELAND ELECTRIC ILLUMINATING COMPANY	)	
	)	
(Davis-Besse Nuclear Power Station)	)	

STATE OF OHIO)
) SS
COUNTY OF Ottawa)

Josua H

TESTIMONY FOR DAVIS-BESSE HEARING

I, George Ogden Trenchard,
residing at Toyssaint Fur Farm, R.F.D.#1, County Road 19A, Oak Harbor, Ohio
being first duly sworn on oath, depose and say that the following statements are true and correct to the best of my knowledge and belief.

I have 4/5 mile frontage on the south side of
the Toussaint River directly across from the
Toledo Edison property on which the Davis-
sse plant is located. I was at home during
e November, 1972, March, 1973, April, 1973,
d June, 1973 storms, In the main farm
use on my property, there was 2 1/2 feet of
ter in the basement as a result of each of
se storms.

During the storms I saw the water level
the Toussaint River rising due to stiff
e winds. When the winds shifted, the
te stopped rising and slowly began to
ede. If the winds had not shifted, the
ding would have been far more than it
s. Water would have gone to a higher
vel.

The Lake Erie water levels are still above
hat would normally be expected at this
ne of year.

The water level was roughly the same on
ll four of the storms.

During the storms, water went over my dikes facing the river and over the Toledo Edison dikes, facing the river. This happened on all the storms. The storms washed large gaping holes in the Toledo Edison dikes along the river. These holes still can be seen.

Winds blew a leak in my roof. Most of my fields flooded so that there was one to 2 feet of water in them. I have a steel bridge crossing Beaf Creek on my property. This is about 250 yards west from County Road 24. The wooden deck was swept away from the bridge in the November storm. I put it back on but it washed away again in the March storm.

Water was one to two feet deep on roads near me; they were impassable. These included County Road 104 between Toussaint River and Route 2; County Road 23 between Ohio 2 and county Road 24;

and the northern 1/3 mile of County road 24. All these roads were flood too deep to travel.

After the winds shifted in the three Spring storms, my son-in-law's sailboat with heavy anchor (400 lb. stove) on it was blown down the river about 1/3 mile. There was no sail up on it any of those times.

At the Clubhouse at the Toledo Edison marsh, it was necessary to build a four to five foot dike around the house to protect it from the high waters of the storms.

I have lived here since March, 1956. I have never seen anything like these storms previously.

Harry Dyson Townsend

Signed and sworn to before me this 9th day of July, 1973

HARRY W. SHAW
NOTARY PUBLIC OTTAWA CO.
MY COMMISSION EXPIRES 4/5/76

Harry W. Shaw

UNITED STATES OF AMERICA
ATOMIC ENERGY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
The TOLEDO EDISON COMPANY and	)	Docket 50-346
THE CLEVELAND ELECTRIC ILLUMINATING COMPANY	)	
	)	
(Davis-Besse Nuclear Power Station)	)	

Josue II

STATE OF OHIO)
) SS
COUNTY OF Ottawa)

TESTIMONY FOR DAVIS-BESSE HEARING

Mabel Wilkins,
residing at 4385 North Rider Road, Oak Harbor, Ohio
being first duly sworn on oath, depose and say that the following statements are true and correct to the best of my knowledge and belief.

I have lived on North Rider Road approximately 5 years. I have never seen storms and flooding in this area like ~~those~~ that occurred in November, 1972, March, 1973, April, 1973, and June, 1973. I was at home for all four of these storms. I was not evacuated during any of them. During the November storm North Rider Road and County Road 223 were flooded completely to knee depth. The road was impassable during the other three storms also, but the water level was not quite so high with them.

Since November, 1972, the Lake Erie water is at a higher level than previously, especially this spring and summer.

In addition to these four NE storms and floods, there have been many severe thunderstorms this year. There have been more thunderstorms this year than usual and these thunderstorms have been more severe

than usual.

During the four floods my home was on an island. At no time the 8 inches depth of being flooded in the November storm. It is approximately 6 inches above road level.

In the November, 1972 storm, the strong N.E. winds blew continuously at least 36 hours here.

[redacted]

Signed and sworn to before me this 7/9/73 day of July, 1973

HARRY W. SHAW
NOTARY PUBLIC OTTAWA CO.
MY COMMISSION EXPIRES 11/31/76

Harry W. Shaw

UNITED STATES OF AMERICA
ATOMIC ENERGY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
THE TOLEDO EDISON COMPANY and THE CLEVELAND ELECTRIC ILLUMINATING COMPANY	)	Docket 50-346
(Davis-Besse Nuclear Power Station)	)	

STATE OF OHIO)
) SS
COUNTY OF Ottawa)

TESTIMONY FOR DAVIS-BESSE HEARING

I, Lloyd St. Clair,
residing at Toussaint Shooting Club, Oak Harbor, Ohio
being first duly sworn on oath, depose and say that the following statements are true and correct to the best of my knowledge and belief.

I was at home during the November, 1972, March, 1973 and June, 1973 northeast storms.

There are 1800 to 2000 acres of marsh land here at the Toussaint Shooting Club. There are about 6 miles of sand beach and Carlton dikes at the club. These will need to be rebuilt because of damage from the storms. There are now four breaks through in the lake beach as a result of the storms. As a result the marsh now is at Lake Erie level.

I have lived here about 50 years. The level of Lake Erie now is the highest I have ever seen it.

As a result of the November storm, the water backed all the way up to my home. There was 30 inches of water inside my brother's home. It is located about 200 feet north of mine. To the east, north, and west of me in the November storm, I could see water in all directions. I stayed home throughout the flood.

The nearby county parks had approximately 30 inches of water covering them. Some boats floated back into the woods about 300 feet from where they had been tied.

There is a dense beach, then a marsh, then a dike in front of my home. I could see water from my home. The dike never broke on me.

submerged about one foot in depth in the Pamlico Sound.

The first storm came up very suddenly. The water, sand came across on Ocra 100 feet from where it had been to a depth of about 1 foot in a 15 minute period.

If a northeast storm with 30 mph winds or lasting at least a day with the tide as high as it normally is, the flooding that would result would be sufficient to cover most of Ocracoke Island after each of these storms, however, winds at a higher speed can possibly do the same thing in a shorter period of time.

In the past 3 years there have been 3 northeast storms in this location lasting 5 days. I hope we do not have one of the northeast storms during this

under the action of wind. There is [illegible] and obstruction on the site. Also [illegible] moving we could [illegible] the area [illegible] against it.

Sworn before me

Signed and sworn to before me this 9th day of July, 1973

HARRY W SHAW
NOTARY PUBLIC OTTAWA ON
MY COMMISSION EXPIRES 31/5/76

Harry W. Shaw

UNITED STATES OF AMERICA
ATOMIC ENERGY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
THE TOLEDO EDISON COMPANY and	)	Docket 50-346
THE CLEVELAND ELECTRIC ILLUMINATING COMPANY	)	
	)	
(Davis-Besse Nuclear Power Station)	)	

STATE OF OHIO)
) SS
COUNTY OF Ottawa)

Joint II

TESTIMONY FOR DAVIS-BESSE HEARING

I, James Green,
residing at 6450 North Russell Rd, Oak Harbor, Ohio,
being first duly sworn on oath, depose and say that the following statements are true and correct to the best of my knowledge and belief.

I have lived in this general area all my life. (about 44 years). North Russell Rd, runs north from Route #2 toward Sand Beach. I was at home during the Nov. 1972, March 1973, April 1973 and June 1973 storms.

There was flooding on North Russell Rd. during these Northeast storms. It was impassable for automobiles but I was able to get out with tractor or truck. There was approximately 1½ feet of water across the road in various locations on all the storms. There was no more than 6 inches difference between any of the four storms. There was water around my home to a depth of about 4 inches up from the base of the foundation for each of the storms.

The maximum water level there at my home stayed only about 1 to 1½ hours. The water level then slowly receded.

I went along State Route #2 two days after the November 1972 storm and observed much water in the fields resulting from the flooding. I even found some on Route #2 itself. Route #2 was barely passable on Nov. 16 for automobile traffic.

Route #2 was closed to traffic on my property also
in the April storm. There were bridges and culverts
across Rt #2 on both occasions. There was
flooding in November and April on Duff Lake Road
Road east of Rt #19. Route #19 was impassable
between Duff Lake and Route #2. I drove
through these areas in a pick-up truck. Some
cars stalled in these areas on both occasions.

I have never seen storms with just
much flooding in this location. With these
storms there was at least one and a half
feet more water.

I have seen worse North East storms in
the past. Winds blew longer and at higher
velocities but since Lake Erie was the water
lower level the flooding was not as severe.

In the April storm the winds were
strong for only a short period. The winds (
picked up at around 3:00 P.M. on April 6th
then switched direction at around 9:00 P.M.
The wind switch prevented high water flooding.
The flooding would have been much worse
if the winds had continued from the NE for
a longer period.

Dave Greene

Signed and sworn to before me this 9th
day of July, 1973.

HARRY W. SHAW
NOTARY PUBLIC OTTAWA
MY COMMISSION EXPIRES 31/3/74

Harry W. Shaw

Emil

CHAIRMAN PARSONS: I think the Intervenor has an exhibit to offer at this time.

MR. BARON: In addition to the photographs we have already mentioned, as Exhibits -- we will try to solve the problem of copies. Applicant has indicated they will make additional copies of their photographs, is that correct? These are as exhibits?

CHAIRMAN PARSONS: I prefer the photographs be exhibits.

(Discussion off the record.)

CHAIRMAN PARSONS: Mr. Baron, I assume, then, you will offer the photographs into evidence as well?

MR. BARON: That's correct. I will offer Exhibits 8-A through 8-H. Also the green book, Mr. Chairman, which would be Intervenor's Exhibit No. 9.

MR. CHERNOFF: It would be helpful, Mr. Baron, if you would identify the name of the green book.

MR. BARON: It is Information Circular No. 89 entitled, "The November, 1972, Storm on Lake Erie," authored by Charles W. Cartor, published in Columbus, Ohio, 1973.

CHAIRMAN PARSONS: I assume there is a stipulation as to that as well?

MR. CHERNOFF: Yes, sir.

(The document referred to was marked Intervenor's Exhibit No. 9, for identification.)

[illegible] CHAIRMAN VANDENBERG: They will be numbered Avco exhibits as exhibits of Interrogatories.

(The documents referred to, heretofore marked Interrogatories 2-1 through 2-4, and 3, for identification, were received in evidence.)

CHAIRMAN VANDENBERG: Is there anything further on Issue 2? This, then, completes the testimony on Issue 2.

Now, you had something else, Mr. Tarrant?

MR. TARRANT: It is the testimony of Mr. Strauglass with respect to Issue 3.

CHAIRMAN VANDENBERG: Yes, sir.

MR. ARNOLD: It was not offered yesterday. We will not have the facility of making it copies, so I would like to offer it as an exhibit. We discussed it, but it wasn't put into the record. I would like to offer in duly evidence now.

CHAIRMAN VANDENBERG: Any objection to its receipt into evidence? Mr. Chamoff?

MR. CHAMOFF: No, sir, but I am a little unclear. We did study the references -- or, the memo is accepting it subject to the consideration of the references in 1 and 2 as furnished yesterday.

We have no objection.

CHAIRMAN VANDENBERG: Mr. Davis?

Jail

MR. DAVIS: None.

CHAIRMAN FASSMIKIDES: It will be so received.

(The document referred to, heretofore marked Intervenor's Exhibit No. 7, for identification, was received in evidence.)

CHAIRMAN FASSMIKIDES: We will recess for lunch. We will reconvene at 1:30.

Gentlemen, we will proceed at that time with Issue 5, Issue 6, and we will allow time in the afternoon, then, to complete Issue 1 as soon as the Staff's witness comes in.

(Whereupon, at 12:30 p.m., the hearing was recessed, to reconvene at 1:30 p.m., this same day.)

[illegible]

[illegible]

matters outstanding that I would like to conclude. One is the stipulation that I assume you have all looked at; has the Applicant looked at it?

MR. CHURCH: I haven't seen it.

MR. BARON: It has been a slower process than anticipated, but it is about ready to be presented and I assume will be available before the conclusion of the day's hearing. I don't know how rapidly they will be able to look through it, though. It is quite extensive.

CHAIRMAN FARQUHAR: That may well defeat the purpose of the whole thought.

MS. STERLING: A good deal of this, I think, they could look through very rapidly.

CHAIRMAN FARQUHAR: Is that a stipulation that you have in your hand?

MS. STERLING: That is it.

CHAIRMAN FARQUHAR: I think we have misunderstood what we are talking about. Mr. Baron, during the day we will recess at some point and rather than taking 10 minutes, we will take 20 minutes and please get together with the Applicant and see what you-all can work out. That pile looked like it was three inches of material, and it is not what I consider a stipulation. I am sure the Applicant and the Staff feel the same way.

So think it should -- I hope you will all get

together and discuss it. If you cannot conclude it with --
I want to consider that issue and may be troubled, and I want
a decision before this Board.

Let's go to the new issue to have discussed
earlier, the potential schedule, that Board finds that we
do avoid conflict Friday, there is no reason why we cannot have
the new issue argued if not resolved the 7th. Is agreed. We
have all agreed on that.

How much time do you need to exchange your
direct before this Board? It would seem to me the
parties can again exchange themselves as they have in the
past and they can handle it among themselves. What you
agree on a schedule and a procedure and come to us with it.

Then the last item, Mr. Bacon, with respect
to your request for an opportunity to rebut the testimony
of Dr. Bulgarin. Have we agreed on that? We would like
to have a general idea from you, a proposed date from you,
so to which that will be submitted, etc. and we would like
to have the paragraphs, as we said earlier. I would like
to have this presented to us sometime this afternoon before
we break.

MR. CRAVEN: If I understand your
idea that is -- would be before the 4th of August?

CHAIRMAN FARMAKIDES: Tuesday.

MR. CRAVEN: Yes.

ar1 CHAIRMAN FARKUHDES: I think that was understood this morning, Mr. Baron. Is that correct?

MR. BARON: Of course.

CHAIRMAN FARKUHDES: Those are the preliminary matters I wanted to discuss on the record before we proceeded to the Staff's case for Issue 1.

MR. DAVIS: I would like to introduce two attorneys, Mr. James Rowell[illegible], on my left, and Mr. Glen Orman on his left, attorneys for the Federal Power Commission. They would like to present the direct testimony of Mr. Dennis Nightingale on Issue 1.

CHAIRMAN FARKUHDES: Are they ready for cross or what did you wish to do at this particular point in time?

MR. DAVIS: Mr. Baron had indicated that he did have some cross-examination. That is the reason that Mr. Nightingale is here. Otherwise, the stipulation could have been entered into to have the testimony taken on the record. Whereupon,

DENNIS NIGHTINGALE

was called as a witness on behalf of the Regulatory Staff and, having been first duly sworn upon oath, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. ORMAN:

Q Will you please state your name and occupation?

MS

[illegible] Nightingale, 815 North Capitol Street, Washington, D.C. I am previously employed by the Federal Power Commission in the Bureau of Power.

Q Mr. Nightingale, have you prepared or caused to be prepared a written form of your testimony to be presented here today?

A There is one here, sir.

Q Is this a copy of your prepared text?

Is the document that I have handed you a copy of the testimony which you have prepared for submittal in this proceeding?

A Yes, it is, sir, with minor changes to be.

Q Could you please read into the record at this time any changes or corrections which you care to make?

A All right. On page 2, paragraph 3, second sentence, the last word is misspelled. It should be "alternatives."

Page 7, continuation No. 7, it should read "twenty milliseconds applicable."

On page 9, the first sentence, there should be a space between "them" and "is."

In the here numbered on the first paragraph, "manufacturers" should have an "s" in it.

In the second paragraph, the fourth sentence down, it should read "possible increase in our system losses."

ar6

DR. HAND: You probably mean line. You have been saying sentences.

THE WITNESS: Thank you, sir.

On page 6, it should read "they are usually more efficient and cost less to operate per unit of power produced."

And the next sentence should be "the savings in expenditures can be passed on to the utility customers."

The list down there in item 2, the third one, refrigerator is misspelled.

The next one is on page 10. The last part of the first paragraph should say "summer of 1978."

On page 14, the ninth line from the bottom, it should be "of existing buildings etc."

On page 18 in the second paragraph, the second line should have a period here that SOLP.

On page 21, in the next to the last paragraph, "occurrences" is spelled wrong. It should be two Rs.

On page 23, the first sentence should start "as stated previously," comma.

On page 33, at the end of the first paragraph, it should read "nuclear additions and at what output."

DR. HAND: What is the change?

THE WITNESS: The word "at" should be included.

On page 34, the second line down, it should read

UNIT TYPE - NUCLEAR

CAPCO

arb exhibit.

CHAIRMAN PAPANDREU: Do you want it inserted in the record, in the transcript, or as an exhibit?

MR. CHEHAB: In the transcript as if read.

MR. KLEIN: We have already furnished the reporter with copies.

CHAIRMAN PAPANDREU: Any objections?

MR. CHARNOFF: No, sir.

MR. BARON: No.

CHAIRMAN PAPANDREU: All right, it will so be received.

(The document follows.)

TESTIMONY OF DENNIS J. NIGHTINGALE
OF THE FEDERAL POWER COMMISSION
BEFORE THE ATOMIC SAFETY AND LICENSING BOARD
AEC DOCKET NO. 50 - 346

My name is Dennis J. Nightingale, and my business address is 825 North Capitol Street, N. E., Washington, D. C. I am presently employed by the Federal Power Commission as an Electrical Engineer in the Division of Power Supply and Reliability, Bureau of Power. I received my Bachelor of Science degree in Electrical Engineering from Northeastern University, Boston, Massachusetts in June, 1971. I am a member of the Institute of Electrical and Electronics Engineers (IEEE).

My testimony deals with the seven possible methods of energy conservation the Intervenors have cited as altenatives to the power the Davis-Besse Nuclear Power Station could provide. These energy conservation methods are:

(I) Ban on promotional advertising and activities.

(II) Conservation advertising.

(III) Changes in rate structure - cost based pricing rather than promotional pricing, higher rates.

(IV) Changes in use of electricity.

(V) Changes in public attitude.

To my knowledge thereis no Federal agency which has the authority to place a ban on promotional advertising. It may be possible that the state of Ohio may have the authority to ban utility advertising. There may not be any power to ban advertising by manufactures of electric appliances.

Even if such a ban were placed on the utilities this would not stop load growth. The demand would probably still increase due to a decrease in availability of natural gas and fuel oil, possible increase in per capitol income, increase in leisure time development of new uses for electricity, or for other reasons. It is true that the demand may increase at a smaller rate without advertising, but the fact remains the demand would still increase.

The effect of advertising by utilities may be to create a fairly constant demand. With a fairly constant demand a utility can make better use of base load units. Base load units are the units which carry a constant load for long periods of time whereas peaking units are those units used only to satisfy short periods of high demand. Utilities plan to utilize base load units as much as possible because

(VI) Energy - efficient buildings.

(VII) Energy - efficient appliance.

Some of the contentions as stated are extremely ambiguous. However, energy conservation may be an excellent long term method of utilizing our natural resources. As a short term method to decrease the demand on utilities it appears that energy conservation will not produce a significant reduction in demand. It takes time to design and implement programs to change public attitude, to produce and replace existing appliances with more energy - efficient appliances, to design and construct energy - efficient buildings and develop other forms of energy to use in place of electricity. It is apparent that the results of an energy conservation program, by the summer of 1975 or 1976, will not be significant enough to reduce the expected demand on the CAPCO system enough to replace the power the Davis-Besse Nuclear Power Station would generate.

Contention I

As I am uncertain what is meant by promotional activities I will mainly address my testimony toward the first part of the contention about promotional advertising.

they are usually more efficient and cost less to operate per-cent of power produced. These savings in expenditure can be passed on to the utility customers.

Contention II.

Today there are many utilities advising the homeowner to conserve electricity and how to make electricity work more efficiently. Below are some examples of energy conservation advice.

(1) When cooking vegetables use very little water.

(2) Don't keep peeping in the oven.

(3) Defrost regrigerator before ice is one-quarter inch thick.

(4) Use dishwasher only when it is full.

(5) When doing laundry use cold water detergents whenever possible.

(6) Do not play with thermostat settings.

The effect of such conservation advice depends on the involvement of the consumers in the area in response to such a program, which is difficult to predict with any degree of accuracy.

A rule of thumb used by some in the utility field is that with such a conservation program in full force a utility can expect about a 1% to 2% reduction in the peak load. One of the well-known conservation programs is the "Save a Watt" campaign of Consolidated Edison Co. of New York, which was publicly announced in 1970. Con Ed estimated that this program, which became effective in 1971, resulted in a 350-400 mw (4 to 5 percent) reduction in the 1972 summer peak load of 7272 MW. This high percentage may be attributable to a high degree of community involvement resulting from a history of power shortages in the utility service area. On the other hand, there is no real way to determine the validity of such figures.

The effect of a conservation program in the CAPCO area may or may not follow the general rule of thumb. I doubt if such a program would produce any serious load reduction in the CAPCO area for the summer of 1975 due its relatively good service record for the last three years.

Moreover, even if a conservation program were implemented resulting in a reduction of demand of four or five percent, it would not necessarily obviate the need for the Davis-Besse Plant.

Contention III.

Contention III is not explicit in its meaning. Before I go into this matter I would like to point out that the Federal Power Commission regulates the transmission of energy in interstate commerce and the sale of such energy at wholesale in interstate commerce 1/. Most states regulate the rates utilities charge the ultimate consumer.

I would like to point out a basic fact about utility rates. When a utility determines the rate it will charge a customer, the utility will first calculate its cost of supplying the customers expected demand and then add to this any other charges which may be appropriate. One such charge is a return on equity.

The relation of price to energy use in energy demand projection is the subject of continuing studies. The Tennessee Valley Authority (TVA) has recently completed a

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1/ Federal Power Act; Section 201, March 1, 1971.

1969 through 1971 Residential costs increased 5.0 percent, the Commercial cost increased 6.8 percent and the Industrial cost increased by 12.3 percent. During this same period residential demand increased by 12.7 percent, the Commercial demand increased by 13.3 percent and the Industrial demand increased by 4.2 percent. This shows that across the United States even though the price of electricity is increasing the demand is increasing and that the Industrial class may be more responsive to price changes than either the Residential or Commercial markets. The demand for electricity may be more sensitive to the costs of alternative fuels, temperature variations, Gross National Product or some other factor. Even if rates prove to have the most significant effect on demand it would probably take time to have new rate structures approved by the appropriate authorities and additional time would elapse before consumer response would have a measurable effect on the level of demand.

It does not seem reasonable to assume that there can be enough of a change in rates in the CAPCO area by the summer of 1975 to decrease the demand for power sufficiently to eliminate the need for the Davis-Besse Nuclear Power Station.

Contentions IV through VIII.

These contentions are vague but they are closely related, so I have taken the liberty of combining them.

It is probable that attitudes toward energy consumption will have to be changed if no new energy sources are developed. This change, because it involves all levels of society, will be slow and gradual. It may be taking place today but is yet too small to be recognized. However, after a few years it may be possible to look back and note that a change in public attitude has occurred.

In the "Outlook for Energy in the United States to 1985" by the Chase Manhattan Bank, it is pointed out that the major consumers of power are in the 20- to 35-year age bracket. The Chase Manhattan Bank feels that the increase in per capita consumption of energy between 1970 and 1985 will be greater than the increase in per capita consumption from 1955 to 1970. Per capita consumption from 1955 to 1970 increased by more than a factor of two. It is expected that a major part of the 1970-1985 increase will be caused by a preference for single family dwellings instead of multiple home dwellings on the part of people in the 25- to 35-year age group. This age group will

study entitled "The Price Elasticity of the Demand for Residential Electricity in the Tennessee Valley Authority Area 1967 to 1973". 2/ This study concerns itself with the decline in demand after average residential rates increased by 52% between July 1967 and October 1970. At first this decrease was thought to be due to increased rates but further investigation revealed that other factors, mainly temperature variations (mild summers, warmer winters), were responsible for the decline in demand.

In Exhibit DJN1 there are some statistics on the average cost of electricity to consumers and the average energy (kilowatt-hours) used per customer from 1964 through 1971. In this time period the average energy used by a customer in the three major classifications (Residential, Commercial, and Industrial) of energy users has steadily increased. From 1964 to 1969 the cost of Residential and Commercial energy decreased, but it started to increase in 1970. Industrial consumers' rates started increasing in 1969. From

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2/ Appendix V, to "Forecasts of Electric Energy and Demand to the Year 2000". A Report by the Task Force on Forecast Review to the Technical Advisory Committee on Power Supply - National Power Survey - June 19, 1973.

increase between 1970 and 1985 due to the post-World War II baby boom. The prediction here is for a substantial increase in primary energy requirements in the residential and commercial market between 1970 and 1985. In the past twenty years, the residential and commercial markets have consumed approximately one-third of the primary energy sold 3/ and in the period from 1960 to 1968 the growth of electricity in residential energy consumption almost doubled. 4/ There appears to be no evidence that the pattern of energy use described by these statistics will change significantly in the next five years.

In the U. S. Department of Interior's publication, "United States Energy Through the Year 2000", the per capita growth rate of electical consumption is predicted to be about 6 percent in 1975 and 1980. The average annual growth rate will be about 4.5 percent from the year 1970 to the year 2000, which indicates that attitudes toward electrical use will change but

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3/ "Energy Research Needs", a Report to the National Science Foundation by Resources for the Future in Cooperation with MIT Environmental Laboratory, October, 1971, page I-11.

4/ "Patterns of Energy Consumption in the United States", by Stanford Research Institute for the Office of Science and Technology, January, 1972.

not in the near future.

A change in public attitude has already taken place as shown by the current stress on environmental considerations. This change, though, will tend to increase the demand for electricity because large quantities of electricity will be required for such environmental improvement purposes as recycling and waste treatment.

Changing public attitudes may cause further increase in consumption of electrical energy. For instance, electric house heating can be expected to increase in the years ahead as growing shortages of natural gas and fuel oil cause builders to choose electricity. The growth of electric house heating may not be limited to new housing units. As home owners begin to realize the convenience, cleanliness and pollution-free characteristics of electric heat, some existing homes may be converted to electric heat. It should be noted that usually electrically heated housing units are totally electric units.

In 1972 electric space heating accounted for approximately 25 percent of residential energy sales and this is expected to increase to 30 percent in the 80's. 5/

In Exhibit DJN 2 is a list of assumptions taken from Appendix 7 of a report by the Task Force on Forecast Review to the Technical Advisory Committee on Power Supply, National Power Survey. 6/ The results of these assumptions would probably be effective by the year 2000 but not for the year 1975. The change that could be made by 1975 in insulation on the number of buildings that will be serviced by CAPCO will have little if any effect on CAPCO's demand. Similar reasoning can be applied to an increase in efficiency in "frost-free" cycles on refrigerators. It is a good idea but the number of more efficient refrigerators will have little effect on the total demand from all refrigerators Assumption 16 which relates to industrial usage can probably be achieved without too

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5/ "23rd Annual Electrical Industry Forecast" Electrical World, McGraw-Hill Publications, September 15, 1972

6/ "Forecasts of Electric Energy and Demand To The Year 2000". June 19, 1973.

many complications. However by 1975, the number of industrial customers who could afford to replace expensive machinery or modify if possible existing machinery to be more efficient is probably small. All of these assumptions are good for the year 2000 but will have no effect on CAPCO for the Summary 1975.

Energy - Efficient buildings are designed specifically for the conservation of energy using life cycle costing, which is a technique to insure that the building will result in the lowest overall ownership cost attainable within established criteria such as energy conservation, safety and health regulations, and low maintenance cost. This is a satisfactory approach for a building which will have only one owner, and/or operator for the long term. But for buildings which may have more than one owner, the first owner has little incentive to raise his initial costs to provide greater energy conservation, since he expects to pay for only a part of the operating costs. As designed, the energy-efficient buildings should show at

least a 10% decrease in total power consumption, 7/ compared to existing buildings. Some concepts which have been mentioned for energy efficient buildings are; three inches of insulation in a previously uninsulated building may reduce heat losses 80 percent at normal temperatures; variable exhaust air conditioning system with some type of heat transfer between exhaust and intake may reduce energy required for heating 30 to 35 percent and may reduce by 15 to 20 percent the electrical energy required to power the air conditioning and by using fluorescent lighting, and more uniform lighting a 25 percent decrease in energy for lighting may be achieved. Opportunities for improving the energy consumption performance of existing buildings is limited as compared to new buildings. In the Government Services Administration (GSA) Report on its Roundtable on Energy Conservation in Public Buildings, July, 1972, it is stated that GSA will build a series of buildings to "test and develop new environmental technology while housing normal government activities". However, the

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7/ "Roundtable on Energy Conservation in Public Buildings", Sponsored by National Bureau of Standards and Government Services Administration. Report dated July, 1972, page 10.

percentage of buildings designed for energy conservation will probably remain small for years to come. This may be due to the fact that much of the construction industry in the United States is on such a small scale that few builders could afford the applied research in building design necessary to achieve energy-efficient buildings.

In addition to energy-efficient buildings, energy could be conserved by more energy efficient appliances. As shown by Exhibit DJN 3 electric appliances are more efficient than those that are not powered by electricity.

The production of more efficient electric appliances by manufacturers would tend to reduce the consumption of electricity. However, at this point in time there appears to be little pressure moving manufacturers in this direction. Also, consumers who already have a number of appliances may not be impelled to discard the useable but less efficient appliances they now own for newer, more efficient but more costly models.

In summation, energy conservation is a good way to decrease the demand placed on a utility. However, the effects of programs designed to change public attitudes, to produce more efficient electrical appliances, to construct energy-efficient buildings

and to reduce usage of electricity by means of increased rates would not appear to be of significance in reducing demand in the CAPCO area by summer of 1975.

Need for Power.

Before I discuss the need for the power that the Davis-Besse Nuclear Power Station could provide, let me discuss some of the terminology and concepts involved with the reliability of bulk power supply.

The reliability of a power system is largely dependent upon its bulk power supply facilities, generation and transmission. A basic criterion for reliable power system operation is satisfied if bulk power supply facilities meet the demand requirements (measured in megawatts or kilowatts) and energy requirements (measured in megawatts or kilowatt-hours) placed upon them most of the time. Absolute or perfect reliability can be approached but can never be achieved because of equipment failure, human error and natural phenomena.

Bulk power supply facilities are quite often designed to satisfy a demand requirement rather than an energy requirement. Demand is the rate of use of energy. It represents the electricity that must be produced and delivered at the very instant it is requested by the consumer. To supply the consumer's requirements for electricity the demand must be projected in advance so the utility can plan and install generation and transmission facilities to satisfy the demand.

Power systems plan to provide the uninterrupted service that consumers have come to expect and rely upon. To do this, these systems must have or be able to obtain more generating capacity than the anticipated peak load demand. This excess capacity is called the reserve or reserve margin. When this excess capacity is expressed as a percentage of the peak load demand, it is called percent reserve. Reserves are used to provide for various contingencies, such as the following:

1. To replace generating capacity of units out of service for scheduled maintenance.

2. To replace generating capacity that has been forced out of service due to a failure.

3. To replace capacity additions that have been delayed beyond scheduled in-service dates.

4. To replace capacity for units whose capacity may be limited due to environmental restrictions or fuel shortages.

5. Load demand exceeds that forecast.

There is no constant percent reserve margin, that applied to each system will assure its reliability. The magnitude of a systems' reserve depends upon the nature of the system, characteristics of the load and the quality of service desired.

There are several techniques used by electric utilities in determining the size of generation reserves. One method is to plan to have a capacity to provide a percent reserve equal to or in excess of some accepted standard. The Federal Power Commission has found that many power systems plan on a reserve between 15 and 25 percent. It should be emphasized that a reserve in this range does not necessarily indicate that a utility will always have sufficient capability to meet load patterns. If a utility's reserve margin in the last few years has proven adequate, it is likely it will be sufficient in the very near future. However, there is always the chance that the load can exceed the available generating capability.

Another technique being employed by some utilities to determine adequate generation reserve levels is loss-of-load probability (LOLP) 6/ This method includes as factors the sizes, types and number of units, their forced outage rates, and the shape of the load duration curve. The LOLP method will give the probability that generating capacity will be less than the demand for the period under study. Some utilities have chosen a LOLP value of "one day in ten-years" as a nominal guide. "One day in ten years" is defined by some utilities to mean that over a ten-year period the summation of all intervals during which the load exceeds capacity will not surpass 24 hours. Another definition is that the load will not be greater than system capacity more than one time in a ten year period.

6/ An excellent summary of the LCLP method can be found in the 1970 National Power Survey, Part II, Electric Power 1970-1980-1990, pp II-1-52 to II-1-58.

I previously mentioned forced outage rates of generating units were used in LOLP calculations. The forced outage rate (FOR) is defined as the number of hours a unit is forced out of service (FOH) divided by the number of hours in service (SH) plus the FOH and expressed as a percent:

$$FOR = \frac{FOH}{SH + FOH} \times 100$$

The electric utility industry keeps records of forced outage data which are reported to the Edison Electric Institute (EEI). EEI then publishes averaged national statistics with these records. Typical statistics are shown in Exhibit DJN 4.

A system which experiences high forced outage rates and has or plans to install larger generating units requires a higher reserve margin than the identical system would, if its generating capability consisted of smaller size units with lower forced outage rates to maintain the same loss-of-load probability.

I have just discussed some terms and concepts used in the electric utility industry and two of the more prominent indices for ascertaining a systems' reliability. Now I would like to present several methods that can be used by a utility to bring available generating capacity closer to demand when reserves are insufficient.

A list of contingency plans submitted by utilities in response to FPC Order No. 445 (Docket R-405) is summarized in an FPC publication entitled, "Contingency Planning of Utilities", dated June, 1972.

All systems have their own basic procedures to assure orderly response to contingencies so as to minimize customer inconvenience and avoid prolonged

danger to public health and safety. The general order of response is as follows:

1. When possible, purchase from neighboring utilities sufficient capability to meet the forecast peak load plus an adequate reserve margin to cover forecast error and reasonable contingencies.

2. Operate all generating facilities at maximum rating.

3. Masimize energy purchases from interconnected systems to the extent that transmission line loadings permit.

4. Reduce all nonessential electric power usage at all utility owned power plants and offices.

5. Discontinue service to contractually interruptible loads.

6. Request voluntary reduction of nonessential loads or large commercial and industrial customers.

7. Reduce voltage up to 5% as required.

8. Make a public request through the news media for all customers to limit electric usage.

9. Manually disconnect selected low priority loads as required, rotating disconnection if the shortage is expected to extend more than several hours.

To determine the need for the power that could be generated by the Davis-Besse Nuclear Power Station one must look at the needs and capabilities of the members of the Central Area Power Coordination Group (CAPCO). The members of CAPCO are Duquesne Light Company (DL), Ohio Edison Company and its subsidary the Pennsylvania Power Company (which I shall refer to as the Ohio Edison System) (OE), and the applicants: Toledo Edison Company (TE) and the Cleveland Electric Illuminating Company. CAPCO is a member of the East Central Area Reliability Coordination Agreement (ECAR). Because CAPCO has not reported an established reliability criterion such as presented

previously I have used the guideline of 15 to 25 percent reserve margin in my analysis.

The first area of concern then is the load forecast. Exhibit DJN 5 shows the summation of CAPCO company actual June loads from 1963 through 1972 and the projected summer loads through 1977. It appears that the estimated future loads fall close to the line approximating actual loads. Therefore, it may be safe to assume the CAPCO load projections for summers of 1975 and 1976 are fairly accurate. Exhibit DJN 6 shows how close each individual members' estimate was compared to what actually occurred. I would like to point out that for those estimates given 2 and 3 years before the peak the only utility consistently high was Toledo Edison Company and on only one occasion was the error greater than 5 percent.

In ECAR'S response to FPC Docket No. R-362 CAPCO uses the sum of non - coincident peaks as its estimates for native demand. The actual or coincident demand will probably be less than the non - coincident estimate.

The nature of diversity among individual systems load is unpredictable. There is, however a probabilty that all the CAPCO members may attain their summer peak simultaneously; therefore CAPCO plans its' system on the possibility of such an occurence.

To calculate reserves I choose internal load over native load. Internal load is the systems' native load plus any interruptible load they may have contracted for.

As shown previously the use of interruptible load is a means of bringing capacity and load closer together when the load exceeds available capacity. However, utilities usually plan to meet this load.

When looking at the effects a plant has on a system, the other units scheduled for service in the same time period must also bear some examination. In CAPCO there are two nuclear units scheduled for operation for the summer of 1975. They are the Davis-Besse No. 1 (906 MW) and Beaver Valley No. 1 (856 MW), which currently has a construction permit. There is also the large coal fired Mansfield No. 1 Unit (825 MW) due in service for the summer of 1975. If all three of these units should be placed in service as scheduled CAPCO would have a 23.4 percent reserve for the summer of 1975. (Exhibit DJN 7). However, there is no guarantee that all three of these units will be placed in service as scheduled or at full rating. If Davis-Besse No. 1 were delayed CAPCO's reserve margin would decrease to 15.7 percent. This is barely within the range usually considered adequate. If Beaver Valley No. 1 were also delayed beyond the summer of 1975 the resulting reserve margin would be 8.5 percent which is not considered adequate.

For the summer of 1976 the only major addition for CAPCO is the coal fired Mansfield No. 2 (825 MW) unit. If all units scheduled for service for 1975 are in service and Mansfield No.2 is operating CAPCO will have a 21.9 percent reserve margin. If

Davis-Besse were delayed in 1975 and still not in service for the summer of 1976 the reserve would be 14.8 percent, or just short of the usual 15 to 25 percent range. There is also the possibility that Beaver Valley No. 1 may not be operating; if not, the reserves would then be 8.2 percent which is well below the accepted range. There is also a question as to the actual rating of a nuclear unit when it is first given an operating license. Exhibit DJN 8 shows some of the latest nuclear additions and what output they were initially licensed to operate.

Another consideration is how well interconnected CAPCO is with other members of ECAR. It appears that CAPCO is quite well interconnected with 345 kV and 138 kV connections. However, external support from such interconnections is not 100% reliable. Also the required import to replace Davis-Besse No. 1 or Beaver Valley No. 1 may not be delivered without the overloading of some transmission lines causing the lines to go out of service.

All of this indicates that the Davis-Besse Nuclear Power Station is needed to provide adequate generating capacity in the summers of 1975 and 1976.

Data Sources

1. FPC Form 12 - This form is the annual power systems statement filed by each power company or system whicy generates all or part of its system if greater than 20,000,000 kWh. This document lists generating capacity and production by plants, individual generating unit characteristics, energy transactions with other utilities, hourly load data for three specified weeks, high voltage line capability and loading for specified months, and future load estimates. A company officer attests to accuracy, completeness, and truthfulness. The data reported is reviewed and verified by the Regional Engineer's staff by checking for consistency with previously filed forms and applying staff knowledge of the power systems in the appropriate geographic region.
2. FPC Form 12E - This form is the monthly power system statement filed by each utility or formal pool. It includes recent revisions in generation additions and load forecasts. It is verified by the same procedure as for the Form 12 above.
3. East Central Area Reliability Coordination Agreement (ECAR) Response to FPC Docket R-362 - This report is filed annually on April 1 with the FPC, it contains information regarding bulk power supply and capacity forecasts for a ten year period.

STATISTICS ON COST AND CONSUMPTION OF ELECTRICITY
(1964-1971)

Average Cost to Consumers - Cents Per Kilowatt - Hour

	Residential	Commercial	Industrial
1971	2.32	2.20	1.10
1970	2.22	2.08	1.02
1969	2.21	2.06	.98
1968	2.25	2.07	.97
1967	2.31	2.11	.98
1966	2.34	2.13	.98
1965	2.39	2.18	1.00
1964	2.45	2.26	1.02

Kilowatt - hours Per Customer (Billions)

	Residential	Commercial	Industrial
1971	7.639	42.598	1,735.482
1970	6.700	40.480	1,695.087
1969	6.246	37.607	1,666.019
1968	5.706	35.009	1,578.366
1967	5.220	32.234	1,481.496
1966	4.931	30.238	1,445.802
1965	4.618	28.093	1,289.949
1964	4.377	25.450	1,217.878

SOURCE: "Statistics of Privately Owned Electric Utilities in the United States - 1971", Federal Power Commission.

UNDERLYING ASSUMPTIONS USED IN THE DEVELOPMENT OF ENERGY FORECASTS OF THE YEAR 2000

ONSERVATION OF ENERGY CASE

2. The size and horsepower of automobiles will be reduced, allowing a 25% reduction in gasoline requirements per car.

2. Mass transit systems will allow a 12% reduction in automobile travel, and will raise the overall efficiency of population transportation.

3. A 10% improvement in truck transportation is possible through more efficient engines and power trains.

4. 50% of truck transportation can be switched to rail, increasing system efficiency.

5. A 15% reduction in rail transportation energy requirements is possible through improvements in engines, more efficient routing and improved dispatching.

6. 10% of air passenger and freight requirements can be shifted to rail shipments.

7. Miscellaneous transportation uses can reduce energy requirements by 20% through improvements in materials handling equipment, pipeline pumping, buses and waterborne transportation systems.

8. Improvements in insulation standards for houses and commercial establishments will reduce heating energy requirements by 18.6%.

9. Improvements in insulation standards as well as more efficient devices will reduce air conditioning energy by 11%.

10. Better insulation and elimination of constant reheating of stand-by supplies reduces water heating energy requirements by 10%.

11. Improvements in insulation and "frost-free" cycles reduce energy requirements of refrigeration by 5%.

12. Continued movement from incandescent to fluorescent lighting reduces energy requirements by 10%.

13. Microwave, induction and other refinements reduce energy requirements of cooking by 10%.

14. Miscellaneous household and commercial uses of energy can be reduced 10%.

15. Industrial process steam and direct heat requirements can be reduced 5 to 8% by improved processes and more careful attention to leakage paths.

16. Industrial electrical usage can be reduced by 8% by improved machinery and closer machine scheduling.

17. Miscellaneous energy uses in industry can be reduced by 5%.

EFFICIENCY BY FUEL OF MAJOR HOME APPLIANCES

Type	Coal	Natural Gas	Petroleum Products	Electricity
Space Heating				
Residential	55	75	63	95
Commercial	70	77	76	95
Water Heating				
Residential	15	64	50	92
Commercial	70	74	50	92
Cooking	-	37	37	75
Clothes Dryer	-	47	37	57
Refrigeration	-	-	-	50
Electric Driers	-	-	-	90

NOTE: Source for this table is "Patterns of Energy Consumption in the United States", by Stanford Research Institute for the Office of Science and Technology, January, 1972.

GENERATING UNIT AVAILABILITY
AS REPORTED BY EEI

Unit Type	FOR 1/	EFOR 2/	Service Factor 3/	Capacity Factor 4/	Output Factor 5/
Gas Turbine	24.4 6/	24.50 6/	15.52	12.21%	77.61%
Fossil Greater Than 600 MW	16.8	21.88	70.97	57.68%	80.51%
Nuclear	8.39	11.60	75.16	64.91%	88.51%

1/ Force Outage Rate.

2/ Equivalent Forced Outage Rate is the FOR adjusted for partial forced outages.

3/ May be high for units with low service factors.

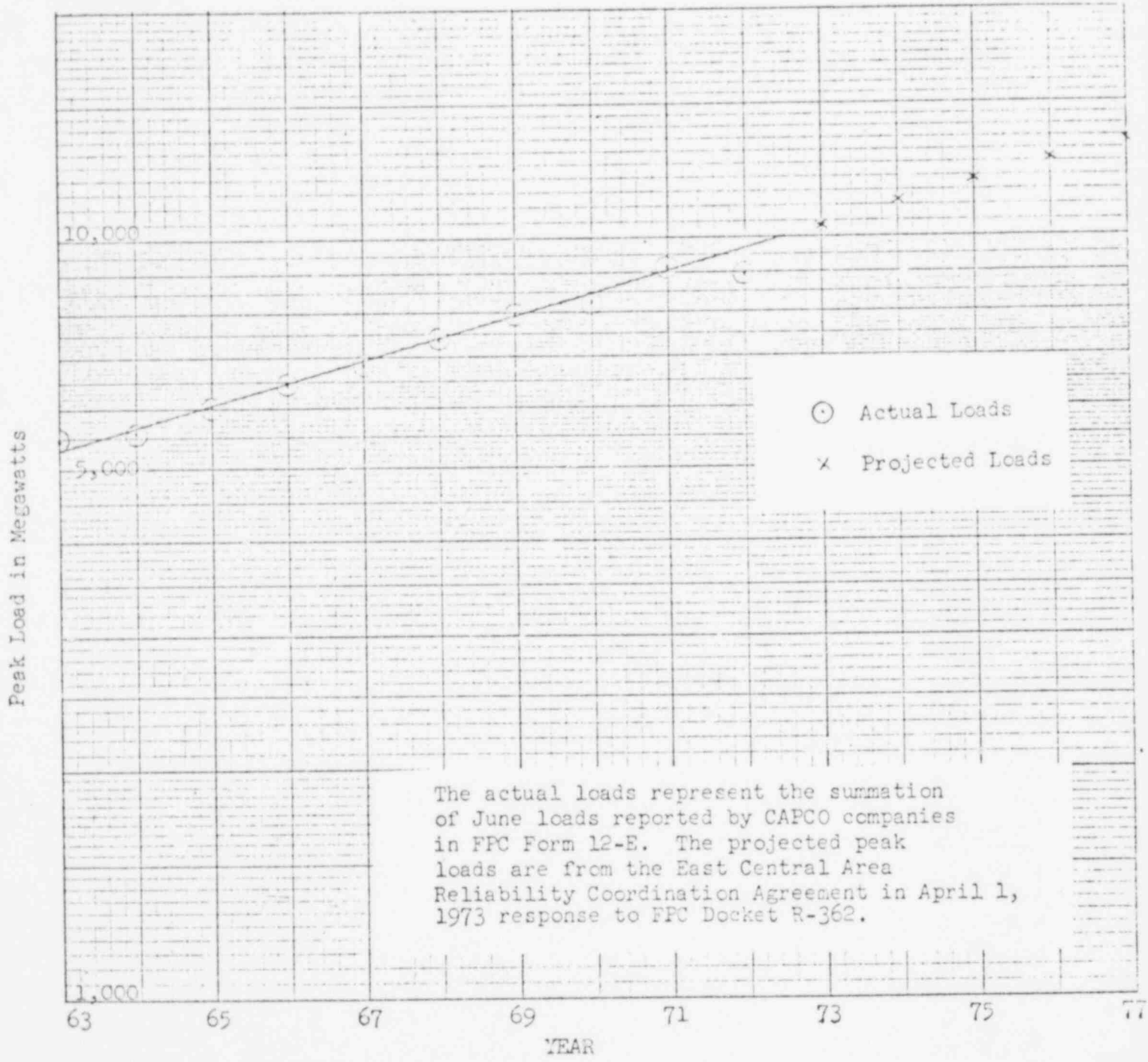
4/ Service Factor = (Service hours/8760 hrs.) x 100.

5/ Capacity Factor = (MWh output/(Unit Capability x 8760)) x 100%.

6/ Output Factor - (MWh output/(Unit Capability x Service Hours)) x 100%.

SOURCE: Report on Equipment Availability for the Twelve-Year Period 1960-1971 by Edison Electric Institute Publication No. 72-44, November 1972.

CENTRAL AREA POWER COORDINATION GROUP (CAPCO)
HISTORICAL AND PROJECTED
SUMMER PEAK LOADS
1963-1977



COMPARISON OF ACTUAL AND ESTIMATED SUMMER PEAK LOADS
CAPCO 1970-1972

Year	Company 1/	Actual Summer Peak Load	Past Estimates 1 Year	2 Year	3 Year
1970	CEI	2,549	2,560	2,560	2,540
	DL	1,863	1,869	1,863	1,854
	OE	2,983	3,085	2,995	2,510
	TE	937	969	960	960
	CAPCO 2/	8,332	8,483	8,378	7,864
1971	DEI	2,792	2,680	2,720	2,720
	DL	2,015	1,970	1,963	1,950
	OE	3,323	3,295	3,295	3,190
	TE	1,052	1,030	1,067	1,064
	CAPCO 2/	9,182	8,975	9,045	8,924
1972	CEI	2,822	2,880	2,880	2,900
	DL	2,075	2,075	2,074	2,066
	OE	3,554	3,520	3,520	3,520
	TE	1,094	1,095	1,118	1,173
	CAPCO 2/	9,545	9,570	9,492	9,659

NOTE: These are native loads, they do not include interruptible loads from respondents Form 12.

1/ Company names are: CEI - Cleveland Electric Illuminating Co., DL - Duquesne Light Company, OE - Ohio Edison System, TE - Toledo Edison Company.

2/ Sum of non-coincident peaks

CAPCO Summer Reserve Table
1975-1976

		All Units Available	Without Davis-Besse (906 MW)	Without Davis-Besse (906 MW) and Beaver Valley (856)
			1975	
Capability 1/	MW	14,637	13,731	12,875
Internal Load 2/	MW	11,866	11,866	11,866
Reserve	MW	2,771	1,865	1,009
Reserve	%	23.4	15.7	8.5
			1976	
Capability 1/	MW	15,371	14,465	13,640
Internal Load 2/	MW	12,605	12,605	12,605
Reserve	MW	2,766	1,860	1,035
Reserve	%	21.9	14.8	8.2

1/ Capability was derived from CAPCO Net Demonstrated Capability times .979 to get seasonal (summer capability) then adding purchases.

2/ Internal load is native load plus interruptible load.

INITIAL OPERATION OF VARIOUS NUCLEAR UNITS

Plant	Capability MW	Provisional Operation License Issued	Initial Operation MW	Initial Operation %
Turkey Point No. 3	725	7/72	725	100
Surry No. 2	780	1/73	585	75
Browns Ferry No. 1	1,065	6/73	799	75
Quad Cities No. 1	809	9/71	200	25 1/
Quad Cities No. 2	809	3/72	200	25 1/
Point Beach No. 2	497	11/71	99	20
Pilgrim No. 1	655	6/72	131	20
Palisades	700	3/71	140	20
Dresden No. 3	809	1/71	809	100
Fort Calhoun No. 1	457	5/73	90	20
Turkey Point No. 4	725	4/73	675	93
Vermont Yankee	514	3/72	514	100
Oconee No. 1	886	2/73	44	5
Maine Yankee	790	9/73	600	75
Nine Mile Point	625	8/60	500	80
Indian Point No. 2	873	10/[illegible]	175	20

SOURCE: AEC Press Releases

1/ Provisions to increase output to 62% or 90% depending on other means of supplying demand.

CHAIRMAN FARBSTEIN: Cross by Applicant?

MR. CHLAMTZ: None, sir.

CHAIRMAN FARBSTEIN: Mr. Baron?

MR. BARON: I have a few, Mr. Chairman.

CROSS-EXAMINATION

BY MR. BARON:

Q On page 3 of your testimony, Mr. Nightingale, in your first paragraph you have a sentence reading, "As a short term method to decrease the demand on utilities it appears --" My question then is from what source you get this impression that you made this statement. It appears from what?

A It appears from the Chase Manhattan Bank's publication that I have referred to previously, Electrical World, the FPC 1970 power survey, that these are all good for long-term future use, but not past three or four years in the future. Past that there may be some significant factor affecting the utility. But through these years, I do not see in my own opinion that they will have any effect at all.

Q You say these two sources, the names that you have given, don't appear on the first page?

A But they are given in other contentions. This basically is a summary of what the contentions go on to prove.

Q May I ask again what were the names of those two sources?

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Q One is the outlook for energy in the United States to 1985 by the Chase Manhattan Bank. There is also the Electrical World, the September issue. It gives the electrical outlook for the future.

Q Are those the only two sources that you used to draw those conclusions?

A No, sir, there are also --

CHAIRMAN FARMAKIDES: Where are you reading from, sir? Are you reading from your testimony, sir?

THE WITNESS: The names of the references, right.

CHAIRMAN FARMAKIDES: What page?

THE WITNESS: One is given on page 9 and another footnote is given on page 12.

CHAIRMAN FARMAKIDES: Could you then redirect yourself back to Mr. Baron's question?

THE WITNESS: I also used -- as you look at page 12, you will see a Footnote 6. This is a forecast of electric energy and demand for the year 2000. It was a research done by the MIT environmental laboratory entitled, "Energy Research Needs," which was reported in October, 1971.

Would you like me to name all other sources also?

BY MR. BARON:

Q If they are contained in the testimony it is not necessary. I didn't know that you were basing that statement on and you indicate now that all the sources you used are

3mil mentioned in here?

A Right.

Q Then further on in that same page and in that same paragraph you begin a sentence, "It is apparent that the results of an energy conservation program --" I would ask you the same question. It became apparent to you, based upon the reading of these articles?

A Yes, sir.

Q Was there any independent determination made by you other than from what you gleaned from these various articles?

A I am not sure what you mean by "independent."

Q From your own experience, shall I say?

A From my experience? Somewhat, yes, as far as the energy efficient appliances. I knew, myself, that I don't think I would discard a good appliance, that I have now for one that is slightly more efficient. I could not convince myself to do that. Most people that I have asked could not convince themselves they could discard a good appliance for one that is more efficient. They thought they would have wasted the initial output for the first appliance.

Q You are suggesting that as one item of an energy conservation program? You have indicated here that the results of such a program would not be significant to reduce the projected demand, either. What I am getting at now -- and you

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say, further, that it is apparent that it won't happen. I was just wondering on what do you base that statement. You have indicated now that nobody will throw away an appliance just for one that is more conservation minded. What else did you use to base that statement?

A Another thing was that it takes time for people to legislate a ban on commercial advertising if one was going to be put into effect. It takes time to get this through the legislature and enforce it. It takes time for people to follow an energy conservation program.

If you read my testimony, as I say, the Save a Watt program for Con Ed was initially announced in 1970 but still took a year or more before they really felt anything from it.

Q Going on with your testimony you have indicated that the effect of advertising by utilities may be to create a fairly constant demand. Are you suggesting that by the repetitive advertisements of a utility company to sell electricity, this will maintain a certain demand for power?

A What I was getting at was that a public utility has what it calls base loads, power that is there most of the time that they want to supply. If they can get through promotional advertising, the more power that will be there continually, they build what are called base load units which are the most economical so that they can get their base load

fail

high enough that the fluctuations that they have in their normal cycle will not be that great and they can utilize those more economical base load units over expensive peaking units. What they are trying to do is to try to levelize their load so that instead of going from up there down to here, they will try to make little bumps in it instead of large bumps in it. That may be one thing.

What other purpose they have in their eye.

Q Was this been, from your experience -- is this one of the reasons that a utility company advertises?

A I don't know why they advertise. It is one reason why they could advertise.

Q Have you made any studies with respect to the impact of advertising on the consumption of electrical power?

A No, I haven't. I have not.

CHAIRMAN FLANIGAN: Mr. Wilson, we are having difficulties. You are speaking a little too rapidly and the reporter can't catch it and neither can we. I would appreciate it if you would slow down a little bit.

BY MR. SHAW:

Q You have no knowledge?

A I haven't formed any opinion.

Q My question was, have you made any studies? Do you know of any studies?

A Personally I do not, sir.

6mil

Q Are you aware of the advertising policies of the Toledo Edison Company or of the Cleveland Electric Illuminating Company with respect to the sale of electrical power?

A I will have to say no, sir.

Q You haven't made any studies with respect to advertising as it affects the use of electricity, the consumption of electricity? You do indicate here that many utilities are advertising the homeowner to conserve electricity. Have you made a study of that aspect?

A I know of three or four that have been doing it.

Q Which ones?

A Con Ed up in New York. There is also Pepco, Potomac Edison Power Company down in Maryland. I am not sure -- there is one in the Middle South area. I am not sure what company it is. Also I have heard Long Island Lighting Company up in New York is doing it also.

Q The information that you listed here, the suggestions for energy conservation that you listed on page 4, are these your own suggestions, or are these items that have been advertised, shall we say, by one of these four companies you mentioned?

A They came from this pamphlet that Pepco gives out to their people. This is a sampling from this one book. These are not my ideas.

7mil

MR. CUNNOFF: I am sorry, Mr. Chairman. Can we have an identification of that book for the record?

THE WITNESS: It is entitled, "Electricity -- How to Get the Most for the Least."

CHAIRMAN FRIEDMAN: It is produced by whom, sir?

THE WITNESS: Potomac Edison Power Company.

BY MR. MYRON:

Q Do you have any idea of the number of such books that company issues to the public?

A No, I do not, sir.

Q So when you indicate many utilities, you are really talking about perhaps four?

A That is four that I know of.

Q You go on to indicate that the effort of such a conservation effort would depend upon the response -- and this is at the bottom of page 4 -- of the consumers in that area. Now, might that response -- may I ask you this question. Might the response of the consumer be directly correlated to the amount of money that the utility company would be spending to sell the idea of conservation?

MR. CUNNOFF: Objection. The witness is not qualified as an advertising expert.

CHAIRMAN FRIEDMAN: Mr. [illegible], do you object to that question being asked?

MR. [illegible]: It doesn't seem to be germane

Emil

to his testimony.

BY MR. ZARON:

Q On page 5 you discuss the Save a Watt program. Are you familiar with the Con Edison program?

A By "familiar," in what way, through their operation, have I studied it?

Q Yes.

A The only people I know who have studied it are the Con Ed people themselves. It is hard to determine the effect of a Save a Watt Program. It is just at best an estimate. There is no actual way of determining what it would have been without the Save a Watt program. They can estimate.

Q And their estimate, as you reflected, was a savings of four to five percent reduction?

A Yes.

Q There was some confusion in the minds of the Coalition with respect to your sentence on page 5 in the second paragraph, the second sentence. "I doubt if such a program would produce any serious load reduction in the CAPCO area for the summer of 1975 due to its relatively good service record for the last three years." We are not exactly sure what you meant by that, the relatively good service record. What are you referring to?

A I was looking at voltage reductions that were

performed during the summer for the last three years, major outages during the last three years and comparing it to other systems like Con Ed which has such a Save a Watt program. Compared to Con Ed, the CMPCO area doesn't have such problems. In the last three years they had three compared to Con Ed's almost 30.

Q Three what?

A No, excuse me, it was the voltage reductions in the last three years. Con Ed had over 30 voltage reductions.

Q Wouldn't you say, though, that three or 30 -- three is the way, and that a program that might produce a load reduction would be a good program to have?

MR. CHERNOFF: Objection. That calls for an opinion beyond the competence of this witness.

CHAIRMAN HENDRICKS: Rephrase your question, Mr. Baron.

MR. BARON: I will just withdraw it.

MR. CROM: I would like some clarification. The sentence that was read to you, "I doubt if such a program would produce a serious load reduction in the CMPCO area due to its relatively good service record," you are suggesting, are you not, in that sentence that whether or not a load reduction can be effected by this kind of Save a Watt program, this publicity program, depends on whether or not there have been power failures in the area, presumably

10mil

because of the influence these would have on people? Is that what you mean?

THE WITNESS: What I am saying is that that may be a factor in it, yes.

MR. SHON: And that if there were a lot of power failures, people would respond more to this program as with Con Ed and if there were very few they won't respond to it?

THE WITNESS: Yes.

MR. SHON: All right.

BY MR. BARON:

Q Also on page 5 at the bottom your paragraph indicates that even if a four to five percent reduction could be derived from a conservation program, this would not necessarily obviate the need for the Davis-Besse plant. Exactly what do you mean there? Why wouldn't that obviate it? This would obviously reduce the amount of electricity they would need in this area by four to five percent. What additional factors would there be, then, that would still require the plant's construction?

A If Beaver Valley is not in or -- if Beaver Valley No. 1, which is another Unit 1, is not in, or at full rated, and if the Mansfield No. 1 unit is not in full service, then they will need something from this unit.

Q In many of the paragraphs throughout your written

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testimony you have indicated that -- you have used the year 1975 as sort of a target year, that it would be difficult to achieve any reductions in electric consumption through advertising. You are saying by 1975 it couldn't happen. How about the year 1977?

A It is possible. To what degree, I am not qualified to say.

Q Mr. Nightingale, do you have any training or qualifications with respect to forecasting power, the amount of light power that should be used in a building or anywhere?

A No, I don't pretend.

Q Are you aware of any other plants being built in the next few years in the area of Davis-Besse that might be available to meet the proposed increase in power demand?

A For the 1975-1976 time period?

Q The next few years, let's say.

A As far as -- If you are looking for units that may usually replace Davis-Besse, I do not think there are any available.

Q I was thinking of a plant like Beaver Valley. That is being constructed now, isn't it?

A Right.

Q Anything else along that line?

A I do not believe so.

Q Let's just leave that line of questioning, then.

42mil

Electrically heated housing, you have indicated, is usually total electric?

A In most cases. Well, let's put it this way. From what I have read that is what they have implied and stated.

Q Your training is that of an electrical engineer?

A Right.

Q So really in the area of the effects of advertising campaigns to either sell electrical power or to conserve electrical power -- really that is outside of the field of electrical engineering, isn't it?

A It is not directly in it, ~~this~~ IRHE, but in my function with the Federal Power Commission I am doing studies of reliability in which I need to know how accurate the load estimates are for various utilities, to see how accurate they are and try to determine what other factors go into making up their load estimates. I do --

Q So really the essence of your testimony is that you have looked at the projections of the Davis-Besse plant for the need of future power and using the statistics that they have given you and in the light of your own knowledge and training, you can say that their estimates are accurate?

A Are fairly accurate, yes.

13mil

Q But you really do not have any expertise to be able to tell this panel what effect, if any, the expenditure, let's say, of over 30 million in a year would be upon the consumption of electrical power? You can't answer that question, can you?

A No, sir.

Q And you could not answer the question as to -- let's use the hypothetical -- the same amount of money spent to conserve electrical power. You really don't have the expertise to say how much electrical power might be conserved if whatever amount of money were spent in that same year?

A Correct again, sir.

Q And you can't answer that?

A No.

MR. BANOU: I have no other questions of this witness.

CHAIRMAN RAMMELKAMP: Any further redirect?

MR. ROUNTREE: I have just a couple of questions.

REDIRECT EXAMINATION

BY MR. ROUNTREE:

Q Mr. Wightsman, the business of predicting reliability for the Power Commission involves knowledge of electrical engineering, is that right?

A Yes, sir.

14mil

Q And you also deal in estimating reliability of systems -- you also deal in probabilities, do you not?

A Yes, sir.

Q And the probabilities you deal in may involve what plant is built or not. That would have an effect on how reliable a system might be, mightn't it?

A Yes, sir.

Q And you also consider whether or not the system has a tendency for outages or not, isn't that right?

A Yes, sir.

Q And in all these things you are taking probability into account and that is about the best way that you can plan for a system and tell whether or not it is going to be reliable, isn't that right?

A Yes, sir.

Q And when the question is put to you as to whether or not advertising can reduce a load or not reduce a load, you have to consider the fact of its existence or non-existence as one of those problematical things that you would consider in forecasting reliability in other respects, wouldn't you?

A Yes, it is involved in looking at their load estimates to see how accurate they actually are.

MR. FOURMENTOUX: No other questions.

CHAIRMAN PARMENTER: Have you any further

examination? Mr. Baron?

MR. BARON: I have no other questions, Mr. Chairman, but I would move to strike from the testimony any references that the counsel therein with respect to the effects of conservation programs, et cetera, in light of the witness' admission that he has no actual skill in estimating the effects on electric consumption of advertising.

CHAIRMAN RUNNERSTROM: Is there any response, Mr. Counsellor?

MR. COUNSELLOR: It seems to me that counsel is putting the witness in a rather peculiar position, in that

ENGINEER HE IS PRESUMABLY

To the other hand, the only person who could certify as to the effects of advertising would be an advertising expert who could not testify as to the electrical side of the question. It also seems to me that on redirect examination I think it was made clear that advertising is one of those psychological things that is taken into consideration in making his estimate or reliability.

While he may not be an expert in advertising in the extent that he would walk into a Madison Avenue firm and demand a six-figure salary, it seems to me that he can consider advertising as an important factor in making his overall determination. If you use the same argument that counsel

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in using you could say that he is not an expert in construction and therefore he doesn't know whether a plant will be constructed or not. And he is not an expert in house building so he doesn't know whether there will be all electric homes or not. And so on and on in that fashion.

It seems to me that the witness has made it clear that this is one of the factors that he has taken into consideration. He has also demonstrated in his testimony that he has relied upon others who are expert in the field and who have made detailed studies of their own.

I believe that his testimony should be allowed to stand.

CHAIRMAN FARBSTEIN: Thank you.

MR. CHARNOFF: Mr. Chairman?

CHAIRMAN FARBSTEIN: Mr. Charnoff.

MR. CHARNOFF: I am just searching through the testimony. Mr. Baron, of course, did not identify which portions of the testimony he really wants struck. If I were to address myself to the testimony I believe that any specific statement with respect to the effect of advertising would appear on page 3 as the last sentence of the middle paragraph which reads, "It is true that demand may increase at a smaller rate without advertising, but the fact remains demand would still increase."

And the first sentence of the next paragraph, "The

Unit 17 effect of advertising by utilities may be to create a fairly constant demand."

In addition to that, there is on page 5 a kind of commentary on the conservation advertising program that involves a certain subjective judgment. The Applicant, I think, has a great deal of sympathy with the position just advanced by counsel for the Federal Power Commission, but if these are the specific areas of objection by Mr. Baron -- and I don't readily see a course dealing with advertising in here -- we would have no objection if those areas were stricken.

CHAIRMAN PARKINSON: In other words, we have found an area where the Applicant agrees with the Intervenor?

MR. CHAMOFF: Mr. Parkinson, it is fair to say that there is a great deal of agreement between Mr. Baron and Mr. Chamoff in this hearing.

CHAIRMAN PARKINSON: I must say that truly the parties have proceeded very responsibly in getting their issues before this Board, both the Intervenor and the Applicant as well as the Staff. What was just meant for light humor.

MR. MARCH: If I may clarify the --

CHAIRMAN PARKINSON: I would appreciate that, Mr. Baron, in view of the remarks of Mr. Chamoff.

MR. MARCH: I cannot take issue with the representation in the written testimony of course material from other locations. But for example, on page 5 in reference to this

10mll have a Watt program, that is just a repetition by the witness. He is not making a conclusion of his own. But, for example, if we go down on page 4 to the third paragraph, he indicates there what I would consider to be a conclusion on his part. It is the conclusions to which I am -- with which I am taking issue because I don't think he is qualified to make these kinds of conclusions. I can rephrase the motion and really ask the panel to read this for what it is worth as was done with regard to other testimony introduced in this hearing, in light of my remarks.

I can withdraw my motion and ask the panel to consider it in that way.

MR. CHAIRMAN: I would support the proposition that the testimony remain in, Mr. Chairman, and those elements of judgment with regard to advertising impact be used for what it is worth just like ~~Arthur~~ DR. Shoenglass' testimony.

CHAIRMAN ANDERSON: We are going to defer ruling on this motion until it is clarified a little further. Dr. Shon is going to ask some questions.

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MR. SHON: There are chiefly two questions. Did I understand someone to say -- I think you, Mr. Nightingale -- that the way in which advertising enters your portion of the work is chiefly through the forecasts of electrical power requirements?

THE WITNESS: True.

MR. SHON: In making a forecast, is there some specific number, weighting factor or something, that you apply to the presence or absence of advertising, that you know of?

THE WITNESS: No, sir.

CHAIRMAN FARMINGDALE: In your opinion, sir, what expertise would be needed to evaluate a forecast as to the advertising potential?

THE WITNESS: You would need somebody, I would say, who is in advertising and who possibly has utility experience or someone who knows the area extremely well, who has lived here and worked here in the advertising field. They may be able to give more definite answers. I would say you would have to live in the area and know what is actually happening in the area, do severe studies, to find out what the effect would be.

CHAIRMAN FARMINGDALE: Mr. Terwilliger, would you have any objection in view of Mr. Dawn's

ar2 withdrawal of his initial motion and his restated motion if the Board accepts the testimony for whatever it is worth?

MR. TOURTELLOTTE: We have no objection.

CHAIRMAN FARMAKIDES: Fine. We will receive the testimony then.

Is there anything further, gentlemen? The Board has another question.

MR. SHON: Regarding the CAPCO system, have you or has anyone calculated a loss-of-load probability for the system with and without Davis-Besse, for example? You mentioned that there exists no real loss-of-load probability criterion, but I wasn't clear as to whether such a number was ever actually calculated.

THE WITNESS: The Commission did a study on CAPCO last year. I was not there -- was not the engineer in charge of it so I can only look and see if he did do that analysis.

HE DID NOT

MR. SHON: Is there any sort of rough rule of thumb or feel for this calculation that you have that would suggest what a 20 percent reserve above native load would correspond to in this probability?

THE WITNESS: It depends on the characteristics of the system. I have -- let's see if I have it with me. In the National Electrical RELIABILITY Council report

and titled "Review of Overall Adequacy and Reliability of the North American Bulk Power Systems," there is a table in the beginning which shows you each loss-of-load probability is not being directly applied to present reserve margin because it depends too much on the type of units you have, the forced outage rate you have and your load to ratio ratio. There are too many variables to take an offhand number.

CHAIRMAN RASMUSSEN: Thank you very much, Mr. Nighswonger.

Mr. Rosenbluth and Dr. Garrick, thank you very much.

(Witness excused.)

CHAIRMAN RASMUSSEN: Let's complete Issue 1 and we will proceed to Issue 3.

MR. CHRISTY: For this purpose, we call Dr. Norton K. Goldman to the witness stand.

Whereupon,

NORTON K. GOLDMAN

was called as a witness on behalf of the Applicants and, having been first duly sworn by a oath, was examined and testified as follows:

MR. CHRISTY: Mr. Chairman, I am handing the reporter a number of copies of a document entitled "Testimony of N. K. Goldman, Relating to Issue No. 3, July, 1973," as

ar4 well as three copies of a document we will be marking as Applicant's Exhibit No. 6.

(The document referred to was marked Applicant's Exhibit No. 6, for identification.)

MR. CHANOFF: Applicant's no. 6 is a document bearing the number NUS1044, and it is entitled "Radiological Impact of Nuclear Power Generation on the Water Quality of Lake Erie, Prepared for Toledo Edison Company by Dan E. Martin, June, 1973."

On the cover page it shows it was approved by Dr. Norton I. Goldman, senior vice president of the NUS Corporation. The Intervenors and the Regulatory Staff have stipulated to the admission of this information, of Exhibit No. 6, as well as the document that I previously described as the testimony of Dr. Goldman in this proceeding. I move that the document, a cover page plus a three-page document with references to Exhibit No. 6, then be incorporated into the record as if read and that Exhibit 6 be received in evidence with it.

CHAIRMAN FARKINGTON: Any objections?

MR. BARON: None.

MR. DAVIS: None.

CHAIRMAN FARKINGTON: It will be so received.

(The document follows.)

UNITED STATES OF AMERICA
ATOMIC ENERGY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
THE TOLEDO EDISON COMPANY	)	
and THE CLEVELAND ELECTRIC	)	Docket No. 50-346
ILLUMINATING COMPANY	)	
	)	
(Davis-Besse Nuclear Power	)	
Station)	)	

TESTIMONY OF

M.I. GOLDMAN

RELATING TO

ISSUE NO.5

JULY 1973

TESTIMONY OF MORTON I. GOLDMAN

Concerns have been expressed in Issue 5 about cumulative effects of all plants operating on the Great Lakes above Lake Erie. NUS has studied the potential contributions of these nuclear power plants and has found them to be insignificant contributors of dose to the general population. This study[1] was based on Regulatory Staff projections of discharges from all presently operating or planned nuclear generating stations on the Great Lakes (except Lake Ontario), in both Canada and the U. S.

Transfer of this material through the series of lakes to Lake Erie was calculated, assuming that no depletion mechanisms other than decay were operative, and concentrations in Lake Erie were calculated for the period out to 2010. Doses to individuals were then calculated which would derive from consumption of water and fish from Lake Erie in the year 2010. The maximum exposure so calculated is to the human liver and amounts to 0.13 mrem/year. The calculated annual population dose to the assumed 15 million users of Lake Erie in the year 2010 is about 220 man-rem from these sources; this can be compared to the approximately 2,000,000 man-rem received by this same population from natural sources. On this basis, the cumulative effects of all these plants is considered insignificant.

1. Martin, D. E. Radiological Impact of Nuclear Power Generation on the Water Quality of Lake Erie. NUS-1044. June 1973.

TECHNICAL QUALIFICATIONS

MORTON I. GOLDMAN
SENIOR VICE PRESIDENT
ENVIRONMENTAL SYSTEMS GROUP
NUS CORPORATION

My name is Morton I. Goldman. My address is 4 Research Place, Rockville, Maryland 20850. I am Senior Vice President, Environmental Systems Group, NUS Corporation, and have served in this capacity since February 1973. I am responsible for all site evaluations, safety analyses, waste management system design and environmental programs conducted by this Group. This has included the evaluation of site and environmental safety factors for a number of nuclear and fossil-fueled plants in this country and abroad including the following nuclear plants: Trino Vercellese (ENEL, Italy), San Onofre (SCE), Malibu (LADWP), H. B. Robinson and Brunswick (CP&L), Point Beach (Wisconsin-Michigan Power Company), Surry and North Anna (VEPCo), Three Mile Island (Metropolitan Edison), Crystal River (Florida Power Corporation), Pathfinder, Monticello Prairie Island and Tyrone (NSP), Burlington, Salem and Newbold Island (PSE&G-N.J.), Dresden, Quad Cities and Zion (Commonwealth Edison), Kewaunee (WPSCo), Calvert Cliffs (BG&E), Diablo Canyon (PG&E), Beaver Valley (Duquesne Light Company), Rancho Seco (SMUD), Trojan (PGE), Duane Arnold Energy Center (Iowa Electric Light & Power Co.), Davis-Besse (Toledo Edison Co.), Perry (Cleveland Electric Illuminating), Greenwood Energy Center and Fermi (Detroit Edison Company), Bell (NYSERG) and Big Rock, Palisades and Midland (CPCo).

I was graduated from the New York University in 1948 with the degree of Bachelor of Science in Civil Engineering. In 1950, I received a Master of Science degree in Sanitary Engineering; in 1958, a Master of Science degree in Nuclear Engineering; and in 1960, a Doctor of Science degree, all from the Massachusetts Institute of Technology.

From 1948 to 1949, I was a Research and Teaching Assistant at the Sanitary Engineering Research Laboratory, New York University, conducting research on water coagulation and assisting in teaching sanitary chemistry and sanitary biology laboratory courses.

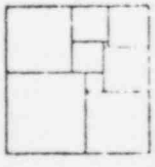
From 1949 to 1950, I was a Research Assistant at the Radioactivity Research Laboratory, Sanitary Engineering Department at Massachusetts Institute of Technology, conducting original research on removal of radionuclides from water by standard water treatment techniques.

From 1950 to 1961, I was a Commissioned Officer with the United States Public Health Service, Division of Radiological Health. I was first assigned to the Radiological Health Training Section from 1950 to 1954 as the engineer staff member lecturing on appropriate aspects of radiological safety and waste disposal.

From 1954 to 1956, I was on loan to the Oak Ridge National Laboratory as Chief of Soils and Engineering Section, Waste Disposal Research Activities. In this position I conducted and supervised research on disposal of radioactive wastes at Oak Ridge National Laboratory.

From 1956 to 1959, I was assigned to Massachusetts Institute of Technology as Project Leader for the Radioactive Waste Disposal Project of the Sanitary Engineering Department and in training in the Nuclear Engineering Department. In the former capacity, I initiated and supervised research on novel methods of disposal of high activity fission product waste materials. In addition, I served on the MIT Reactor Safeguards Committee as its secretary.

From 1959 to 1961, I was designated as Nuclear Installation Consultant with the Division of Radiological Health in Washington, D.C.

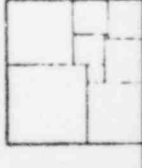


In this capacity I provided technical consultation and assistance to State Health Agencies and other Federal Agencies on health and safety problems associated with nuclear installations. As part of my responsibility, I served as the evaluator responsible for the following nuclear plants: Yankee, Elk River, Indian Point, Carolina-Virginia, Hallam, Pathfinder, Peach Bottom and Humboldt Bay.

Since 1961, I have been with NUS Corporation and active in all of the environmental safety activities described earlier. In February 1966, I was elected Vice President and General Manager of the Environmental Safeguards Division, and in February 1973, elected to my present position which includes responsibility for both my former Division and the Cyrus Wm. Rice Division, The latter Division carries out water and waste water research, design and ecological studies.

I am the author and co-author of a number of papers on radiation and public health, nuclear safety and radioactive waste management.

I am a member of the American Society of Civil Engineers, the American Association for the Advancement of Science, the American Nuclear Society and the Air Pollution Control Association. I am a Licensed Professional Engineer in the States of New York, Maryland and the District of Columbia, and a Diplomate of the American Academy of Environmental Engineering in Radiation Hygiene and Hazard Control. I am also a member of Committee N18 "Nuclear Design Criteria" of the American National Standards Institute. In 1968, I served as the U.S. representative to, and chairman of, an expert panel on waste management practice at nuclear power plants at the International Atomic Energy Agency in Vienna.



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(The document heretofore marked Applicant's Exhibit No. 6, for identification, was received in evidence.)

MR. CHURCHY: I have no further questions of Dr. Goldman on Contention 5, sir.

CHAIRMAN FARMAKIDES: Mr. Davis?

MR. DAVIS: None.

CHAIRMAN FARMAKIDES: No cross-examination?

MR. DAVIS: No.

CHAIRMAN FARMAKIDES: Mr. Baron?

MR. BARON: Mr. Chairman, with the assistance --

CHAIRMAN FARMAKIDES: Excuse me, sir. Before we go into cross, as we said the other day, we would ask you what is the purpose of your cross, sir, and what do you intend to show?

MR. BARON: Would the Chair care for a statement to that effect?

CHAIRMAN FARMAKIDES: Yes, sir.

MR. BARON: That is what I am asking Dr. Davies now.

Mr. Chairman, Dr. Owen Davies is prepared to make a statement to the panel as to the direction the cross-examination would go, if permitted.

CHAIRMAN FARMAKIDES: Dr. Davies, you may do so.

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DR. DAVIES: We would like to establish the bases for some of the assumptions that have been made in this report in order to evaluate the reliability of the conclusions drawn. The reason for this is that it appears to us that the results of this report are the type of thing that was raised by the Intervenors in their contention.

If this is the case, I think it would be of importance to establish whether in fact the calculations are reasonable in nature based upon the assumptions which have been made.

CHAIRMAN FARNAKIDES: Do you have reason to believe, sir, they are not?

DR. DAVIES: I am not sure whether I do or do not until I ask a couple of questions. I think they are in general proper.

CHAIRMAN FARNAKIDES: Excuse me, sir. That is not the issue before us here. First of all, what report are you talking about, sir?

DR. DAVIES: I am talking about the Martin report, NUS1044.

CHAIRMAN FARNAKIDES: As we said the other day, because of failure on your part to proceed with your burden, we did, however, allow you and would permit you to cross if you could show us there was a reason for it. Now, we don't want to fish here. This is not a fishing expedition and I

ar7 cautioned you against it. I want to know if there is a reason that you disbelieve the testimony or if there is a reason why you feel that there is something here that can be developed by you that will be of benefit to the record. If there is nothing that you know of at this point in time that will benefit the record, there is no use in proceeding, sir.

I will give you an additional five minutes to talk to each other.

(Recess.)

CHAIRMAN SAUNDERSON: Mr. Baron, you may proceed.

Dr. Davies, could you please respond?

DR. DAVIES: There are three particular aspects that appear to be wrong in the assumptions, as I see them, from a careful look at the study. The first one being the neglect of the presence of frac fractures. This is indicated in the footnote on page 3 of the text. The assumption made on page 5 of uniform mixing in light of the known current patterns in portions of the lake, especially the western portion of Lake Erie.

In addition, the neglect of long-lived radioisotopes daughters from short-lived parents. I can give you a couple of illustrations of that.

CHAIRMAN SAUNDERSON: So you are taking issue with those terms, and you feel that you have -- that you can

ar8 develop through cross-examination some contrary evidence?

MR. BARON: That is the thrust, yes.

CHAIRMAN FARMAKIDES: All right, proceed.

Before you do so, the Board would like to clarify one thing here.

Dr. Goldman, this study was prepared by Mr. Martin?

THE WITNESS: That's right.

CHAIRMAN FARMAKIDES: What is your relationship, sir, to that study?

THE WITNESS: At the time the study was initiated, I was his supervisor. Now I am his supervisor twice removed.

CHAIRMAN FARMAKIDES: In other words, this was prepared under your supervision?

THE WITNESS: That's correct. I signed the report and approved it.

CHAIRMAN FARMAKIDES: And you are able to discuss it in detail?

THE WITNESS: Yes.

CHAIRMAN FARMAKIDES: All right, Mr. Baron, we will permit the cross.

MR. BARON: Thank you, Mr. Chairman.

CROSS-EXAMINATION

BY DR. DAVIES:

Q With regard to the test reactors, you say there

are numerous reactors. Does this mean five, 10, 15, 20, or what, roughly?

A My guess would be, considering university reactors, it might be in the range of 10 to 20.

Q Are these largely located in the immediate vicinity of the Great Lakes involved, or are they on tributary streams thereto?

A I think they would be primarily on streams which would drain into the Great Lakes rather than directly on them, with the exception, perhaps, of the Big Rock Point reactor --

Q We are not considering that.

A -- which I do not consider to be a test reactor.

Q How are these to be distributed as far as how many would be affecting Lake Michigan and how many would be affecting Lake Huron and how many would be affecting Lake Erie, at least in your estimate, as you see it, by location?

A I don't think I can make any reasonable distribution of these. They would tend to be largely associated with university organizations, but I have no basis for making any numerical estimate of the distribution.

Q Would you have any basis for making a numerical judgment with regard to the size of them? In some cases a research reactor may certainly be fairly large size.

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MR. CHAINOFF: Mr. Chairman, I would object to that question. In addition to the failure of the Intervenors to present any testimony on Contention 5, you will recall that there were interrogatories that we addressed to the Intervenors. One of them was, "State the quantities and concentrations of the effluents from nuclear reactors operating adjacent to Lakes Michigan, Superior, and Huron at the point where such effluents interact with effluents from the Davis-Besse Plant. Specify all assumptions and calculations used to determine such quantities and concentrations."

"Answer: This information will be provided in our testimony."

In terms of trying to anticipate just where the Intervenors think they are going, this was exactly the function of our discovery. So I would say to you that failure to provide testimony was a deficiency all by itself. The failure to provide an answer to an interrogatory, to which this question by Dr. Davies relates, is perhaps a more serious failure.

CHAIRMAN FARMAKIDES: Can we have the first part of the question of Dr. DAvies read back?

(Whereupon, the reporter read the pending question, as requested.)

CHAIRMAN FARMAKIDES: Answer that question, Dr.

Anll Goldman.

MR. CHARNOFF: May I also comment that question NO. 1 in Issue 3 identifies --

CHAIRMAN FARMAKIDES: Mr. Charnoff, let Dr. Goldman answer this. The Board wants to know the answer.

THE WITNESS: The university research reactors with which I am familiar range in size from a few kilowatts in power up to the largest one that, at least, I am familiar with, 5 megawatts in thermal power.

CHAIRMAN FARMAKIDES: Thank you.

Dr. Davies, the point made by Mr. Charnoff is, of course, correct. We have gone over this before. We, the Board, intend to cross in this area. We are allowing you Intervenors to cross in these limited areas that you have indicated to us that there is some contrary evidence that you can develop in cross-examination. We don't want to violate, however, the ruling of this Board of yesterday and the day before. I would hope that you would be able to keep the rest of your questions directly on the point that you initially enunciated to me relating to page 3 and then to page 5.

DR. DAVIES: These are all based on the footnote to 3.

CHAIRMAN FARMAKIDES: I think you are going a little far afield, sir.

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CHAIRMAN FARMAKIDES: I think the Board is going to help here and the Board is going to ask a question.

MR. SHON: Dr. Goldman, I would like to put it as succinctly as I can.

These test reactors, or more properly research reactors, have unknown number and size which you have omitted in this report. Can you give us any idea of what your estimate is as to the amount, the quantity of radioactive materials of various sorts, the percentage, the fraction, that they would contribute at the Davis-Besse point of release compared to what is already there from the reactor or what would be there under the hypothetical situation you have hypothesized for these reactors in the report?

THE WITNESS: I think the only way I can answer that, Dr. Shon, is by reference to the literature on at least one research reactor with which I am familiar. The release of, in this instance, liquid wastes which would affect the Lake Erie area are essentially zero from research reactors. There is no persistent release of radioisotopes as a result of reactor operations. Most of the releases are more related to experiments that are carried out in association with the reactor rather than the reactor operation itself. There is no definitive relationship that I could provide that would relate to power plants, except that they would be minuscule in comparison to an individual power plant, let

the COLLECTION IN this MODEL

2a11 alone [illegible] the [illegible].

CHAIRMAN FARMAKIDES: I would like to see Mr. Chamoff and Mr. Baron and Mr. Davis for an off-the-record discussion.

(Discussion off the record.)

MR. BARON: Mr. Chairman, I think we have another specific question that I have been able to assist Dr. Davies in phrasing.

CHAIRMAN FARMAKIDES: All right. You might also be advised, Mr. Baron, that the three areas of interest to Dr. Davies -- the Board is aware of them and we have already asked one question that we think is ~~not relevant~~ relevant and we will ask a couple of others in that same area.

You may proceed, sir.

BY DR. DAVIES:

Q On page 5 you have indicated that -- you have assumed that projected concentrations are estimated average concentrations over the entire volume of the lake considered. I would like to ask the question, based on this, what evidence exists to indicate that uniform mixing in these lakes is a reasonable assumption?

A I think within some limits -- and the limits relate largely to the times over which these averages are taken and the nature of the sources that contribute to them the assumption of more or less uniform dissemination throughout

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the lake is primarily not a bad one based on the evidence of fallout distribution within Lake Michigan and within Lake Erie. In both of those lakes, this material has been measured throughout the lake and it has been reasonably constant. By reasonably constant, I would mean no more than a factor of three to five different between one location and another averaged over a period of time.

Q Are you saying that this is fallout that has come into the lake from the atmosphere?

A I think the fallout that has been present in the lakes has come both from direct deposition on the lakes and by contributions from the streams and rivers that feed the lakes, so there are contributions from both sources.

Q On page 10 you are having a choice of isotopes to be considered. A couple of those that you have neglected are fairly short half-life isotopes, radioisotopes, which decay into extremely long-lifed radioactive daughters. I am wondering whether we can justify eliminating many of the short-term -- these particular two short-term isotopes, neptunium-239 and plutonium-239 and tellurium-129 decaying to iodine-129.

CHAIRMAN FARMAKIDES: What was your question, sir?

BY DR. DAVIES:

Q Can we justify the neglect of neptunium-139 and tellurium-129 since they decay to very long half-life

Q I wasn't questioning the size of the terms. I was asking about the neglect of long-life daughters that are radioactive from ones that are listed here that have very short half lives.

A I am afraid I can't give any reason for the neglect in the AEC statements.

Q Would you have put them in if you had been doing this study?

A To the best of my knowledge, the only power plants at which these isotopes have been identified -- in fact, I can think of only one -- is Oyster Creek, which is a boiling water reactor. I might have included them on that basis in those boiling water reactor plants which were treated in this analysis. I am not aware of there being identified in discharges from pressurized water reactor systems such as Davis-Besse, although they may have been more recently identified than my examination would have noted.

DR. DAVIES: I think that is adequate.

CHAIRMAN FARMAKIDES: Thank you.

Dr. Shon?

MR. SHON: I think it might be to the point, Dr. Goldman, if you would tell us in the case of the isotopes that Dr. Davies mentioned, that is, neptunium-239 and uranium-129, do you have any idea what kind of contribution to dose downstream calculated by the method used

ans in your report would be contributed by the subsequent plutonium-239 and iodine-129 that comes from these isotopes.

THE WITNESS: In the case of iodine-129, I think it would be infinitesimal. In the case of plutonium, I cannot state that because I think it would require more examination than I have given to that isotope in this context. I don't know, that might be. I would expect it to be extremely small, but I would not be as confident about that prediction as I am about the iodine-129.

MR. SHOW: With regard to the other question posed by Dr. Davies, that of uniform mixing, I feel sort of intuitively that uniform mixing in as large a body of water does indeed reduce concentrations very greatly.

Further, these lakes at certain times of the year, at least, exhibit thermoclines, is they not?

THE WITNESS: Yes, they do.

MR. SHOW: You would not expect this material to mix across a thermocline, would you?

THE WITNESS: I would expect that it would not mix across a thermocline during the stratified season, but this particular phenomena was one of the reasons for my statement earlier that the averaging in the lake volume really depended on the period over which the average took place.

At the time of creation, I would expect that these

ar3 materials would be thoroughly mixed.

MR. SHON: Of course, at the time of overturn. Do you have any idea how much larger the concentrations or rather the doses might be downstream than your report shows if one took the time of year at which the mixing would be least effective in diluting the radionuclides, that is, the most conservative calculation?

THE WITNESS: I think that considering the thermocline typically to have a depth of something in the range of 30 to 50 feet, that the -- that under the worst circumstances, that is, those in which the dilution volume available was essentially the top 30 to 50 feet, that the doses might be as much as a factor of five higher than those projected in this report. The average depth of the Great Lakes, particularly Lake Erie and to some extent Lake Michigan, is somewhere less than 100 feet, so I recall. On this basis, perhaps half or more of the volume might be available -- half or less of the volume might be available for this. It would vary from lake to lake. It would affect the flow-through time, which would in turn affect the decay of materials. I don't think I could give a very straightforward, precise answer, but I would expect that it would be less than a factor of five, greater than those in this report.

MR. SHON: So one might conclude that the

vertical dispersion, so to speak, could be less than you calculated by a factor of three or four or five?

THE WITNESS: During the stratified season, yes, sir.

MR. BROX: As regards the horizontal mixing, have there been any studies using any kind of tracer or marker in water to discover as a function of time of year or anything else how effective lateral mixing is in spreading out.

THE WITNESS: There have been a number of dispersion studies conducted in the Great Lakes. I am most familiar with ones conducted in the Lake Michigan area. There have been some conducted in Lake Erie and Lake Ontario. These generally show a predominance of mixing in terms of what I might call the diffusion mechanism in the nearshore area with rather less involvement of the central areas, so that perhaps only a limited -- I use that term very loosely, but not the entire lake surficial layer is involved in this.

MR. BROX: Superficial, perhaps?

THE WITNESS: I think I would prefer surficial, surface layers. Now I have forgotten what I was. The total surface layer of the lake is not involved in mixing. It is much more effective near shore for those materials contributed from shoreside areas.

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MR. SHON: Do you have any idea what kind of a factor this might introduce into your calculations, be it--

THE WITNESS: Perhaps a factor of two.

MR. SHON: So we are talking from those two effects of something you would estimate as a factor of 10 in order of magnitude?

THE WITNESS: That's right.

MR. SHON: Thank you.

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One other more general question. I gather that the only pollutants, the only cumulative or synergistic effects that you have looked at from effluents produced by other nuclear reactors, as it says in Issue 5, are radioactive pollutants?

MR. WETMORE: The purpose of this particular report was to determine the cumulative amount of radioactive material that might result in Lake Erie as a result of the operation of these plants. Dr. Hollingsey, who testified yesterday, dealt with the synergistic effects of radiation or doses resulting from radiation discharge from Davis-Besse.

An examination of the doses resulting from this analysis of the cumulative effects of all the stations operating indicated that they are sufficiently low, even recognizing the potential uncertainty of an order of magnitude, that any synergism would be no more likely to be effective in this instance than in the instance of the single plant operation.

MR. SHON: How about other things such as, for example, the biological oxygen demand that one plant may create by dumping something into the water and affecting others downstream?

MR. WETMORE: We did not look at that. The request was made for us to look at the radiological effects.

MR. SHON: Thank you.

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CHAIRMAN FARMAKIDES: Did you have any further redirect?

MR. CHARNOFF: No, sir.

CHAIRMAN FARMAKIDES: This concludes the examination by the Board. Thank you very much, Dr. Goldman.

(Witness excused.)

MR. CHARNOFF: Is the next issue Contention 6, sir?

CHAIRMAN FARMAKIDES: No, we are still on 5. Staff?

MR. DAVIS: The Staff has some direct testimony to put in on Issue 5. I will now call Hugh Thompson and Dr. Norman Frigerio. They have both been previously sworn. Whereupon,

HUGH L. THOMPSON, JR.

and

NORMAN A. FRIGERIO

were recalled as a witnesses on behalf of the Regulatory Staff, and, having been previously duly sworn, were examined and testified further as follows:

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DIRECT EXAMINATION

MR. DAVIS: Gentlemen, have you prepared a document entitled, "Supplemental Testimony to Final Environmental Statement Related to Construction of Davis-Besse Nuclear Power Station"?

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WITNESS THOMPSON: Yes.

WITNESS FRIGERIO: Yes.

MR. DAVIS: Are there any corrections to that document?

WITNESS FRIGERIO: None.

WITNESS THOMPSON: No.

MR. DAVIS: Are the contents of that document true and correct to the best of your knowledge and belief?

WITNESS FRIGERIO: Yes.

WITNESS THOMPSON: Yes.

MR. DAVIS: Mr. Chairman, we have previously distributed copies of this supplemental testimony to the members of the Board and the other parties. I have given the reporter 30 copies. I now move that they be bound into the transcript as if read as the direct testimony of the Regulatory Staff on Issue 5.

CHAIRMAN FARNELL: Any objections?

MR. GOLDHOFF: No, sir.

CHAIRMAN FARNELL: Hearing no objections, it will be received and bound into the transcript as if read.

(The document follows.)

SUPPLEMENTAL TESTIMONY

TO FINAL ENVIRONMENTAL STATEMENT
related to construction of
DAVIS-BESSE NUCLEAR POWER STATION
TOLEDO EDISON COMPANY and
CLEVELAND ELECTRIC ILLUMINATING COMPANY

Docket No. 50-346

Issue 5

CUMULATIVE AND SYNERGISTIC EFFECTS ON LAKE ERIE

Effluents from other nuclear reactors operating adjacent to Lakes Michigan, Superior and Huron fall into three categories: thermal, chemical and radioactive.

Thermal and chemical snyergism has been adequately evaluated in the FES in that no significant contributions were attributable to other reactors operating adjacent to those Lakes. The thermal contributions are, at most, a few thousand megawatts per reactor. Similarly, the chemical contributions are, at most, a few tons/year per reactor. Even if several hundred reactors were operating, their total contributions to temperature rises and/or chemical concentrations in Lake Erie would not be detectable by even the most sensitive of biota. Such contributions would be very much smaller than the observed natural variations in Lake Erie. Since at least two of three effects are nonexistent in Lake Erie, there can be no synergism. Synergism requires the interaction of at least two factors.

Radiological effects themselves are certainly no more than additive. Monitoring stations in the area (see section 2.8 of the FES) have failed to show local increments of radioactivity attributable to currently operating reactors.

MR. ENVIS: What is the extent of the Staff's direct testimony on Issue 5.

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CHAIRMAN FARMANIDES: Thank you.

I am going to ask the Applicant first for cross, but I will be asking the same question, Mr. Baron, with respectto this witness as I did on the previous witness. What is it you intend to show on cross?

MR. CHANDLER: I have no cross-examination of those witnesses.

CHAIRMAN FARMANIDES: Thank you.

Mr. Baron?

(Discussion off the record.)

CHAIRMAN FARMANIDES: Back on the record.

Mr. Baron, cross-examination?

MR. BARON: There is no cross-examination, Mr. Chairman.

MR. ENOS: As I understand your supplemental testimony here, you are asserting that the chemical synergism has already been evaluated?

WITNESS VANDENKOLK: Because it was negligible we did not specifically address it in the environmental statements to speak of.

MR. ENOS: There are no cases where thermal or chemical effluents than ourselves, so to speak, upstream of Davis-Besse in the Lake, have effects that are detectable

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at Davis-Besse, are there?

WITNESS FRIGERIO: There are additive effects detectable in the sense that emissions from the early Fermi plant were detected by radiation alert network stations down Lake Erie until it vanished into the noise level someplace between Toledo and Painesville. However, this would be an additive effect, since it is radiative. I know of no way of detecting chemical or thermal effects at that distance unless the quantities of chemicals would be much larger than they have been. That is the only case I can think of and that is the test operation of the Fermi plant.

The Plumbrook plant certainly shows some radioactive additivity again, but since this is a single factor I coudin't consider synergism.

MR. SHON: Thank you.

CHAIRMAN PARMAKIDES: I would like to ask a question.

Have you evaluated the requirements of the Federal Water Pollution Control Act, Amendments of 1972, with respect to Davis-Besse?

WITNESS FRIGERIO: I am familiar with the requirements.

CHAIRMAN PARMAKIDES: In the sense of the Final Environmental Statement, have you examined any applicable limitations?

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WITNESS FRIGERIO: Yes.

WITNESS THOMPSON: With what respect?

CHAIRMAN VARNAKIDES: Are there any applicable limitations that you think relate to Davis-Besse?

WITNESS THOMPSON: They certainly state limits, yes.

CHAIRMAN VARNAKIDES: Have you evaluated those?

WITNESS THOMPSON: That's correct.

CHAIRMAN VARNAKIDES: What is your conclusion?

WITNESS THOMPSON: Davis-Besse, as is stated in the Final Environmental Statement, will meet all the water quality criteria that is presently, as I understand it, in effect in relationship to the Federal Water Pollution Control Act, Amendments of 1972.

MR. SUSH: Has the State of Ohio issued a certification under 401?

CHAIRMAN VARNAKIDES: Are you aware of this?

WITNESS THOMPSON: They have a 21-B certificate.

CHAIRMAN VARNAKIDES: You know this of your own personal knowledge?

WITNESS THOMPSON: That's correct.

MR. CHANOFF: May I just clarify something for the record?

CHAIRMAN VARNAKIDES: Yes, you may.

MR. CHANOFF: Under the Federal Water Quality Act

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of 1970, sir, we were required to have a certification under Section 21-B of that act within 12 months after issuance of the construction permit. I believe that was March 3, 1971, that we received the permit, or March 24, rather. Prior to March 24, 1972, in order to retain the viability of the permit, we did file a Section 21-B certification from the State of Ohio, certifying that we were in compliance with applicable water quality standards.

As you know, in 1972, in the fall, there was the amendment to the Federal Water Pollution Control Act of 1972 establishing the Section 401 certification. There is, I guess, a debatable proposition as to when we receive our operating license or apply for it or obtain it as to whether we will need, in addition to the 21-B certification a Section 401 certification. That is because there is a saving clause in that Federal Water Pollution Control Act of 1972 which at least has been interpreted by the General Counsel of the Environmental Protection Agency in a letter to a number of electric companies, stating that the prior certifications under the 1970 act will continue in effect under that savings clause.

We are examining the question as to whether we ought to apply to the state for a Section 401 certification in connection with our operating license. There is no requirement in connection with this matter.

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CHAIRMAN FARMAKIDES: I was just curious as to whether the Staff had examined it and I wanted to raise that question.

MR. CHARNOFF: Mr. Silberg just reminds me that in the hearings held last May and July on the question of whether the permit should be suspended, the State of Ohio certification under 21-B which had earlier been submitted to the Atomic Energy Commission and to the Environmental Protection Agency was also introduced into the record of the hearing last May and July. So it is a matter of record in this proceeding.

MR. SHON: That was prior, however, to the passage of the FWPCA which requires that [illegible] to 401 certification or does the savings clause eliminate that

CHAIRMAN FARMAKIDES: We won't reach any judgment on that. I wanted to know what the Staff had done.

Would the parties have any objection -- and if so, I would like to hear the objection and I will rule on it -- if this Board were to receive into the record of this case, incorporated by reference into the record of this case, the record of the decision with respect to whether or not construction should be suspended pending a full NEPA review?

MR. CHARNOFF: You are referring to the hearings that were held in May and July, 1970, and the decisions

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thereto? The Applicant would have no objection, sir.

CHAIRMAN FARMAKIDES: Would the Staff have an objection?

MR. DAVIS: I think I understand you, Mr. Chairman. You are saying both the record of the hearings and the initial decision?

CHAIRMAN FARMAKIDES: Yes. Actually the only evidence, of course, insofar as we are concerned would be the record.

MR. DAVIS: The Regulatory Staff has no objection to that.

CHAIRMAN FARMAKIDES: Would the Intervenor have an objection?

MR. BARON: We are just discussing that.

There is no objection.

CHAIRMAN FARMAKIDES: It will, then, be incorporated and this Board might have reason to use it. We are not sure. But it will be incorporated into the record of this case.

We have no further questions. Is there any further redirect?

MR. DAVIS: None.

CHAIRMAN FARMAKIDES: Gentlemen, thank you very much. You are excused.

(Panel excused.)

mr3 CHAIRMAN FARNKIDES: Let's proceed to Issue No. 6.

MR. DAPON: Mr. Chairman, it is a little bit out of order. I realize we have gone beyond. Would it be possible for us to call Mr. Goldman back for one question? It didn't come to our minds at the time, but we had something we wanted to ask him.

CHAIRMAN FARNKIDES: What is the question?

MR. PAPON: It is with regard to the mixing effect of the lake waters. We did talk about that, and there was a question that the Coalition wanted be present to Dr. Goldman with respect to one of the specific lakes.

CHAIRMAN FARNKIDES: Could you state it for me, please?

MR. DAPON: Lake Huron --

CHAIRMAN FARNKIDES: What is the question?

MR. DAPON: Where is it? You had it.

MS. STEBBINS: I didn't write it.

MR. DAPON: Why don't you state it, then?

MS. STEBBINS: I was going to ask him if he was aware of the current effects coming out of Lake Huron into Lake Erie.

CHAIRMAN FARNKIDES: For what purpose, madam? What is the thrust of your question?

MS. STEBBINS: With respect to the water quality of Lake Huron, across through St. Clair, through the Detroit

arf

River, and can be picked up in Lake Erie with practically the same quality, thereby indicating there has been no mixing with the polluted side of the Detroit River.

CHAIRMAN FARMAKIDES: I think the Board will ask that Dr. Goldman please, since he is still in the room, make himself available.

Whereupon,

MORTON I. GOLDMAN

resumed the stand as a witness on behalf of the Applicant and, having been previously duly sworn upon oath, was examined and testified further as follows:

MR. SHON: The penetration through the Detroit River from one lake to the next apparently results in no great mixing with the sides of the river. I think what the Coalition wants to drive at, but I am sure what the Board wants to know, is would the fact that it doesn't mix with the sides of the river have any appreciable effect on that factor we spoke about before, that factor of 10 that one might --

THE WITNESS: I think, Dr. Shon, that is exactly what I was referring to when I said that there was not full participation in dilution of material injected from the shore in the full width of the lake or stream.

MR. SHON: I assumed that is what you meant.

and

THE WITNESS: That is exactly the effect. That would be included in this order of magnitude.

CHAIRMAN FARINGTON: Thank you. We will proceed then to Issue 6, Mr. Cassmeiro.

MR. CHANDLER: Mr. Silberg will adduce the testimony.

MR. SILBERG: Copies of Dr. Goldman's prepared testimony have been earlier distributed to all parties and to the Board. Pursuant to calculation we would move that this be incorporated into the transcript as if read.

CHAIRMAN FARRINGTON: The Board approves and it will be so received.

(The document follows.)

UNITED STATES OF AMERICA
ATOMIC ENERGY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
THE TOLEDO EDISON COMPANY	)	
and THE CLEVELAND ELECTRIC	)	Docket No. 50-346
ILLUMINATING COMPANY	)	
	)	
(Davis-Besse Nuclear Power	)	
Station)	)	

TESTIMONY OF

M.I. GOLDMAN

RELATING TO

ISSUE NO.6

JULY 1973

TESTIMONY OF M. I. GOLDMAN
RELATING TO RADIOACTIVE WASTE MANAGEMENT
AT NUCLEAR POWER PLANTS

Discharges of radioactive materials from nuclear power plants have been governed by a number of different factors. These include fuel clad performance, energy generation and load cycling, waste system design and component performance, and plant systems leakages. With ideal fuel clad performance, fission products are retained within the fuel clad boundary, and radioactivity in fluid systems is confined to products of corrosion and activation. Energy generation and power level will determine the quantities of radionuclides available for discharge, whether from fission or activation.

Load cycling or frequent changes in plant power level may place additional stress on fuel integrity and, perhaps more importantly, result in additional quantities of coolant requiring processing by cleanup or waste management systems. Intermittent leakages may also occur in systems containing radioactive fluids. Such leakages may result in the transfer of radioactive materials into areas or systems which do not normally contain radioactivity. Maintenance and repair activities may also result in the creation of radioactive wastes from decontamination operations. Finally, the capabilities of waste systems and their components to handle and process effectively, unanticipated volumes or compositions of radioactive wastes, has also had a direct bearing on the quantities of radioactive materials released from nuclear plants.

To a considerable extent, these factors operate independently of each other, i.e., leakage of fluid can occur without radioactivity being present due to fuel clad defects, etc. Therefore, the gross behavior of waste discharges from a given nuclear power plant is the result of the effects of each of the factors considered. These radioactivity release data are available for inspection in documents published by AEC,[1,2] HEW/EPA,[3,4,5] and in reports filed by utility companies operating nuclear power plants. These records for operating U. S. nuclear power plants have been examined and are summarized in Tables 1 through 4, and presented graphically in Figures 1 through 6.

Table 1 and Figures 1 and 2 present the total annual discharge of radioactivity (except tritium) in liquids for pressurized water (Figure 1) and boiling water (Figure 2) reactors. Examination of these data indicate a significant degree of variation both between plants and between years for the same plant. Perhaps most noticeable in Figures 1 and 2 is the tendency for the discharges to rise over the first few years of plant life before reaching a plateau (containing significant variability). The rate of rise from initial startup appears to be most significantly affected by fuel clad performance, although other factors have also affected the discharges.

Table 2 and Figures 3 and 4 present data on annual discharges of tritium. The amount of tritium released is primarily affected by the power level, type of reactor (PWR plants release significantly more tritium than BWR plants with the same fuel), and fuel cladding (stainless steel cladding permits the transfer of tritium much more readily than does zirconium alloy cladding). No "aging" trend is apparent.

Table 3 and Figures 5 and 6 present gaseous waste quantities discharged annually by nuclear plants. Again, there is a tendency over the first few years of plant life for discharges to increase, followed by a leveling off of the quantities discharged. In the BWR plants shown, this is directly related to fuel defects. In the PWR plants, the relationship is not as straightforward, since gaseous releases are affected by steam-generator tube leaks and by leakages into containment buildings from the reactor coolant systems, as well as the presence of fuel clad defects.

In the instances of defected fuel and steam generator (and other) leaks, both are amenable to correction on a frequent basis. Partial refueling of a reactor is carried out on an annual basis and defective elements can be replaced at that time, or more frequently if defects are sufficiently severe in number or magnitude. Thus, although a plant may "age", the major source of potential radioactive releases is replaced on a regular basis. Similarly, leaks in steam

generators are plugged during annual refueling outages (or more frequently, if necessary). Additionally, in current plant designs, provisions are usually made to treat this potential source of contaminated fluids prior to their discharge from the plant.

Other differences between plants shown in the attached tables and figures can be related to differences in waste system designs and performance or overall plant operation. Some plants use only filtration and ion exchange for liquid waste processing; others may use evaporators with varying degrees of effectiveness. Hold-up periods for PWR off-gas systems differ, and the quantities released may reflect both this variation and the fraction of gases discharged via other routes (i.e., containment purges and secondary system leakages). Finally, releases may vary due to extended shutdown and maintenance activity. In those instances, cleanup operations would increase radioactivity discharged in liquids, while gaseous emissions would decline sharply.

Taken all together, there is no basis for expecting discharges to continually increase as a plant ages, for the reasons described above. This is supported by the reported releases from operating nuclear power plants, several of which have been in operation for 12 years or more. In view of the further fact that, even at the maximum discharge levels experienced, doses were substantially below regulatory limits, there are no grounds for concern based on "aging" effects as expressed in Issue 6.

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1. Joint Committee on Atomic Energy, Congress of the United States. Hearings, Environmental Effects of Producing Electric Power, Parts 1 and 2, Pp.191-194, 2316-2317. October, November 1969 - January, February 1970.

2. Directorate of Regulatory Operations, U.S. Atomic Energy Commission. Report on Releases of Radioactivity in Effluents from Nuclear Power Plants for 1971.

3. Logsdon, J.E., and Chissler, R. I. Radioactive Waste Discharges to the Environment from Nuclear Power Facilities. BRH/DER 70-2, Bureau of Radiological Health, PHS, HEW. March 1970.

4. Logsdon, J.E., and Robinson, T.L.. Radioactive Waste Discharges to the Environment from Nuclear Power Facilities, Addendum-1 ORP/SID 71-1, EPA. October 1971.

5. Logsdon, J.E. Radioactive Waste Discharges to the Environment from Nuclear Power Facilities. Radiation Data and Reports, 13: 117-129. March 1972.

6. Plant Operating Reports. Data extracted by L. F. Garcia, NUS Corporation.

TABLE 1. TOTAL ANNUAL LIQUID WASTE DISCHARGED[a]

Facility	Gross Beta-Gamma Exclusive of Tritium (curies)													
	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Pressurized water reactors:														
Shippingport	0.083	0.21	0.129	0.09	0.19	0.53	0.14	0.06	0.07	0.08	0.08	0.07	--	--
Yankee			.008	.008	.003	.002	.029	.036	.055	.008	.29	.034	0.011	0.001
Indian Point-1				.130	.164	13.0	26.3	43.7	28.0	34.6	26.0	7.8	81.1	--
San Onofre									.32	1.6	8.0	7.6	1.54	30.29
Connecticut Yankee									.216	3.9	12.8	6.7	5.9	12.29
Robert E. Ginna											.017	10	0.96	.37
Boiling water reactors:														
Dresden-1		.770	2.095	2.61	2.78	3.82	8.7	11.5	4.3	6.1	9.5	8.2	6.2	6.8
Big Rock Point				.2	.63	6.22	2.80	6.12	10.1	7.9	11.81	4.7	3.5	1.09
Humboldt Bay					.397	.664	1.89	2.34	3.13	3.2	1.5	2.4	1.8	1.4
La Crosse											8.7	6.4	17.1	--
Nine Mile Point											.9	28	32.2	34.56
Oyster Creek											.40	18.5	12.1	13.32
High temperature gas-cooled reactor:														
Peach Bottom-1									.0017	.0004	.000185	.006	.007	

(a) 1959-1970 data, from reference (5);
1971 data, from Reference (2); and
1972 data, from Reference (6).

TABLE 2. TOTAL ANNUAL LIQUID TRITIUM DISCHARGES[a]

Facility	Liquid Tritium Discharge (curies)														
	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971[b]	1972[c]
Pressurized water reactors:															
Shippingport	50.0	64.0	99.0	13.2	1.33	2.17	1.39	3.04	27.3	34.8	35.2	20.0	1.71	--	--
Yankee				-	-	-	-	1,300	1,920	1,690	1,170	1,230	1,500	1,680	678
Indian Point-1					-	-	-	-	125	<297	787	1,100	410	725	--
San Onofre										-	2,353	3,530	4,800	4,570	3,478
Connecticut Yankee										221	1,740	5,100	7,400	5,830	5,893
Robert E. Ginna												1.26	110	154	198.11
Boiling water reactors:															
Dresden-1			-	-	-	-	-	-	-	-	2.9	6.0	5	8.7	43.25
Big Rock Point					-	-	-	-	-	-	34	28	54	10.3	10.35
Humboldt Bay						214	100	54	60	166	6.6	<5	<7	<7.5	N.M.
La Crosse												25[b]	20	91.4	--
Nine Mile Point												<1[b]	20	12.4	27.82
Oyster Creek												5.066	22	21.5	61.611
High temperature gas-cooled reactor:															
Peach Bottom-1										-	1	40	<50	14	

(a) 1958-1970 data, from Reference (5);
(b) 1971 data, from Reference (2); and
(c) 1972 data, from Reference (6).

TABLE 3. TOTAL ANNUAL GASEOUS WASTE DISCHARGED[a]

Facility	Noble and Activation Gases (curies)													
	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Pressurized water reactors:														
Shippingport	0.014	0.029	0.103	0.012	0.351	0.0024	0.032	0.030	0.002	0.001	0.000075	0.000019	--	--
Yankee			.00096	21.7	7.4	.95	1.7	2.4	2.3	.68	4.14	17	12.8	33.0
Indian Point-1				-	.0072	13.2	33.1	36.4	23.4	59.7	600	1,800	360	--
San Onofre									4.02	4.83	256	4,200	7,670	19,430
Connecticut Yankee									.021	3.74	190	700	3,250	652
Robert E. Ginna											0	10,000	31,800	31,805
Boiling water reactors:														
Dresden-1			34,800	284,000	71,600	521,000	610,000	736,000	260,000	240,000	862,300	910,000	753,000	877,000
Big Rock Point				25.6	803	783	132,000	705,000	264,000	232,000	200,000	280,000	284,000	258,000
Humboldt Bay					716	5,975	197,000	282,000	896,000	853,000	492,000	540,000	514,000	430,000
La Crosse											480	950	530	--
Nine Mile Point											55	9,500	253,240	683,119
Oyster Creek											7,000	110,000	516,000	866,284
High temperature gas-cooled reactor:														
Peach Bottom-1								.00126	7.76	109	71.5	5.7	122	

(a) 1959-1970 data, from Reference (5);
1971 data, from Reference (2); and
1972 data, from Reference (6).

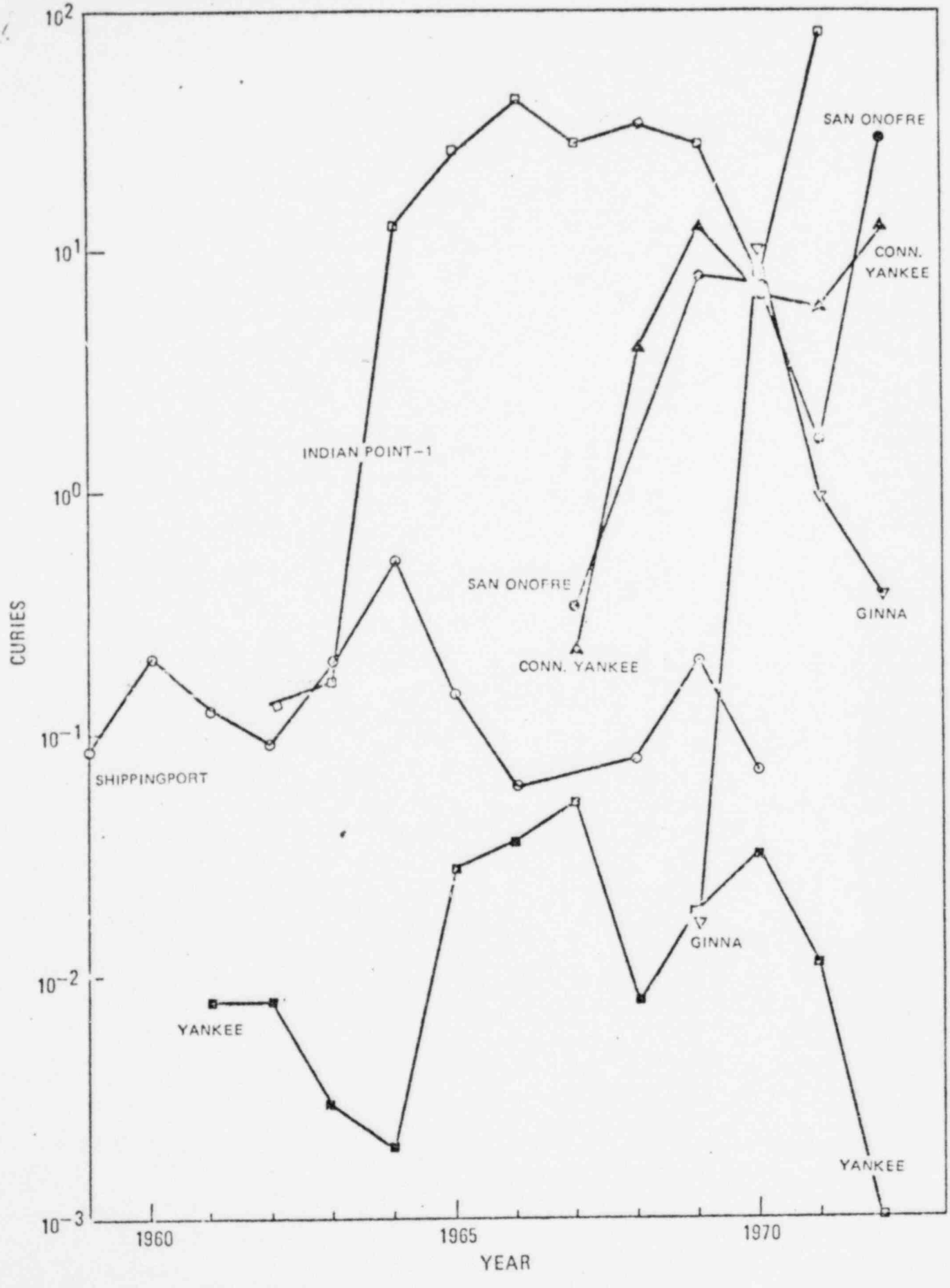


Figure 1 Total Annual Liquid Waste Discharged, Gross Beta–Gamma, Exclusive of Tritium (Curies), Pressurized Water Reactors

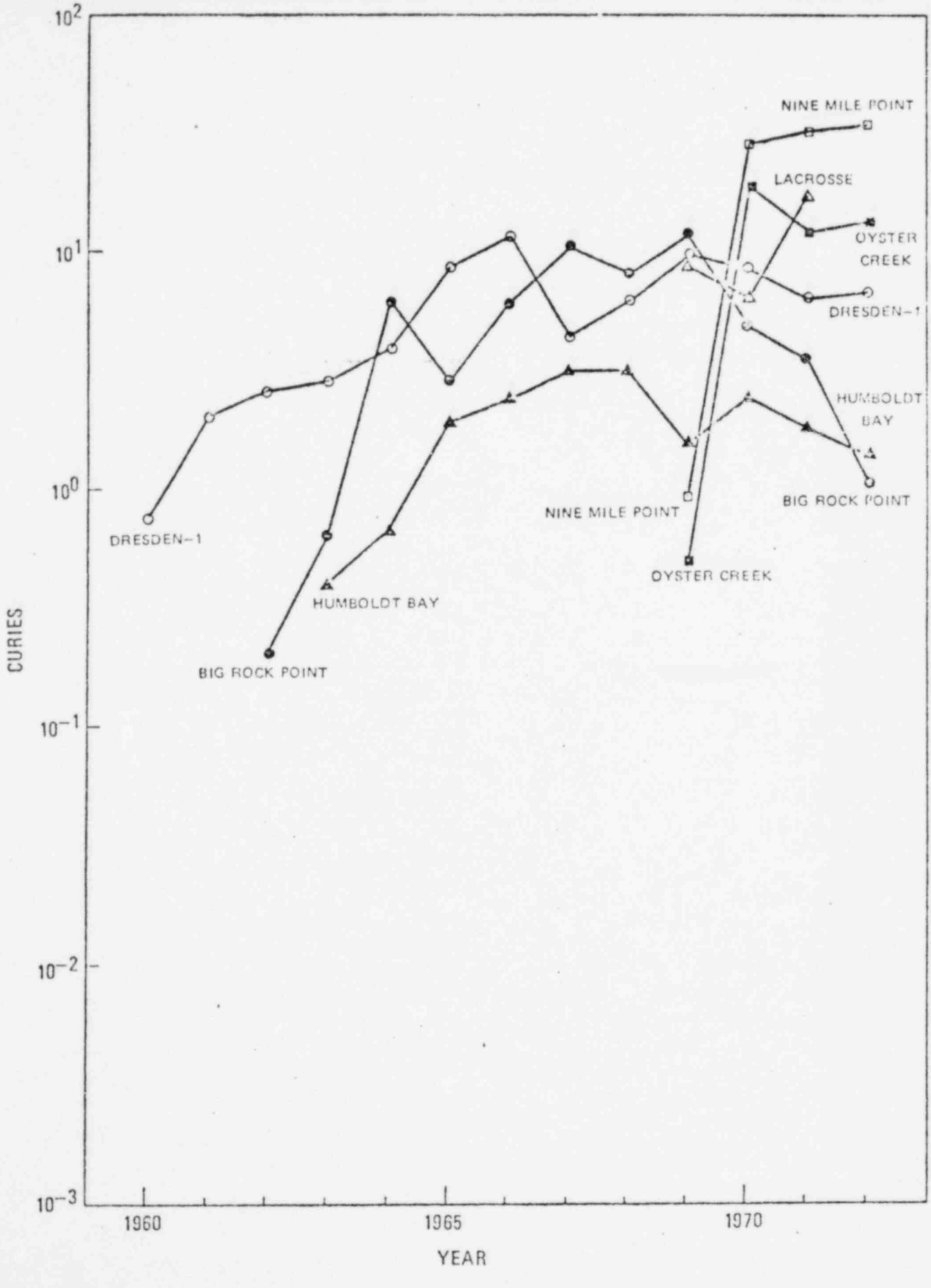


Figure 2 Total Annual Liquid Waste Discharged, Gross Beta–Gamma, Exclusive of Tritium (Curies), Boiling Water Reactors

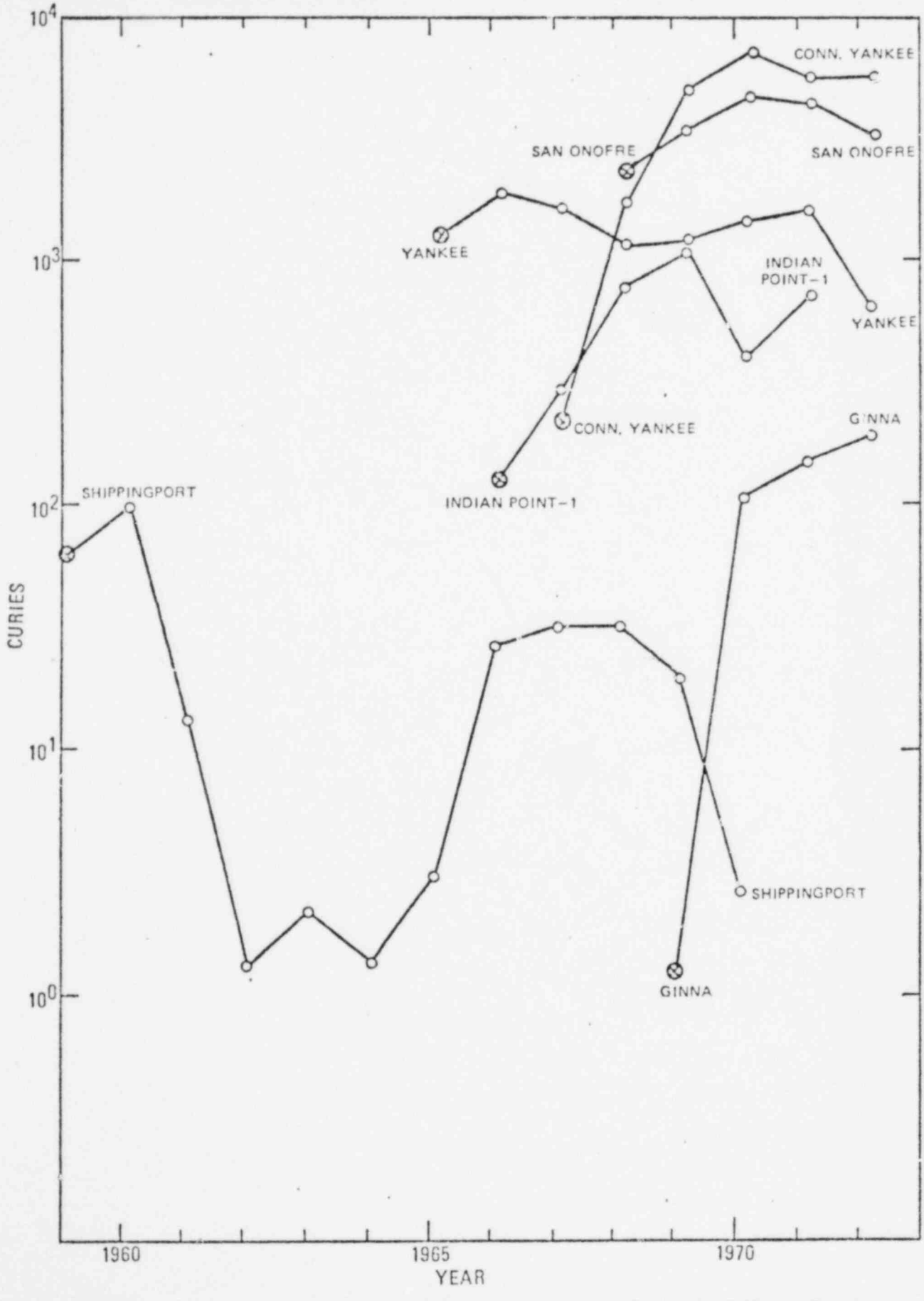


Figure 3 Total Annual Liquid Tritium Discharges, Pressurized Water Reactors

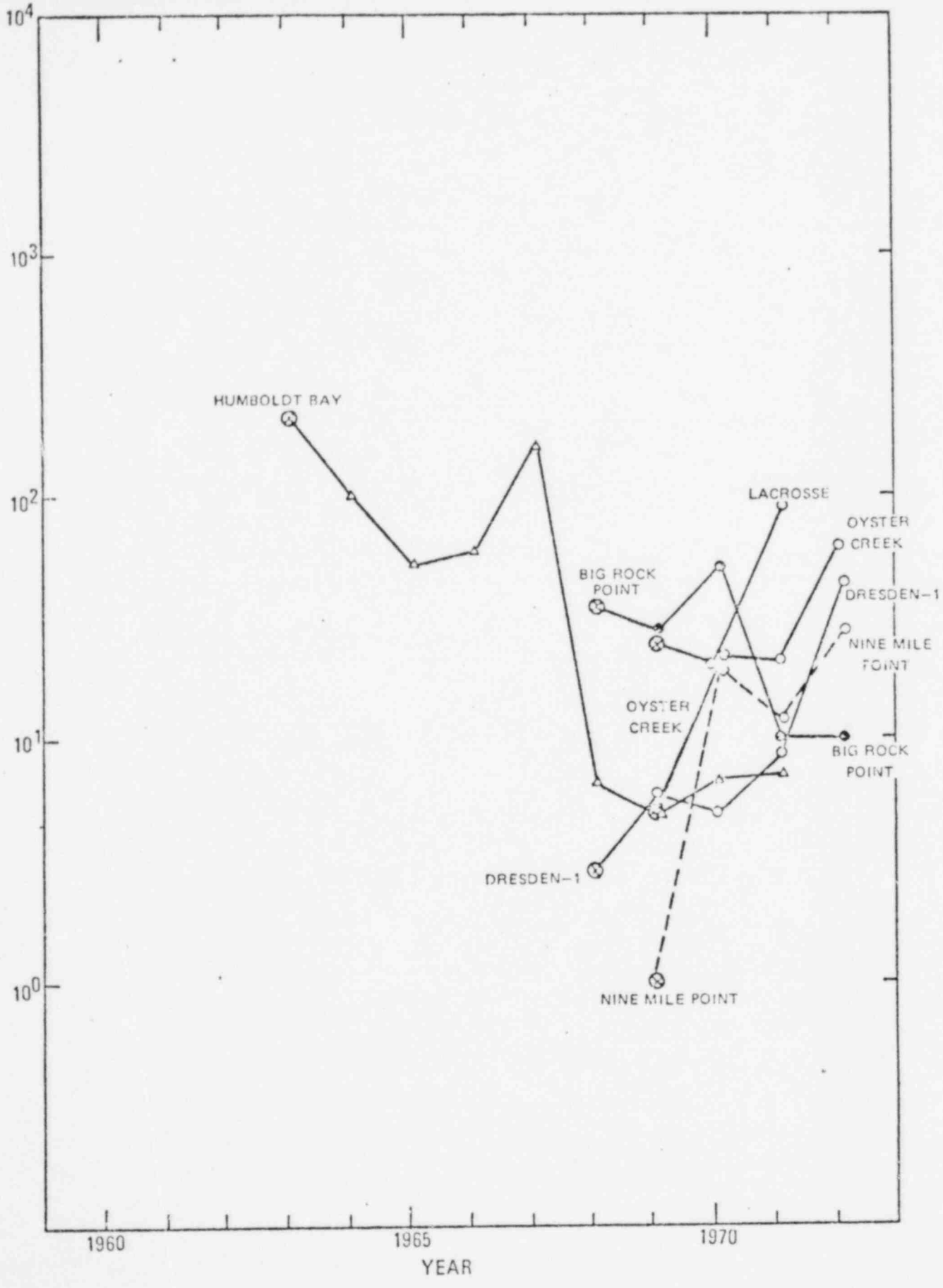


Figure 4 Total Annual Liquid Tritium Discharges, Boiling Water Reactors

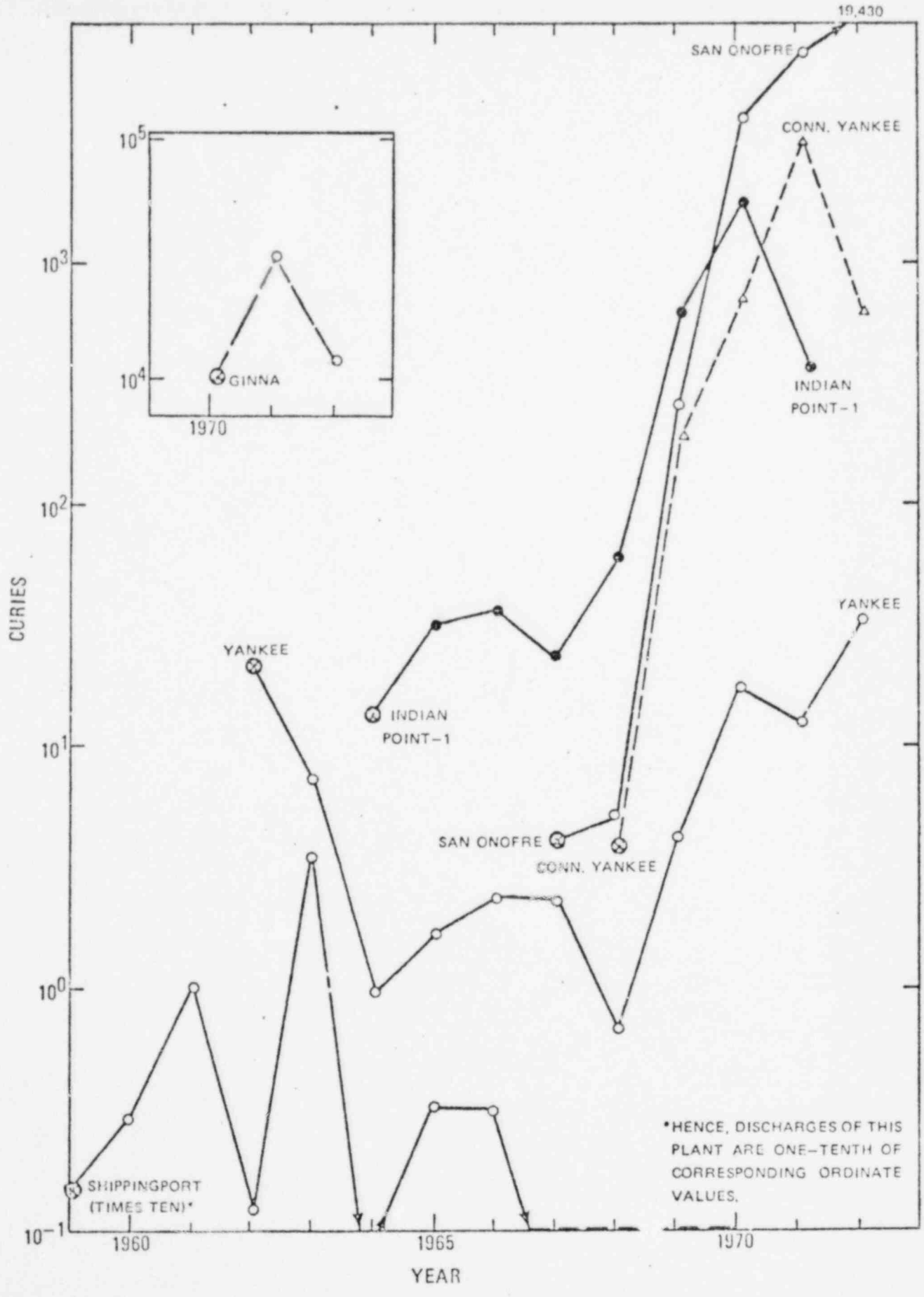


Figure 5 Total Annual Gaseous Waste Discharged, Noble and Activation Gases, Pressurized Water Reactors

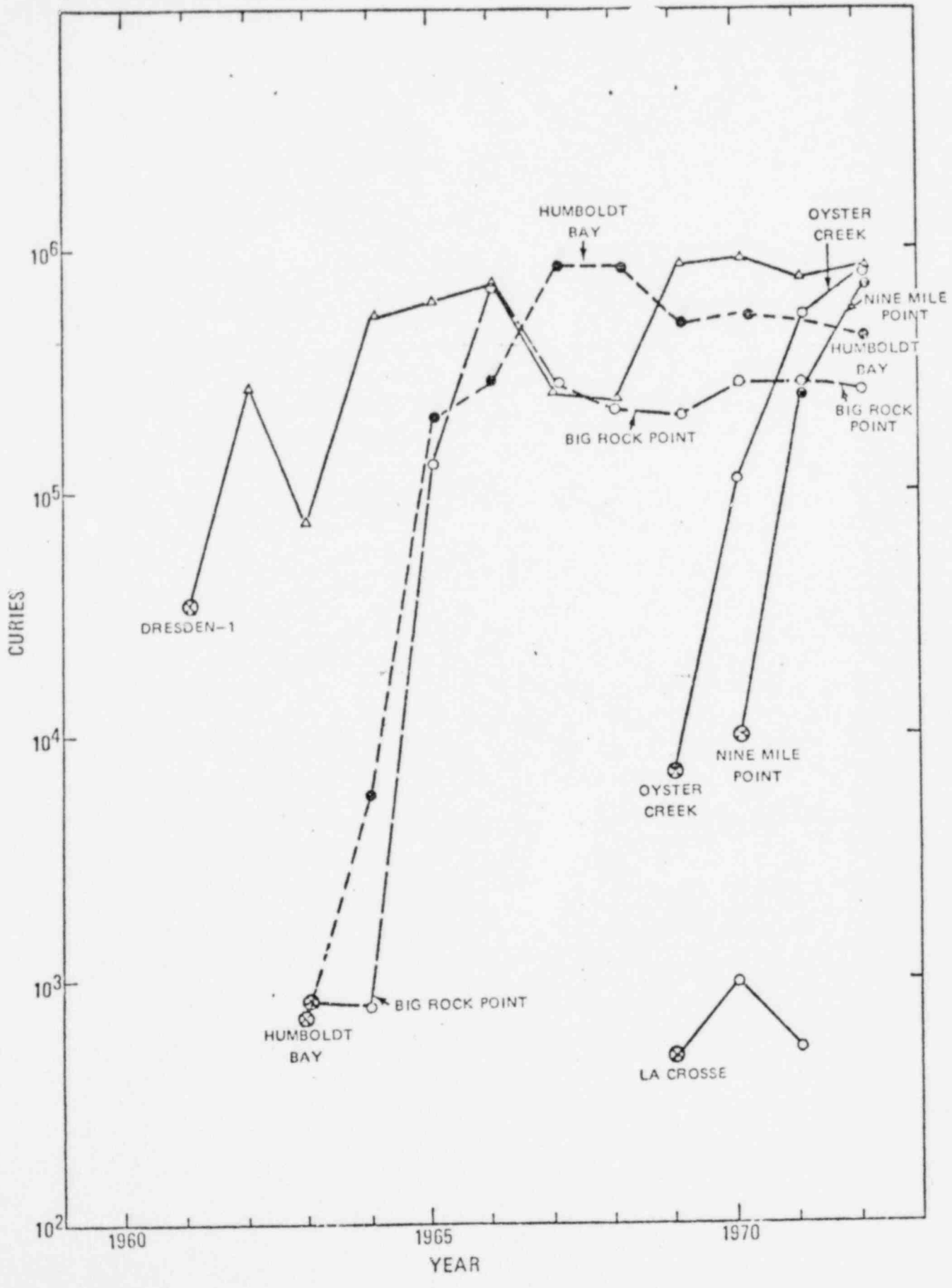


Figure 6 Total Annual Gaseous Waste Discharged, Noble and Activation Gases, Boiling Water Reactors

TECHNICAL QUALIFICATIONS

MORTON I. GOLDMAN
SENIOR VICE PRESIDENT
ENVIRONMENTAL SYSTEMS GROUP
NUS CORPORATION

My name is Morton I. Goldman. My address is 4 Research Place, Rockville, Maryland 20850. I am Senior Vice President, Environmental Systems Group, NUS Corporation, and have served in this capacity since February 1973. I am responsible for all site evaluations, safety analyses, waste management system design and environmental programs conducted by this Group. This has included the evaluation of site and environmental safety factors for a number of nuclear and fossil-fueled plants in this country and abroad including the following nuclear plants: Trino Vercellese (ENEL, Italy), San Onofre (SCE), Malibu (LADWP), H. B. Robinson and Brunswick (CP&L), Point Beach (Wisconsin-Michigan Power Company), Surry and North Anna (VEPCo), Three Mile Island (Metropolitan Edison), Crystal River (Florida Power Corporation), Pathfinder, Monticello Prairie Island and Tyrone (NSP), Burlington, Salem and Newbold Island (PSE&G-N.J.), Dresden, Quad Cities and Zion (Commonwealth Edison), Kewaunee (WPSCo), Calvert Cliffs (BG&E), Diablo Canyon (PG&E), Beaver Valley (Duquesne Light Company), Rancho Seco (SMUD), Trojan (PGE), Duane Arnold Energy Center (Iowa Electric Light & Power Co.), Davis-Besse (Toledo Edison Co.), Perry (Cleveland Electric Illuminating), Greenwood Energy Center and Fermi (Detroit Edison Company), Bell (NYSERG) and Big Rock, Palisades and Midland (CPCo).

I was graduated from the New York University in 1948 with the degree of Bachelor of Science in Civil Engineering. In 1950, I received a Master of Science degree in Sanitary Engineering; in 1958, a Master of Science degree in Nuclear Engineering; and in 1960, a Doctor of Science degree, all from the Massachusetts Institute of Technology.

From 1948 to 1949, I was a Research and Teaching Assistant at the Sanitary Engineering Research Laboratory, New York University, conducting research on water coagulation and assisting in teaching sanitary chemistry and sanitary biology laboratory courses.

From 1949 to 1950, I was a Research Assistant at the Radioactivity Research Laboratory, Sanitary Engineering Department at Massachusetts Institute of Technology, conducting original research on removal of radionuclides from water by standard water treatment techniques.

From 1950 to 1961, I was a Commissioned Officer with the United States Public Health Service, Division of Radiological Health. I was first assigned to the Radiological Health Training Section from 1950 to 1954 as the engineer staff member lecturing on appropriate aspects of radiological safety and waste disposal.

From 1954 to 1956, I was on loan to the Oak Ridge National Laboratory as Chief of Soils and Engineering Section, Waste Disposal Research Activities. In this position I conducted and supervised research on disposal of radioactive wastes at Oak Ridge National Laboratory.

From 1956 to 1959, I was assigned to Massachusetts Institute of Technology as Project Leader for the Radioactive Waste Disposal Project of the Sanitary Engineering Department and in training in the Nuclear Engineering Department. In the former capacity, I initiated and supervised research on novel methods of disposal of high activity fission product waste materials. In addition, I served on the MIT Reactor Safeguards Committee as its secretary.

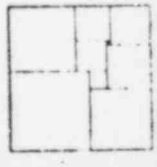
From 1959 to 1961, I was designated as Nuclear Installation Consultant with the Division of Radiological Health in Washington, D.C.

In this capacity I provided technical consultation and assistance to State Health Agencies and other Federal Agencies on health and safety problems associated with nuclear installations. As part of my responsibility, I served as the evaluator responsible for the following nuclear plants: Yankee, Elk River, Indian Point, Carolina-Virginia, Hallam, Pathfinder, Peach Bottom and Humboldt Bay.

Since 1961, I have been with NUS Corporation and active in all of the environmental safety activities described earlier. In February 1966, I was elected Vice President and General Manager of the Environmental Safeguards Division, and in February 1973, elected to my present position which includes responsibility for both my former Division and the Cyrus Wm. Rice Division, The latter Division carries out water and waste water research, design and ecological studies.

I am the author and co-author of a number of papers on radiation and public health, nuclear safety and radioactive waste management.

I am a member of the American Society of Civil Engineers, the American Association for the Advancement of Science, the American Nuclear Society and the Air Pollution Control Association. I am a Licensed Professional Engineer in the States of New York, Maryland and the District of Columbia, and a Diplomate of the American Academy of Environmental Engineering in Radiation Hygiene and Hazard Control. I am also a member of Committee N18 "Nuclear Design Criteria" of the American National Standards Institute. In 1968, I served as the U.S. representative to, and chairman of, an expert panel on waste management practice at nuclear power plants at the International Atomic Energy Agency in Vienna.



[illegible]

[illegible]

BY MR. [illegible]:

Q Mr. Goldman, let me ask you a few questions with respect to Item No. 6, directing your attention to the response of the candidate to Applicant's request for property disposition. Paragraph No. 6 under Item 6 in the affidavit signed by Evelyn Stebbins sets forth the Alaska Directory Concentration for the Fairbanks, the Indian Point Unit No. 1 and the Fox Park Point [illegible], as a percent of timber.

Would you tell me -- Mrs. Stebbins' numbers referred to in paragraph 6 stop at 1961 for the Indian Point Unit No. 1 and 1969 for the Big Bear Point Unit. What does the table cited by Mrs. Stebbins as the source of her numbers show on the percentage of limits for those numbers in more recent years?

A Your Indian Point No. 1 in the year following the last year in her response, 1967, it shows 1.30 percent. 1968 shows 1.65 percent. 1969 shows 1.5 percent, and 1970 shows 0.28 percent. The percentages in these four years are lower than those in the years '61, '65 and '67, which she includes in her response.

lmij

Q And for the Big Rock Point Unit?

A For Big Rock Point the values for 1969 and 1970, which are the two years following those she has included, go down to 5.5 percent and 3.1 percent.

Q Thank you.

In any event, are these percents of limits a valid basis for comparison from year to year of releases from these reactors?

A Not in my judgment in terms of looking at releases because the basis, as indicated by the table to which she referred, changes from year to year in a number of these cases. That is, in one year the appropriate limit may be one numerical value. In another year it may be another numerical value. So that the percentage of limit is really a percentage of a constantly shifting number. It makes it very difficult, then, to compare those.

Q For the record, Dr. Goldman, in paragraph 5 of Mrs. Stebbins' affidavit, referring to Table No. 4 in Addendum No. 1 of the report on radioactive waste discharges, does this document to which I just referred present the actual release information for these two reactors?

A Yes, it does.

Q What does that data show?

A Well, the data is shown for those years in the testimony that I prepared and submitted for this hearing.

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This is the material referred to in Table 1 of my prepared testimony and also presented graphically in Figures 1 and 2 for liquid waste releases.

Q Looking at all reactors and not just the few that are referred to in Mrs. Stebbins' affidavit, what conclusion would you draw on the effects of aging on releases from nuclear power plants?

A As indicated in my prepared testimony, there is not any obvious effect of aging as such on the radioactive releases from nuclear power plants. Releases do tend to increase after start-up, which is anticipated, since you start with a clean nuclear plant with essentially no radioactivity inventory.

As the fuel is burned up, so to speak, more radioactivity is generated and more becomes available for release. However, there is no consistent pattern in continually increasing these releases since first the source of the radioactive material, that is, fuel which given rise to, shall we say, free-floating fission products, can be and is replaced at regular intervals, usually annually, but more frequently in these because of leakages, and other components in the plant that may deteriorate with use can be and are replaced as they are necessary to make the requirements of the technical specifications and normal good housekeeping practices within the plant.

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MR. SILBERG: At this point, I would like to ask Mr. Lowell Roe also to take the witness chair for some supplemental questions, again addressed to matters raised in the Intervenor's response to our motion for summary disposition.

Whereupon,

LOWELL ROE

was recalled as a witness on behalf of the Applicant, and, having been previously duly sworn, was examined and testified further as follows:

DIRECT EXAMINATION

MR. SILBERG: In the Intervenor's response to summary disposition motion, Mrs. Stebbins in her affidavit indicated that corrosion of valve packings, bearings, and fittings would lead to increases in the releases of radiation. Would you expect that corrosion in reactor systems would occur which could result in increased releases?

WITNESS ROE: No.

MR. SILBERG: What is the basis for your conclusion?

WITNESS ROE: Because the selection of material in all the nuclear systems containing radioactive fluid has been made to assure that there is a minimum of corrosion potential. As an example, the material for the tanks, pressure vessels, piping, and valves is stainless steel or is

carbon steel clad with stainless steel, which has excellent corrosion resistance properties. In any event, the very small amount of corrosion which will normally occur will not affect the integrity of any station system, their pressure-retaining capability or their ability to perform their design functions.

MR. SILBERG: With specific reference to valve packing, what steps have you taken to minimize any possible corrosion?

WITNESS NOE: Very careful attention has been made to the selection of valve stem packing for valves in the nuclear systems of this station to minimize the normal wear associated with stem packings.

MR. SILBERG: In the event that leakage of radioactive fluids were to occur as a result of wear or corrosion of valve packing, would such leakage be detectable and how would it be detected?

WITNESS NOE: Yes, it would be detected. Any leakage from the station fluid systems would be detected by normal instrumentation within the systems and buildings where the systems are located. This instrumentation includes pressure, flow, level, sump-tap, sump levels, radiation and humidity monitoring as well as visual observation.

MR. SILBERG: Referring to the question of leakage, also mentioned in Mrs. Stubblefield's affidavit, would

5mil

these be subject to corrosion?

WITNESS ROE: Bearings are generally not located within and are not a part of the pressure-retaining system and as such are not subject to corrosive -- to corrosion conditions.

MR. SILBERG: In the event that corrosion of bearings were to occur and that this corrosion resulted in leaks, would these leaks be detectable and how would they be detected?

WITNESS ROE: They would be detectable by the same methods previously described.

MR. SILBERG: In her affidavit, Mrs. Stebbins also mentioned the possibility of corrosion of fittings.

Would you expect corrosion of these to occur and if not, why not?

WITNESS ROE: No, because the fittings in the fluid piping system are the same material as the pipe system themselves, which are corrosion-resistant.

MR. SILBERG: But even in the event that corrosion of fittings were to occur and that this corrosion would cause leaks, would these leaks be detectable and by what methods would they be detected?

WITNESS ROE: Yes, by the same methods previously described.

MR. SILBERG: Are there any valves, bearings, or fittings which could leak that are inaccessible to

6mil repair if repair were necessary to stop leakage?

WITNESS NOE: No.

MR. SILBERG: Is there any reason why a leak which is so small as to be undetectable would need to be repaired at all?

WITNESS NOE: If it is so small as to be undetectable, it can't be termed a leak.

MR. SILBERG: Are there any leaks which could occur which would not be detected by normal plant instrumentation or normal visual observation?

WITNESS NOE: There are no leaks of any significance or consequence.

MR. SILBERG: Thank you.

Those are all the direct questions I have. The witnesses are available for cross.

CHAIRMAN FARKUHSON: Let's take a recess until a quarter of 4:00, 3:45.

(Recess.)

21 CHAIRMAN FARMAKIDES: May we proceed, please?

arl The parties are continuing on the stipulation that we spoke about earlier so we are going to give them additional time. How much time would you need?

MR. CHARNOFF: Three minutes ought to be enough to decide this.

CHAIRMAN FARMAKIDES: We will grant an additional five minutes of recess.

(Recess.)

CHAIRMAN FARMAKIDES: Please come to order.

We are very pleased that the parties were able to reach an understanding with respect to the procedure on the stipulation and I think we are very close to having a stipulation. However, it hasn't been completed and the Board has given the parties the opportunity of submitting the stipulation during the week of August 6. In addition, we expect, as we said earlier, to receive the rebuttal of Dr. O'Farnglass and you may give that to us on August 6.

MR. BARON: Fine.

CHAIRMAN FARMAKIDES: If you can't send it in the interim, you may bring it on August 5 and give it to the parties.

MR. CHARNOFF: There were a number of limited appearances, while we are on the subject. I think you

mt2 invited comments from the Regulatory Staff and the Applicants on those. Can we provide a response to those on that occasion?

CHAIRMAN HARBOUR: Rather than today? That would be fine.

Now, have the parties also agreed to a schedule for proceeding toward August 6? Are you all -- have you discussed it at all? We will do it, then, during the week. Perhaps Monday or Tuesday we might get together by a telephone conference call and discuss it. It shouldn't be much of a problem. I will facilitate the conference call.

The proposed findings coming in from the parties -- I want to be clear on this right now because I am sure some of you will begin to prepare your proposed findings on the issues completed. We want them to be complete. We want them in accordance with the rules. We want citations for the proposed findings. I think that is very clear.

Gentlemen, we are ready for cross. Does the Staff have any cross?

MR. DAVIS: None.

CHAIRMAN HARBOUR: Mr. Baron?

MR. BARON: Dr. Davies has proposed some questions. I have indicated to him again as we did with respect to Issue 5 that he should indicate to the Board the specific direction in which he is going and he is prepared to do that.

CHAIRMAN FARMAKIDES: Dr. Davies?

DR. DAVIES: Dr. Goldman looked at the overall trend of all the sectors that he was considering. There seemed to be examples that do not agree with this overall trend in the data that he has presented.

CHAIRMAN FARMAKIDES: Does this testimony relate to the -- the motion for summary disposition of the Applicant was granted except as to those facts that were controverted. Now, does your cross go to these facts, the controverted facts?

DR. DAVIES: May I have a clarification on what the controverted facts were?

(Discussion off the record.)

CHAIRMAN FARMAKIDES: Do you have it before you, sir?

MR. BARON: No. Give me a reference.

CHAIRMAN FARMAKIDES It is in the transcript.

(Discussion off the record.)

DR. DAVIES: There are two specific examples that do not seem to agree with fact 2 in Issue 6 as proposed by the Applicant in his summary motion for disposition.

CHAIRMAN FARMAKIDES: And you would tend to --

DR.DAVIES: To cite them as examples to indicate that perhaps the fact may apply in many cases, but not necessary to all cases.

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CHAIRMAN RANDOLPH: Dr. Davies, proceed, sir.

CROSS-EXAMINATION

DR. DAVIES: One of the documents Dr. Goldman has referred to in his testimony is radioactive waste discharges to the environment from nuclear power facilities, addendum 1, ORP-SID-71-1. We look on page 3 of this item and we find the statement in the first full paragraph of that page, "Gaseous discharges per unit of power produced from San Onofre and Connecticut Yankee increased by factors of 140 and 175 respectively from 1960 to 1970."

MR. GILBERT: Is there a question?

DR. DAVIES: The question is coming now.

The first question, do you agree with that statement?

WITNESS GOLDMAN: I have no basis to question the arithmetic of EPA.

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DR. DAVIES: How do you explain it?

WITNESS GOLDMAN: I think in both of those plants over those years the plants had difficulty with steam generator tube leaks which resulted in a substantial increase in thedischarge of gaseous waste via the secondary system thrcugh the turbine condenser air ejector valve gaseous discharges were larger than they had been. During this time period they generated less electricity because they were shut down for repair. As a result, the combination of the higher release and the lower energy generation resulted in a substantially higher discharge per unit of power produced as this report indicates. Those repairs, however, I think were made and if you refer to the figures attached to my testimony, they will indicate that in later years the gaseous discharges -- I had better make sure of that -- for Connecticut Yankee came down substantially between 1971 and 1972. Those for San Onofres continued up.

I am not aware of the data for 1973 for that plant so far.

DR. DAVIES: The data referred to in your Figure 5 for clarification purposes is not discharge per unit power, but discharges?

WITNESS GOLDMAN: That's right. It is the total number of curies. The gaseous discharges per unit of power have no biological effectiveness on their own. It is the

total gaseous discharges that do have the biological effect.

DR. DAVIS. I will ask one more question. If it is one of cubic, you can call me. If the increase chain is the discharge product then the discharge per electric power unit, which is the great value of the Davis No. 2 listed in your -- under Canus 2?

MR. CARPENTER. Mr. Chairman, that is a legal question, but that is in connection to his contention to. I think how to do with aging. What we were demonstrating is that if, in fact, there were aging phenomena, one would expect that over a period of time the reliance would begin to exceed the generation of power. If the plants operated to some high half power level. If aging occurred to put worse as a statistical matter one would expect to see the reliance tools to exceed that. The purpose of the Davis chapter in No. 2 is supported by the affidavit by Dr. Goldman and is supported by the direct showing that the various reactors have had different experiences, some going up at different times and some going down, is that there is no aging phenomena or such that is not controllable.

CHAIRMAN KRAMISCHEVSKY. Thank you, Mr. Chappell. Let me try that question. We have an interest. The Board would like to frame it. Mr. Shon.

MR. SHON. I believe that you have covered it,

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since it is a discharge it is that it is pertinent to the hazard that will be presented, the question that Dr. Davies wanted answered was simply why you had used discharge per unit power and I will ask was it indeed to show something else. I think Mr. Charnoff was trying to explain this, as a matter of fact, weren't you?

MR. CHARNOFF: Yes. The statement of fact is prepared by the attorney, sir, based upon the affidavit. It seems to me that since we prepared the statement of fact that if you would like to examine us on that, I think that would be reasonable.

CHAIRMAN PAPADAKIS: We are asking for Dr. Goldman's opinion on it.

WITNESS GOLDMAN: I think the figure that I presented with my affidavit was a figure taken from this same document to which we have been referring and the discharges shown are the total discharges shown, but they are shown on the same graph as the total electric generation in that year. It is not a discharge per unit energy generation as such that these graphs represent, although the two parameters involved are identified on the same graph, although separately. The point that I was attempting to make in the affidavit that I felt could be made most succinctly and without benefit of the material attached to my testimony, which was frankly not available

at the time the affidavit was filed, was to indicate a general parallelism between electric power generation and waste discharge, whether gaseous or liquid, that there was an approximate parallelism in these two curves. One was not increasing radically more rapidly than the other and that, therefore, there would be more or less constant relationship between the energy generation and waste discharge and since this primarily reflects older plants the data in the affidavit represents other plants, some of which have been in operation since 1957, 1958, and 1960, and it does represent a condition which would be expected to show agony if such a phenomena were present.

The gaseous discharges would rise at a rate very much more rapidly than would the generation rate or the energy generation. And similarly, for the liquid waste. This does not appear in either of these two graphs. It does not appear in the individual plants when plotted separately as I have done in the testimony that I have prepared for this hearing. There is no continual increase in release from a plant which proceeds at a rate substantially greater than the energy generation developed from that plant.

23 Releases have a tendency to rise during
arl the first few years and then to oscillate around what I called in my testimony a quasi-equilibrium value. They rise over a narrow range and don't continue to rise over the life of the plant. In looking further at this, at about 2:00 o'clock this morning I examined data that was used as a basis for my testimony in this same sort of graphic representation to see if the addition of new plants, substantially since 1970, had changed this trend in any way as shown in those figures attached to my affidavit. And in fact, it does not appear to do so. The total of gaseous release and liquid release parallels the energy generation both from the older plants and from the newer ones as well. The totals, of course, are very much larger. The energy generated by new plants is very much greater than the older ones and the amount of waste released from the newer plants has tended so far to be very much greater than the older ones. But the two curves still seem to be relatively parallel to each other.

CHAIRMAN PARMENIDES: Thank you, sir.

Mr. Baron?

MR. BARON: I think now we can address ourselves to that second sentence of Item 3, which was the other one permitted for cross-examination.

MR. SILBERG: Those questions would be addressed

am2 so Mr. Ree is right of his supplemental subsidy.

MR. DAVID: You make the normal customer of that paperweight?

MR. STONE: That's correct.

CR. CRUZ: I have one additional question. This is what needed to transpire I and the public transit thereof, I am supported by adequate mass to Mr. Ree. The question is, do trains to weathers always develop where they can be located readily and expelled readily during normal scheduling outages?

MR. [illegible]: I'm sorry. You are making the assumption that leaks always develop. I can't necessarily --

CR. CRUZ: All right. Let's put it at least to develop. If leaks develop in quarters, are they likely to develop in locations where they can be readily located and together during normal scheduling outages?

MR. [illegible]: This is totally based. I wish in the design of a plant we could always select my where we might have a leak. It would call a lot of things and it would be of great benefit. That is the best I can say. We try to design, as I pointed out, so that equipment and components that are most vulnerable to wear and to maintenance are located so they receive and routine maintenance can be done. It is impossible to locate every component of a fluid recirculating system so it can that area and accessibility as any point.

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DR. DAVIES: That is all, Mr. Chairman.

CHAIRMAN TSAMANIDES: The Board has a couple of questions that it wishes to pose.

MR. SHON: One is sort of further in this direction. I think what we would like to get on the record is, to your knowledge, in the experience of the nuclear industry have there been many cases where leakage paths did develop that were not readily repaired? Dr. Goldman, for example, mentioned steam generator tubes. Have there been cases, any or many cases, in which leaks developed which were not detected or were not readily repairable?

WITNESS ROE: I would say, sir, that leaks are, to my knowledge -- there have been very few instances where there were leaks that were not detected. Leaks that were not repairable -- it depends upon the particular area of the leak, as to how easy it is to repair. There have been steam generator tube leakage experiences which have been extremely difficult to repair. The difficulty is essentially the radiation dosage to the workers involved and the health physics precautions that you have to take to protect the workers in order to permit them to work and to decontaminate the radioactivity as much as possible prior to that.

lmfl

MR. SHON: What in general happens when a steam generator tube leak, for example, occurs and it is very difficult to repair? Do people usually repair them anyway, although it is difficult, or go on at a higher emission rate?

WITNESS ROE: No, sir. You can operate for a very limited time or with a very limited leak. However, we are faced with extremely stringent technical specification limits that are imposed by the operating license conditions and we cannot operate if we approach or exceed -- or I should say if we exceed that technical specification limit. In that case we would have to shut down and repair the leak.

MR. SHON: Thank you.

CHAIRMAN FARMAKIDES: Any further examination?

MR. STILLMAN: Nothing further.

CHAIRMAN FARMAKIDES: Then concluded, then, the Board's questions with respect to Dr. Goldman and Mr. Roe.

Thank you very much, gentlemen.

(Witnesses Goldman and Roe excused.)

CHAIRMAN FARMAKIDES: Does the Staff have further direct?

MR. DAVIS: Yes, Mr. Chairman.

I will now call Hugh Thompson again.

Whereupon,

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HUGH L. THOMPSON, JR.

was recalled as a witness on behalf of the Regulatory Staff, and, having been previously duly sworn, was examined and testified further as follows:

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DIRECT EXAMINATION

BY MR. DAVIS:

Q Mr. Thompson, have you aided in the preparation of a document styled, "~~Supplemental Testimony to Final Environmental Statement Related to the Construction of Davis-Besse Nuclear Power Station, Unit 1~~" ace - Federal Reporters are making arrangements for the ~~the~~ distribution of this document,?

A Yes.

Q Are the contents of that document true and correct to the best of your knowledge?

A Yes.

MR. DAVIS: I now would move, Mr. Chairman, that this document, copies of which have been furnished the Board and the other parties, be incorporated into the record as if read.

CHAIRMAN FARKANIDES: Any objection to introducing this document into evidence?

MR. SILBERG: No objection, Mr. Chairman.

MR. BARON: No.

CHAIRMAN FARKANIDES: It will be received into evidence and placed in the transcript as if read.

(The document follows.)

SUPPLEMENTAL TESTIMONY

TO FINAL ENVIRONMENTAL STATEMENT
related to construction of
DAVIS-BESSE NUCLEAR POWER STATION
TOLEDO EDISON COMPANY and
CLEVELAND ELECTRIC ILLUMINATING COMPANY

Docket No. 50-346

Issue 6

Our evaluation of the radioactive waste systems in a nuclear power plant is based on a model that is consistent for a generic type plant. The model utilizes data developed from a review of available information from operating nuclear power plants.

Our analysis of the radioactive waste systems assumed the following leaks and sources:

Primary to Secondary leak in steam generator	20 gpd
Primary leak to Auxiliary Building	20 gpd
Primary leak to Containment Building	40 gpd
Sample drains	35 gpd
TOTAL	115 gpd

The liquid source term actually calculated using these flow rates was 0.15 Ci/yr. To compensate for equipment downtime, expected operational occurrences, and equipment degradation over the 40 year life of the plant, this source term was normalized to 5 Ci/yr. This value is approximately 33 times greater than the calculated value and is equivalent to a value calculated using a total leakage flow of 3833 gpd rather than 115 gpd.

The following total primary system leakage rates have been measured in operating pressurized water reactor plants:

Facility	Leakage gpd
Point Beach	461
Haddam Neck	288
Yankee Rowe	145
San Onofre	433

The leakage flow of 3833 gpd that corresponds to our normalized liquid source term of 5 Ci/yr as reported in Table 3.4 of the Final Environmental Statement is from 8 to 26 times greater than the leak rates reported for the plants listed in the above Table. Thus, a substantial margin over measured leakage rates is available to compensate for equipment degradation, operational upsets, etc.

While operational occurrences and equipment degradation may be expected to occur during the life of a plant, the effects of these are expected to be minimized through normal maintenance procedures. Such procedures adjust, repair, or replace equipment as necessary to maintain the efficient operation of the systems in the plant.

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MR. DAVIS: Thank you.

That is the extent of the direct evidence the Staff has.

CHAIRMAN FARBSTEIN: Are you going to cross, Mr. Silberg?

MR. SILBERG: We have no cross-examination.

CHAIRMAN FARBSTEIN: No cross-examination, Mr. Baron?

MR. BARON: There isn't any.

CHAIRMAN FARBSTEIN: No cross-examination. None from the Intervenors, none from the Applicant, and none from the Staff. The Board has no questions of the witness. Thank you very much, sir.

(Witness excused.)

CHAIRMAN FARBSTEIN: So far as the Board is concerned, this concludes the testimony of the parties on Issues 1, 2, 5, 6, and 8.

Is there anything else that can be brought up at this moment that would aid in the disposition of this case?

MR. CHERNOFF: Have we set a time for Monday the 6th?

CHAIRMAN FARBSTEIN: We will have to wait until the proceedings branch finds a place for us to meet. I assume that we will meet either at 9:00 or 9:30 or 10:00

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o'clock or in that area unless there is reason to meet later.

MR. CHARNOFF: We would prefer to start Monday morning.

CHAIRMAN FASCARIDES: Is there any reason for us to stay further on the record?

We will adjourn until August 6. That completes, then, this phase of the proceeding.

(Whereupon, at 4:30 p.m., the hearing was adjourned.)