ORIGINAL

STATE OF CONNECTICUT

SITING COUNCIL

CONNECTICUT LIGHT & POWER COMPANY AND UNITED ILLUMINATING COMPANY	*	JULY 29, 2004 (10:05 A.M.)
APPLICATION FOR A CERTIFICATE OF ENVIRONMENTAL COMPATIBILITY AND PUBLIC NEED FOR THE CONSTRUCTION OF A NEW 345-kV ELECTRIC TRANSMISSION LINE AND ASSOCIATED FACILITIES BETWEEN THE SCOVILL ROCK SWITCHING STATION IN MIDDLETOWN AND THE NORWALK SUBSTATION IN NORWALK, CONNECTICUT	*	DOCKET NO. 272

BEFORE: PAMELA B. KATZ, CHAIRMAN

BOARD MEMBERS: Colin C. Tait, Vice Chairman
Brian Emerick, DEP Designee
Gerald J. Heffernan, DPUC Designee
Edward S. Wilensky
Daniel P. Lynch, Jr.
Philip T. Ashton
Brian O'Neill
James J. Murphy, Jr.

STAFF MEMBERS: S. Derek Phelps, Executive Director
Fred O. Cunliffe, Siting Analyst
Robert L. Marconi, AAG

APPEARANCES:

FOR THE APPLICANT, CONNECTICUT LIGHT & POWER COMPANY:

CARMODY & TORRANCE, LLP
195 Church Street
P.O. Box 1950
New Haven, Connecticut
BY: ANTHONY M. FITZGERALD, ESQUIRE
BRIAN T. HENEBRY, ESQUIRE

FOR THE APPLICANT, UNITED ILLUMINATING COMPANY:

WIGGIN & DANA, LLP
One Century Tower
P.O. Box 1832
New Haven, Connecticut 06508-1832
BY: LINDA L. RANDELL, ATTORNEY
BRUCE L. McDERMOTT, ESQUIRE

FOR THE PARTY, THE CITY OF MERIDEN:

DEBORAH L. MOORE, ATTORNEY
142 East Main Street
Room 239
Meriden, Connecticut 06450

FOR THE PARTIES, THE TOWN OF WESTON AND THE TOWN OF WOODBRIDGE:

COHEN & WOLF
1115 Broad Street
Bridgeport, Connecticut 06604
BY: DAVID BALL, ESQUIRE

FOR THE PARTY, THE TOWN OF MILFORD:

HURWITZ & SAGARIN
147 North Broad Street
Box 112
Milford, Connecticut 06460
By: JULIE DONALDSON KOHLER, ATTORNEY

FOR THE PARTIES, THE TOWN OF WALLINGFORD AND THE TOWN OF DURHAM:

HALLORAN & SAGE
One Goodwin Square
225 Asylum Street
Hartford, Connecticut 06103
BY: PETER BOUCHER, ESQUIRE

FOR THE PARTY, THE TOWN OF ORANGE:

SOUSA, STONE & D'AGOSTO
375 Bridgeport Avenue
Box 805
Shelton, Connecticut 06084
BY: BRIAN M. STONE, ESQUIRE

FOR THE PARTY, THE TOWN OF WILTON:

COHEN & WOLF
158 Deer Hill Avenue
Danbury, Connecticut 06810
BY: MONTE E. FRANK, ESQUIRE

FOR THE PARTY, ATTORNEY GENERAL BLUMENTHAL:

MICHAEL WERTHEIMER
Assistant Attorney General
Ten Franklin Square
New Britain, Connecticut 06051

FOR THE PARTY, THE OFFICE OF CONSUMER COUNSEL:

BRUCE C. JOHNSON, ESQUIRE
Office of Consumer Counsel
Ten Franklin Square
New Britain, Connecticut 06051

FOR THE PARTY, THE TOWN OF NORTH HAVEN:

UPDIKE, KELLY & SPELLACY
One State Street
Box 231277
Hartford, Connecticut 06123
BY: BENJAMIN J. BERGER, ESQUIRE

FOR THE PARTY, THE WOODLANDS COALITION FOR RESPONSIBLE ENERGY:

PULLMAN & COMLEY
90 State House Square
Hartford, Connecticut 06103
BY: LAWRENCE J. GOLDEN, ESQUIRE

FOR THE PARTY, PSEG POWER CONNECTICUT LLC:

McCARTER & ENGLISH
Cityplace I
185 Asylum Street
Hartford, Connecticut 06103
BY: DAVID REIF, ESQUIRE
JANE K. WARREN, ATTORNEY
JOEL B. CASEY, ESQUIRE

FOR THE INTERVENOR, ISO NEW ENGLAND:

WHITMAN, BREED, ABBOTT & MORGAN
100 Field Point Road
Greenwich, Connecticut 06830
BY: ANTHONY MacLEOD, ESQUIRE

FOR THE INTERVENORS, EZRA ACADEMY, B'NAI JACOB, THE JEWISH COMMUNITY CENTER OF GREATER NEW HAVEN, THE DEPARTMENT OF JEWISH EDUCATION, AND THE JEWISH FEDERATION OF GREATER NEW HAVEN:

BRENNER, SALTZMAN & WALLMAN
271 Whitney Avenue
New Haven, Connecticut 06511
BY: DAVID R. SCHAEFER, ESQUIRE
KENNETH ROSENTHAL, ESQUIRE

FOR THE INTERVENOR CONNECTICUT BUSINESS & INDUSTRY ASSOCIATION:

ROBERT E. EARLEY, ESQUIRE
350 Church Street
Hartford, Connecticut 06103

FOR THE PARTY, THE CONNECTICUT DEPARTMENT OF TRANSPORTATION:

CHARLES W. WALSH, III, AAG
EILEEN MESKILL, AAG
Office of the Attorney General
55 Elm Street
Hartford, Connecticut 06106

FOR THE PARTY, THE TOWN OF WESTPORT:

WAKE, SEE, DIMES & BRYNICZKA
27 Imperial Avenue
Westport, Connecticut 06880
BY: EUGENE E. CEDERBAUM, ESQUIRE

FOR THE PARTY, SOUTH CENTRAL CONNECTICUT WATER AUTHORITY:

MURTHA CULLINA LLP
Cityplace I
185 Asylum Street
Hartford, Connecticut 06103
BY: ANDREW W. LORD, ESQUIRE

FOR THE PARTY, COMMUNITIES FOR RESPONSIBLE ENERGY:

PATRICIA BRADLEY, PRESIDENT
47 Ironwood Lane
Durham, Connecticut 06422

FOR THE PARTY, THE CITY OF BRIDGEPORT:

MELANIE J. HOWLETT, ATTORNEY
Assistant City Attorney
City Hall Annex
999 Broad Street
Bridgeport, Connecticut 06604

FOR THE INTERVENOR, THE TOWN OF FAIRFIELD:

EILEEN KENNELLY, ATTORNEY
Assistant Town Attorney
Sullivan Independence Hall
725 Old Post Road
Fairfield, Connecticut 06824

FOR THE PARTY, THE CITY OF NEW HAVEN:

ELIZABETH GILSON, ATTORNEY
383 Orange Street
New Haven, Connecticut 06511

FOR THE PARTY, THE TOWN OF MIDDLEFIELD:

BRANSE & WILLIS, LLC
41-C New London Turnpike
Glen Lochen East
Glastonbury, Connecticut 06033
BY: ERIC KNAPP, ESQUIRE

FOR THE PARTY, THE CITY OF NORWALK:
LOUIS CICCARELLO, ESQUIRE
Corp. Counsel

FOR THE PARTY, THE TOWN OF CHESHIRE:
RICHARD J. BURTURLA, ESQUIRE

FOR THE PARTY, THE CITY OF MIDDLETOWN:
TIMOTHY P. LYNCH, ESQUIRE

A PARTY, THE TOWN OF EASTON

A PARTY, THE TOWN OF BETHANY

A PARTY, THE TOWN OF HAMDEN

AN INTERVENOR, THE FIRST DISTRICT WATER COMPANY

AN INTERVENOR, NORWALK ASSOCIATION OF SILVERMINE HOMEOWNERS

A PARTY, ROBERT W. MEGNA, STATE REP. 97th DISTRICT

AN INTERVENOR, MARY G. FRITZ, STATE REP. 90th DISTRICT

AN INTERVENOR, AL ADINOLFI, STATE REP. 103rd DISTRICT

AN INTERVENOR, RAYMOND KALINOWSKI, STATE REP. 100th DISTRICT

AN INTERVENOR, THEMIS KLARIDES, STATE REP. 114th DISTRICT

AN INTERVENOR, JOHN E. STRIPP, STATE REP. 135th DISTRICT

AN INTERVENOR, WILLIAM ANISKOVICH, STATE REP. 12th SEN. DISTRICT

AN INTERVENOR, JOSEPH CRISCO, JR., STATE REP. 17th SEN. DISTRICT

AN INTERVENOR, LEONARD FASANO, STATE REP. 34th SEN. DISTRICT

. . .Verbatim proceedings of a hearing before the State of Connecticut Siting Council in the matter of an application by Connecticut Light & Power Company and United Illuminating Company, held at Central Connecticut State University Institute of Technology & Business, 185 Main Street, New Britain, Connecticut, on July 29, 2004 at 10:05 a.m., at which time the parties were represented as hereinbefore set forth . . .

CHAIRMAN PAMELA B. KATZ: I'd like to call the resumption of this public hearing to order in Docket 272. And again, please if you could put your cell phones and pagers on silent, we would be appreciative.

Before we get this started this morning, I want to say something. We do not have any hearings in August. And I think that's a good thing because this Siting Council has a lot of thinking to do and so do all of you. Last night I replayed in my mind all the testimony -- in fact replayed it all night -- and this buffer zone has the potential to be a scorched earth buffer zone. Think about it. And I'm thinking maybe we should be doing this to protect -- or I should be doing this to prove I can protect the children. We could under

this docket restrict all uses and facilities in the right-of-way. We could also be restricting uses and facilities in this expanded milligauss area. I'm not sure that's what you all want. The question that you and the communities and the companies have to be thinking about is what you want this buffer zone to look like when we're done. Do you want to have no net increase in EMFs over what you have now at the 115? I think we can do that. Do you want us to reduce the amount of EMFs that you have now? I think we can do that. It might require takings, it might require more drastic work. But at the end, you've got to paint a picture for us of what you want this buffer zone to look like. Because frankly, right now I cannot see it, and I think the other Council members would agree.

Now, after the August report and the September hearings, we'll have a better idea of what is left above ground. And at that time, you, the Towns, hopefully of having had discussions back in your towns, are going to come back and paint a picture for us of how far you want us to take this.

The public act says the Siting Council will take into consideration all these things. We can take it very far or we can take it not so far, but you've got to

tell us, you've got to help us define this because we can have a buffer zone that's going to restrict parks, playgrounds, schools and residences now, we're going to restrict how you use them in the future.

And I was thinking yesterday -- we were told that we're being watched by the Legislature and we're being judged. So, I'm ready to step up and do what needs to be done and so is the rest of this Council. So it's up to you people to help explain to us how far you want us to take it. Take this back to your communities, companies think about this, come back to us when we know what's going to be overhead, and tell us. We can have scorched earth, we can do less than that. A lot of it is going to decide how much of an impact on your communities you want. I went through the aerial photographs last night and I looked at Eisenhower Park, High Plains, Ezra Academy, JCC. It could make a difference.

That's all I wanted to say. Let's get started.

MR. COLIN C. TAIT: If the Chairman would permit me, I'd like to second her comments and add one thought about the legislation because of yesterday and some of our thoughts going through this is it says go underground. What happens if undergrounding creates more

EMFs than going overhead? What do we do with the buffer zone on underground? The legislation does not say buffer zones only apply to overhead. So the Chairman and I and other members of the Council would like some thoughts on that.

This is a draconian law, it doesn't say the environment is relevant. It says go underground, not when it's prudent and feasible, but if it's feasible. What isn't feasible? Other environmental statutes say prudent and feasible. If cost is irrelevant, if the environment is irrelevant, because that's what the Legislature wants, we will follow it.

CHAIRMAN KATZ: Okay. The first item on the agenda this morning in the public hearing is the Siting Council has invited back its witness -- yes, Mr. Fitzgerald.

MR. ANTHONY FITZGERALD: Just -- just a procedural question. Mr. Tait asked for input on that point --

MR. TAIT: At some point --

CHAIRMAN KATZ: A brief would be appropriate.

MR. TAIT: Yes.

CHAIRMAN KATZ: We have new legislation and

we're all trying to work with it to the best of our abilities.

MR. TAIT: And as the facts come in, questions arise that hadn't been thought about before that we would like advice.

MR. PHILIP T. ASHTON: Also Colin -- (indiscernible) -- how the people view feasible -- the word feasible and what does that mean.

MR. TAIT: I think in the end we'll have to define feasible, define --

CHAIRMAN KATZ: Yeah --

MR. TAIT: -- residential area, define public.

CHAIRMAN KATZ: Okay. The first item on the -- today is the -- the Siting Council has invited back its witness, Dr. Gary Ginsberg of the Department of Public Health. We are going to -- Dr. Ginsberg has literally delayed his vacation -- and thank you to Mrs. Ginsberg also on that I guess -- has delayed his vacation to come back. The Council is going to first cross-examine, we want to make sure we understand Dr. Ginsberg's point of view. And then as time permits, we will allow others to cross Dr. Ginsberg. If we run out of time, we will bring Dr. Ginsberg back in the future.

MR. TAIT: After your vacation.

CHAIRMAN KATZ: After his vacation, and ours --

DR. GARY GINSBERG: Thank you --

CHAIRMAN KATZ: -- so that everyone has an opportunity. And Dr. Ginsberg, you have been sworn, correct?

DR. GINSBERG: Yes.

CHAIRMAN KATZ: Dr. Ginsberg, there was -- we have been in your absence discussing if buffer zones should be defined by milligausses on the edges of those zones. We have been discussing various milligauss numbers. For example, 3 milligausses. Two fold of that, 6 milligausses. One of the parties and intervenors discussed 0.6 milligausses. And so we'd just like a clarification from you, from the point of view of Public Health if you could just clarify your testimony and -- we'd appreciate that?

DR. GINSBERG: Sure. I'm sorry if there have been any confusion about my previous testimony. And I'll try to clarify not just my position, but the position of my department regarding EMF exposures.

Our read of the scientific literature and our understanding of prudent avoidance would suggest that

6 milligauss is a level which is clearly well beyond background exposures and which, according to the Meta analyses does confer -- well, the Meta analyses do suggest that there is an increase of approximately two-fold of childhood leukemia risk. So anything at 6 milligauss and above we feel is too high.

Three milligauss is a number that we looked at the background range, and it's the high end of background. But if you're above 3, you are on the cusp -- at 3 you're on the cusp of what is normal background. Above 3, you're above that.

What we like to think about in terms of giving guidance -- these are not standards, but this is guidance to the Council, is when you go back to thinking about drinking water quality -- and we have things in drinking water like benzene where the federal goal for benzene in drinking water, it's a known human leukeminogen also, is zero, but they allow -- so the goal is to bring all water quality down to zero parts per billion or non-detectable for benzene. However, the MCL is not zero, it's five parts per billion. In other words, that is the level at which -- above which it's completely intolerable and absolutely no-brainer, you can give those people bottled water.

So we like to think of the EMF along similar lines. Above 3, it's -- or between 3 and 6, it's sort of that window for like benzene, between 0 and 5. It's a good idea to get -- the goal is to get down to background, to get down to 3, to not have thousands and thousands of people exposed above 3 because we're not quite sure what's going on above 3 -- between 3 and 6. So it's -- it's a matter of public health prudence to try to minimize the amount of exposure that goes on above background. We're not quite sure what's happening in that range. However, above 6 it's a little clearer to us that there is a stronger concern. It's all in the theoretical range.

So our guidance again to the Siting Council, if I can state it as succinctly as possible, is that above 6 is a clear public health concern. Between 3 and 6, best management practices to try to minimize the number of people exposed in that range. Below 3, we can really argue with those exposures as that could -- there's no clear documentation that there is a health risk below that.

CHAIRMAN KATZ: Thank you, Dr. Ginsberg. We'll make you first available for Council questions.

MR. ASHTON: Dr. Ginsberg, between 3 and --

between 3 and 6 would you recommend measures of prudent avoidance?

DR. GINSBERG: Yes, we would. It would be a matter of thinking about what kinds of uses are in those areas where people, where children are not there full-time would be a mitigating factor, between 3 and 6 perhaps, because again where the evidence and the literature suggest that there may be a concern is the long-term time weight average, people living in para-fields that are above 3 or above 4 according to the Meta analyses. So, you know, a mitigating factor would be less time of the day spent in that field.

MR. ASHTON: Let me come at this issue another way. Let's arguendo assume that the level is 3, okay --

DR. GINSBERG: 3.0.

MR. ASHTON: Three point -- .00 -- (laughter) -- how are we to measure that? And let -- by -- let me explain what I'm driving at behind the question. The magnetic fields and electric power line are driven by the load the line carries, the number of amperes flowing through the line. There are in my example here many hours where the level will be below 3 because the load on the line is very light. There will be a -- less than 10 hours

per year at very peak load where the level might get up to 5, and conceivably under contingent conditions, which I assume you understand what I mean by that, where there's a system disruption, an abnormality in the normal flow of power on the system, it could get up to 12, but the -- the time average figure is 3 or -- 3.0 or below. Is that acceptable?

DR. GINSBERG: That would be acceptable to us, yes.

MR. ASHTON: So your answer of 3.0, using the number I plugged here, is a weighted time average recognizing that there are a few instances where the number gets up high due to either peak load or contingent operation for a very short time, but also recognizing the number is very low for many hours a year because the load is low. Is that fairly said?

DR. GINSBERG: That's fairly said. Let me just caveat that by saying that we don't have good literature information on how high a peak on a short-term would be acceptable --

MR. ASHTON: I understand --

DR. GINSBERG: You threw out numbers of 5 and 12. Those to me don't sound extreme given that you can pick up those kinds of exposures by being very close

to a home appliance --

MR. ASHTON: Yeah --

DR. GINSBERG: -- and so when you move away, you're not exposed, but, you know, very short-term excessive exposures in that range does not to me sound --

MR. ASHTON: My numbers were obviously extremely arbitrary --

DR. GINSBERG: Right --

MR. ASHTON: -- but nonetheless --

DR. GINSBERG: -- but if you said the number was a hundred, I don't know if -- you know, I don't know if I'd feel comfortable with an excursion of that nature.

MR. ASHTON: I understand. And the numbers I chose were numbers that we're generally familiar with on existing rights-of-way in existing applications.

Now, let me ask you another question that is sort of parallel with the last one. There are defined in the statute so-called public -- statutory facilities. These include but are not limited to playgrounds, schools -- residential areas which are not defined. There are differences I'm sure you can appreciate in that certain facilities get a great deal of use, i.e. a residential area, and certain facilities get very limited use. By way

of example, a baseball field. And a baseball field might be used for a few hours a day primarily driven by the Little League season just to pick an example. Could you give us some feel for your evaluation of how we should look at public -- at statutory facilities recognizing the different levels of use? Is it analogous to the 3.0 example we just went through or what?

DR. GINSBERG: The -- the concept of time weight averaging is again central to our thinking on this. And so if you have a public open space or a park space, even a playground where very young children would go, and the scenario is that they would only be there for a couple of hours a day, that would to some degree mitigate the concern, so that levels above 3 but below 6 might be fine in those ranges.

A school I think is a different matter, because I think a school is a place where children spend considerable amounts of time even though you might say it's only eight hours a day, and you would -- we'd be tempted to prorate that to 24 hours and say two-thirds of the time they're not there. We, typically, clean up schools, school yards to residential standards in Connecticut because this is -- there is the potential for longer than extra hours, children spending a lot of time

there, getting -- it's sort of their home away home environment.

MR. ASHTON: Okay. Thank you, that was very helpful.

CHAIRMAN KATZ: Mr. O'Neill.

MR. BRIAN O'NEILL: I yield to Mr. Tait.

MR. TAIT: Yesterday it was suggested that we use 0.6 as background. Is that your understanding of background? I thought your testimony just today was 3 milligauss was background? That we should aim for 3? We were told yesterday we should aim for .6.

DR. GINSBERG: Well, 0.6 certainly is part of the background range. As a matter of fact, if you look at the distribution from federal studies of what the background numbers look like, the median of that normal distribution -- you know, in a statistical sense that distribution -- you know, around .6 or 1 is where most of the background is, but then there's a fairly long tail to that distribution that suggests that you can even get some, quote/unquote, "background" locations that are 4 or 5, but they are very very unusual. And if you -- I believe it was -- the 90th percentile on background was 3 --

MR. TAIT: Okay --

DR. GINSBERG: -- and we typically look at -- you know, when we're -- for example, our arsenic and soil standard is based upon the upper 90th percentile of background. So that when we go into a site and we see that it's above that number, we know it's not due to background, but it's due to some other extraneous source.

MR. TAIT: So your recommendation to the Council is to use 3 --

DR. GINSBERG: That's correct.

CHAIRMAN KATZ: Other Council questions before we yield to -- first we'll yield to --

DR. GINSBERG: Could I -- could I just make one other --

CHAIRMAN KATZ: Yes, of course --

DR. GINSBERG: -- sort of caveating statement? And that is that this in no way should be construed of as a DPH standard. We are not aware of any regulatory bodies that have grappled with this whether at the state, federal, or international level that have actually been able to come up with a milligauss standard of exposure for any scenario, whether it's a school, residential, industrial, in terms of this low level EMF exposure. So we are not trying to turn this into some enforceable hard regulatory type of number. Again, this

is -- the purpose of -- you asked the question, so we're doing our best to try to give you some guidance in terms of what we feel are prudent levels of exposure.

CHAIRMAN KATZ: Thank you. Mr. Fitzgerald, do you have questions for this witness?

MR. FITZGERALD: I do, just one. Good morning, Dr. Ginsberg. Dr. Ginsberg, I made this note of something you said in the course of giving an explanation. As I wrote it down -- and the transcript may be different -- but as I wrote it down, you said benzene is a known human leukeminogen also. Now, I'm sure that that -- I have to protect the record -- I'm sure you didn't mean to say that EMF is a known human leukeminogen, did you?

DR. GINSBERG: I stand corrected.

MR. FITZGERALD: Thank you. That's all I have.

CHAIRMAN KATZ: (Indiscernible) -- and ask is there any other party or intervenor who wishes to cross-examine Dr. Ginsberg at this time? (No audible reply).

MR. TAIT: Bon voyage.

CHAIRMAN KATZ: Thank you, Dr. Ginsberg, for coming in and making yourself available, we appreciate you taking the time out of your vacation.

DR. GINSBERG: Okay. Let me know if I'm needed again.

CHAIRMAN KATZ: We shall.

MR. ASHTON: Send us a postcard -- (laughter) -- we'll still be here --

MR. GERALD J. HEFFERNAN: We'll be here, right.

CHAIRMAN KATZ: Okay, at this time we have some exhibits to be verified on -- from --

MS. LINDA RANDELL: As soon as I find out what number we're looking at.

A VOICE: 130 --

CHAIRMAN KATZ: First, I'm going to ask --

MS. RANDELL: No, this is the direct testimony --

CHAIRMAN KATZ: First, I'm going to ask the companies to verify their thing. And then, Mr. MacLeod, I'll ask you to verify Mr. Knowlton's prefiled -- Mr. Kowalski's, I mean, prefiled testimony.

A VOICE: These witnesses have been sworn --

CHAIRMAN KATZ: And all the witnesses have been sworn, correct? Thank you.

MS. RANDELL: Bear with us, we're finding

our hearing program so we can get the right number. What -- maybe I've got one --

A VOICE: I thought we put all these things in already --

MR. FITZGERALD: -- I've got it --

A VOICE: Tony, aren't these --

MR. FITZGERALD: I wasn't here --

MS. RANDELL: Did we have this -- has Roger already verified --

MR. FITZGERALD: Uh -- oh, that's right -- yeah, because --

CHAIRMAN KATZ: We'll go --

MR. FITZGERALD: Ours -- I'm sorry --

MS. RANDELL: I'm told that the direct testimony of Roger Zaklukiewicz regarding the potential use of HVDC dated July 19th has already been verified.

CHAIRMAN KATZ: Thank you. Is the same true for Mr. Kowalski?

MR. ANTHONY MACLEOD: No, that has not been done yet, Madam Chairman.

CHAIRMAN KATZ: Let's do that now then.

MR. MACLEOD: Very well. Mr. Kowalski, did you submit supplemental prefiled testimony dated July 19, 2004 in this proceeding?

MR. RICHARD KOWALSKI: Yes, I did.

MR. MACLEOD: And do you have that with you at this time?

MR. KOWALSKI: Yes, I do.

MR. MACLEOD: Okay. Did you prepare that testimony yourself or was it prepared under your direction and assistance?

MR. KOWALSKI: Yes, it was.

MR. MACLEOD: And would you like -- and do you believe the facts stated therein are true and correct to the best of your knowledge and belief?

MR. KOWALSKI: Yes, I do.

MR. MACLEOD: And would you like to adopt that testimony at this time as your testimony in this case?

MR. KOWALSKI: Yes, I would.

MR. MACLEOD: Okay. I would move that that be submitted as a full exhibit, Madam Chairman.

CHAIRMAN KATZ: Any objection to making it a full exhibit? Hearing none, it is a full exhibit.

(Whereupon, ISO New England Exhibit No. 9 was received into evidence as a full exhibit.)

CHAIRMAN KATZ: Any procedural matters we need to do before we do -- yes?

MS. RANDELL: I don't know if this is procedural, but I'll tell you what I'd like to do before Mr. Walling and Mr. Zaklukiewicz are available for cross-examination. Mr. Walling, as you know, testified with respect to harmonics prior -- in a prior hearing, and that primarily related to the AC proposal. Mr. Walling has very extensive DC experience. And with your approval, I'd like Mr. Walling to describe briefly his experience with DC projects.

CHAIRMAN KATZ: Okay. Go ahead please.

MR. REIGH WALLING: My name is Reigh Walling. I've been involved in the engineering of HVDC systems for 23 years.

Previously, General Electric, with whom I've been employed for the past 23 years, was a manufacturer of HVDC systems until about 1987. Since that time, my business, which is a consulting group within GE, has been heavily involved in consulting in the area of HVDC based upon our very practical and in depth experience, working with DC previously as a manufacturer was basically converted to a consulting world.

Most recently -- or actually, right presently I'm engaged with the Long Island Power Authority working on the new HVDC tie to New Jersey that's being

actively pursued. I've been recently involved with several merchant HVDC transmission developers in the Cross Sound Cable System. I developed the technical interconnection specifications and represented LIPA in all proceedings in commissioning of that system.

Previously to that, my organization and myself have been involved in the Sandy Pond, the New England Hydro Quebec HVDC tie internationally. We've done very interesting and similar work regarding resonant interactions in systems with HVDC in Japan at the Key Channel system.

And also my organization was responsible for compiling an Electric Power Research Institute's or EPRI's HVDC handbook in which I wrote at least one chapter in that handbook.

CHAIRMAN KATZ: Thank you, Mr. Walling. At this time, we are treating Mr. Kowalski and Mr. Walling and Mr. Zak as one panel. What we are going to do first is we're going to allow the companies to cross-examine ISO and then we're going to allow ISO to cross-examine the companies, and then we're going to allow the rest of the parties and intervenors to cross the whole panel. So, Mr. MacLeod, do you want to go first, or --

MR. MACLEOD: No. If I understood

correctly, you were going to have the companies cross-examine ISO --

CHAIRMAN KATZ: We can do that first --

MR. MACLEOD: -- so I will turn over Mr. Kowalski for cross-exam by the companies.

CHAIRMAN KATZ: We'll do that first then.

MR. FITZGERALD: Good morning, Mr. Kowalski.

MR. KOWALSKI: Good morning.

MR. FITZGERALD: I just want to ask you for an explanation of a couple of statements in your prefiled testimony. Turning to page 3, you say at the answer that begins at the top of the page that the transfer analysis that ISO performed for identical generation conditions favored the Applicant's proposal by 225 megawatts, suggesting a three to four year shorter lifetime for the HVDC plan. What's the significance of that? So what?

MR. KOWALSKI: Well, the significance is frequently -- if we're doing planning analysis, we test a variety of conditions and examine a number of items. The transfer limit analysis for an importing area is very much relevant to the lifetime of the project. And that is the longer a project that's being designed with multiple purposes with a higher transfer limit or import capability

will have a longer lifetime in being able to do its job. Because of the lack of resilience of the DC system, their import capability is lower. that means it will not be able to provide a supply for as long as the Applicant's system would.

MR. FITZGERALD: So -- so -- but the Applicant's system itself isn't going to last forever either, right?

MR. KOWALSKI: It -- neither will, but certainly the objective is to maximize the lifetime, cost-effective solutions. And the difference here is three to four years, which is --

MR. FITZGERALD: Okay. So that -- what that means is that three to four years earlier then what otherwise need to be the case, you're going to need to do something else to beef up the system's transfer capability?

MR. KOWALSKI: That's correct.

MR. FITZGERALD: And is there any distinction there between HVDC and an AC system, I mean other than the fact that you're faced with doing another addition somewhat earlier? When it comes to doing the addition itself is there any different set of considerations if you're dealing with HVDC as opposed to

AC?

MR. KOWALSKI: Okay -- if I understand the question and put it in my own terms, it's if you've done an expansion that's based on a DC system that got to a particular point in time versus an expansion that's been based on an AC system --

MR. FITZGERALD: Right --

MR. KOWALSKI: -- it's the contrast? Yes, there is a big difference. The -- the AC systems are much more naturally expandable. It's very simple, straightforward to reconfigure lines, reconnect, add transformation. Adding and making modifications to a DC based system is very much more complicated, if it can be done at all practically.

MR. FITZGERALD: Okay. In that same answer you go on to talk about a line out transfer limit in which you say -- you say your analysis showed very significant differences in the line out transfer limit between the proposal and the HVDC plan and that when the Southington area line was out -- or lines were out, the HVDC plan faired worst by differences in the range of 700 to 2200 megawatts. What's the significance of that difference?

MR. KOWALSKI: The significance of that, and it's a very great significance, is the system by

criteria, both operate -- both planning and operating has to be operated and planned to respect the possibility that any major -- or any line or any generator may fail at a given time. So that the fact that the system is so much less capable very much reflects a very much significant inability -- relative inability to operate the system, and that is there will be less opportunity to remove generation from service for repowering. There is greater load at risk of blackouts under those line outage conditions. It would present a very difficult operating situation.

MR. FITZGERALD: Okay. That's all that I have. I think Miss Randell has a question.

MS. RANDELL: Yes, thank you. Mr. Kowalski, did you review the GE report that was appended to Mr. Zaklukiewicz's testimony?

MR. KOWALSKI: Yes, I did.

MS. RANDELL: And you're familiar with the statements regarding line losses?

MR. KOWALSKI: Uh --

MS. RANDELL: That the line losses are higher particularly with the VSC HVDC?

MR. KOWALSKI: Yes, I'm -- that's generally a characteristic of HVDC lines as being loss --

MS. RANDELL: And so if DC lines, if I can just use that generically then, have greater line losses than AC lines, is there a practical impact on the amount of power and cost?

MR. KOWALSKI: If -- I'll interpret your question to mean the implication of -- relative to the implication of losses --

MS. RANDELL: Yes, if you would.

MR. KOWALSKI: Certainly the incremental losses translate into incremental energy, which relates to generally higher prices, which can be significant in a marginal price based system. It also just relates to incremental demand. If there are 10 megawatts, 20 megawatts of additional losses, well that's 10 or 20 megawatts of additional generation, additional emissions that have to be supplied and produced.

MS. RANDELL: Thank you. I have no further questions.

MR. O'NEILL: Excuse me. Mr. Kowalski, when reflecting upon your responses, you seemed to indicate very strongly that there's a reliability criteria that is different on this DC configuration that's being discussed?

MR. KOWALSKI: It's -- there really isn't a

difference in criteria. It's the same criteria --

MR. O'NEILL: Um-hmm --

MR. KOWALSKI: -- it's just when you embed a DC system inside an AC network and you view all of the criteria, what you see is there are some very significant differences that occur because you have an embedded DC system versus an AC reinforcement. And in reviewing the criteria and the conditions, the differences really jump out. So it's the same criteria, it's just the consequences of applying that criteria with the two different technologies.

MR. O'NEILL: Could you reflect upon the reliability factors pursuant to that train of thought?

MR. KOWALSKI: Well -- and again, the -- it's -- the reliability refers not to the reliability of the technology itself, but the fact that you've got -- the network is a whole and it's the behavior of that whole relative to each of its components. So because it's critical to both plan and operate with the potential -- respecting the potential failure of any given line, this technology presents a situation where under these sets of circumstances there are -- there's a definite reduction in relative capability of the system or relative to the AC reinforcement that -- again translating the significance

of the transfer limits, the import capability, the lower -- the more restrictive the import capability is, it's the less load can be served in the area, the less generation that can be off-line either for normal outages or maintenance or for reconstruction or repowering. So that's where the reliability risk is. The area becomes less able under those circumstances to access external power and therefore is more reliant on what it has locally.

MR. O'NEILL: Okay, thank you.

CHAIRMAN KATZ: Can I have a show of hands of parties and intervenors who wish to cross-examine this panel? Okay. We will go with Mr. Ball first, followed by Assistant Attorney General Wertheimer.

MR. DAVID BALL: David Ball on behalf of the Town of Woodbridge. Good morning panel members.

I'd like to focus, Mr. Walling, a little bit on your report. You conducted a harmonics study incorporating DC lines into your configuration, correct?

MR. WALLING: Yes. It was a screening level --

MR. FITZGERALD: Excuse me. The question assumes I think a fact that is not in evidence, which is that it is Mr. Walling's configuration which it was

incorporated --

MR. BALL: I wasn't intending anything by that, but let me just ask you did you run a harmonics study?

MR. WALLING: Yes, we did do some frequency response analysis where we made the simplification that the DC line did not interact with the AC system. So basically, DC transmission systems were excluded from the system and we were looking at the resonant characteristics of the AC system with that path then removed, which is a first order approximation. There are interactions in that frequency range between the DC and the AC, which are extremely complex. And in the time we had here, we could not get into that detail.

MR. BALL: Alright. Can you describe the configuration that was assumed in your study?

MR. WALLING: The configuration we looked at was for the segment of line between Beseck, which I believe is Middletown to East Devon, was represented as an HVDC line of either the conventional technology or the voltage source converter technology and having a nominal rating of 1200 megawatts. Basically -- in the study then to represent the DC line, we basically removed the AC line from the original model, and -- with the assumption that

the DC line did not interact, in the case of the voltage source converter DC, basically then that transmission path was removed and the response of the AC system was analyzed.

MR. BALL: Alright. Now, putting aside the segment that you assumed included a DC line, what other aspects of the configuration were there? For instance, did you simply adopt the Applicant's primary proposed route? What were the other aspects of the configuration?

MR. WALLING: Well, the -- okay, the DC route was approximately the same as the Applicant's AC route. The AC system going west from East Devon was the same configuration. We also looked at a generation dispatch, which would be a minimal generation in the area, which given the economic points of the generation in the area there's a very possible situation of having very minimal generation.

MR. BALL: Alright. Now, I think you just used the word same configuration and I just want to flush that out a little bit. The -- between Norwalk and Singer --

MR. WALLING: That's correct --

MR. BALL: -- what was the assumption?

MR. WALLING: Between Norwalk and Singer

was AC -- a 345-kV AC.

MR. BALL: Okay. And did you assume HFPP or XLPE cables?

MR. WALLING: We actually did both.

MR. BALL: Alright. Did you make any assumptions about the Bethel to Norwalk line?

MR. WALLING: The Bethel to Norwalk line was -- in there as -- as to be built presently.

MR. BALL: Alright. Was the assumption that both cables were operating?

MR. WALLING: Both -- yes --

MR. BALL: In the Bethel to --

MR. WALLING: Yes --

MR. BALL: -- Norwalk line?

MR. WALLING: Yes.

MR. BALL: Alright. Now, when you do the study, for the segment that has a DC line, does it -- do you assume the DC line to be overhead or underground or does it not matter?

MR. WALLING: It does not matter. In the way we did the analysis, it does matter.

MR. BALL: Why doesn't it matter?

MR. WALLING: It doesn't matter because we're assuming that the DC system is not interacting at

all with the AC system, so basically we just exclude that from the model, from the system.

MR. BALL: Now from a capacitance standpoint, does the DC line itself if it's underground have added capacitance?

MR. WALLING: From the first order of approximation, the DC line's capacitance does not add directly into the AC system. However, due to some very complex phenomena, the DC side capacitance would interact but not in a direct -- a very unusual way. Basically, it's -- it involves the modulation theory. And basically, whatever frequency you see on the AC side, you see on the DC side at plus and minus 60 hertz, and you get -- it's extremely complex and there's very little in the way of tools in the industry for analyzing that.

MR. BALL: Alright. Well, we'll bring it down to my level --

MR. WALLING: Yeah --

MR. BALL: -- you said that there is no added capacitance from the DC line itself, I believe --

MR. WALLING: I don't think --

MR. BALL: -- is that why it doesn't matter whether or not you assume it to be overhead or underground?

MR. WALLING: That's correct.

MR. BALL: Okay.

MR. WALLING: And again, that's a simplification.

MR. BALL: I appreciate that. Now, you just mentioned voltage source converter HVDC technology. Is that DC Light technology?

MR. WALLING: DC Light is the sole manufacturer straight name for it.

MR. BALL: Alright. What's the difference between conventional HVDC technology and DC Light?

MR. WALLING: There's a very large difference. The whole converter technology is substantially different. Basically, a voltage source converter synthesizes a voltage, which then allows power to flow into a system or out from a system. And it does it by chopping up the wave form with what's called pulse width modulation.

MR. BALL: In terms of the capacitance of the system is there any difference between an assumption of conventional DC lines --

MR. WALLING: Yes --

MR. BALL: -- or DC Light?

MR. WALLING: Yes. The -- from the first

order of approximation here, the biggest difference is the fact that conventional DC requires substantial harmonic filtering to meet telecommunication interference and system distortion limitations. The amount of -- and filters -- harmonic filters that are filtering the normal frequencies that the converters put out into the system would be up, like the 11^{th}, 13^{th}, 23^{rd}, 25^{th} harmonic. From the standpoint of the resonance problems we're looking at in the system, they look essentially like capacitor banks. So the conventional DC has basically capacitor banks that are on the order of -- in terms of filtering requirements on the order of 30 to about 45 percent of the power rating. And then in addition because conventional DC requires reactive power, you have to add additional capacitor banks to get to full load. And the total capacitance added onto the DC terminal -- conventional DC might be on the order 50 to 60 percent of the power rating of the converter.

COURT REPORTER: One moment please.

(Pause). Okay.

MR. BALL: In your studies you -- well tell me, did you run your studies assuming both conventional HVDC technology and DC Light --

MR. WALLING: That's correct.

MR. BALL: Alright. And I believe in your report you say that the DC Light technology faired better than the conventional technology?

MR. WALLING: That's correct.

MR. BALL: And you ultimately conclude that the resonance frequencies were still too low for either technology --

MR. WALLING: That's correct --

MR. BALL: -- based on what you studied?

MR. WALLING: That's correct.

MR. BALL: Alright.

MR. WALLING: Because basically you're stranding the AC line with -- and cutting off its tie to the strength of the system, which is more up towards the Middletown direction.

MR. BALL: Alright. Now, I just want to ask you a question about a couple of the assumptions that you've testified to in your configuration that you studied. You said that you did assume that the Bethel to Norwalk line was in operation, correct?

MR. WALLING: That's correct.

MR. BALL: And that both cables were in service, correct?

MR. WALLING: Yes.

MR. BALL: Alright. Now, the cables that have been approved are HPFF cables. Is that what you assumed in your modeling?

MR. WALLING: I have to check my --

MR. BALL: Well, actually I should be a little more precise -- I would like you to check, but the -- what has been approved for the Bethel to Norwalk line is about a nine and a half mile stretch of underground 345-kV HPFF cables and then there is a couple of miles of XLPE cables in the northern part near Bethel. And my question is whether you assumed all those cables to be in operation in your studies in service?

MR. WALLING: Yes.

MR. BALL: Alright. Now if you were to remove one of the cables from service as part of your assumptions, you would have better results in terms of capacitance --

MR. WALLING: Very --

MR. BALL: -- is that right?

MR. WALLING: Very slightly.

MR. BALL: Okay. Did you run any studies assuming that one of the cables approved in the Bethel to Norwalk line was taken out of service?

MR. WALLING: No.

MR. BALL: Alright. Now --

MR. WALLING: However, I don't expect that the incremental change to be very significant compared to the large amount of charging for the section of line from Singer to Norwalk.

MR. BALL: Alright. Now, when you also made your assumptions, you assumed that all of the existing capacitor banks were in service, isn't that right?

MR. WALLING: That's -- that's correct.

MR. BALL: Did you run any studies assuming that any capacitors were not in service; for example, the 115-kV capacitors at Plumtree?

MR. WALLING: It was an initial analysis and we basically went for the most severe limiting situation.

MR. BALL: Alright. So -- did you run any studies assuming that some of the capacitors were reduced, such as the capacitors at Glenbrook or Frost Bridge?

MR. WALLING: No.

MR. BALL: Alright. And it's fair to say that if you removed certain capacitors or reduced certain capacitors, the resonance results would improve in your study, isn't that a fair statement?

MR. WALLING: Yes. It moves in that direction.

MR. BALL: Alright. And it's fair to say that there are still additional techniques to reduce the capacitance problems that are not included in your study, isn't that right?

MR. WALLING: That's correct.

MR. BALL: Alright. Now, you did not assume that there was an HVDC line between Singer and Norwalk, did you?

MR. WALLING: I did not in this analysis.

MR. BALL: Okay. You assumed what has been proposed, which is an underground HPFF?

MR. WALLING: HPFF, and also we looked at XLPE.

MR. BALL: You did look at XLPE for that segment --

MR. WALLING: Yes.

MR. BALL: Alright. If -- regardless of whether your looked at XLPE or HPFF, would the capacitance results be better if you assumed a DC line in that segment?

MR. WALLING: It matters whether the -- if everything, all of the transmissions were DC. That's a

different situation than leaving a certain segment of it to be AC cable, and -- basically, the DC cuts off the path for strength -- for short circuit strength in the system. So if it were all DC for the entire transmission loop, perhaps excluding the Plumtree to Norwalk -- I believe you call that Bethel to Norwalk -- that's why I pause sometimes because I confused with different names -- that you would be -- and it was VSC DC where you did not have substantial VAR compensation and filtering at the converter terminals, you would move -- in terms of resonant behavior, you would move towards what the system would be either presently or after this initial Phase 1 project were completed.

MR. BALL: Alright. Well -- so if I understand you, just in terms of the resonance problem, you'd be better off having a DC line all the way without the interruption of an AC line, in other words from Norwalk?

MR. WALLING: Well, I --

MR. BALL: To Singer to Devon to Beseck?

MR. WALLING: From the specific narrow view of just the resonance problems --

MR. BALL: Um-hmm --

MR. WALLING: -- that would be a fair

statement.

MR. BALL: Okay. In your report you mentioned another potential technique to mitigate the resonance problem and it's on page 13 of your report and I'll refer you to it. There's a middle paragraph -- tell me when you're on page 13 --

MR. WALLING: Um-hmm.

MR. BALL: Okay. I'll ask you about one of the sentences in here; because the controllability of a VSC HVDC converter extends to the frequency range of the AC system resonances, it is theoretically possible for the converter to mitigate the AC system resonance problems. Alright, now you're talking about DC Light technology, correct?

MR. WALLING: Right, or it's possible also to use that technology with AC -- you know, as -- like a STATCOM also.

MR. BALL: Okay. Explain to me, first of all, what the converter is that you're referring to?

MR. WALLING: Well in the context of this sentence I was talking about a DC Light trade name or VSC DC generically speaking converter has a theoretical -- and I want to emphasize the theoretical capability of providing some mitigation to system resonance problems,

and if not engineered correctly, could actually compound the problems -- we did not really study that here -- but there is an opportunity for application of that to be a mitigant. However, you are getting outside the realm of any established large scale precedent. There is -- there is precedent for using voltage source converters as active filters in a much smaller scale, industrial scale, very much smaller, and also dealing more with the low magnitude continuous harmonic problems that arise that affect power quality and not necessarily controlling large disturbances that might occur when you have faults and so forth in the system, which is what we're really concerned about here.

MR. BALL: But it's fair to say that you didn't look at this possibility --

MR. WALLING: I did not look at this --

MR. BALL: -- in your studies?

MR. WALLING: That's correct. That's a bit more of an undertaking.

MR. BALL: Okay. Mr. Zak, I believe in your testimony you mentioned that you've commissioned ABB to examine ways to reduce capacitance on the lines. Do you recall that?

MR. ROGER ZAKLUKIEWICZ: Yes.

MS. RANDELL: Can we have a page reference,

Mr. Ball?

MR. BALL: Page 5.

MS. RANDELL: Thank you.

MR. BALL: And Mr. Zak, I was hoping you could simply provide some insight as to what ABB is looking at and what kind of progress they're making in terms of the resonance problem?

MR. ZAKLUKIEWICZ: ABB -- to begin with we raised a number of questions with ABB primarily on the VSC, the voltage source converter technology. Asked a number of questions and so far have received responses to a number of those questions clarifying the capabilities of the VSC converter facilities and questions also regarding the capability of the 100-kV -- or 150-kV DC cables that have been used with other VSC converter transmission links.

MR. ASHTON: Mr. Zak, if you would please -- the name or the initials GE are generally familiar to all in this room -- what is ABB? Is it a company, an institution?

MR. ZAKLUKIEWICZ: It's -- it's a company made up of two separate companies, Azarri, Brown, Bavari, and it's the combined manufacturing consulting firm of -- which is the combination of Azarri, which was a Swedish

firm, with Brown Bavari, which was --

MR. ASHTON: Swiss --

MR. ZAKLUKIEWICZ: -- a Swiss firm, and it is today known as ABB -- Group I think is their official when you look up in the -- on their website in the home page, I believe they're called ABB Group.

MR. ASHTON: And are they a large -- equivalent to GE in terms of a worldwide supplier of high voltage equipment in engineering --

MR. ZAKLUKIEWICZ: At this time I think they are the largest supplier of electrical hardware, both generation and transmission and distribution across the world.

MR. ASHTON: Thank you.

MR. BALL: Mr. Zak, you're aware of the Reliability and Operability Committee, which we refer to as the ROC working group?

MR. ZAKLUKIEWICZ: That is correct.

MR. BALL: Okay. Is ABB running any studies for you in connection with your work --

MR. ZAKLUKIEWICZ: We --

MR. BALL: -- with ROC?

MR. ZAKLUKIEWICZ: -- as a ROC committee are looking at having -- bringing ABB in to ask them to

run similar studies to what General Electric is presently running on the harmonics, including looking at combinations of HVDC installations in Southwest Connecticut, and not only identifying the feasibility of those, but also looking at the impacts on the harmonics issues.

MR. BALL: Okay, so whatever input you will get from ABB, that will come out through the ROC group?

MR. ZAKLUKIEWICZ: That would be our intent, to make them available, not much different than what KEMA is presently doing for the Siting Council. We would provide basically identical information and now we would have three or four different entities performing the analysis on the same -- the exact same data. And hopefully, all four will conclude the same -- come to the same conclusions. And if we don't, then we need to spend a lot of time identifying why one transient and harmonic study comes up with a different answer than someone else's if they're all the -- if the software packages as we understand it are basically the same.

MR. BALL: Okay. Mr. Kowalski, ISO has not run any harmonic studies assuming some DC line introduced into the system, is that right?

MR. KOWALSKI: We -- ISO has not run any

separate harmonic studies, correct.

MR. BALL: Okay. Mr. Walling, can you describe what short-circuit ratio is, you mention it in your report?

MR. WALLING: Short-circuit ratio is defined as the ratio of the short-circuit capacity of the system which we measure in megavolt amperes, which really is a product of the nominal voltage and the short-circuit current divided by the rated power of an HVDC system. Basically, it's the strength of the system compared to the size of the DC system.

MR. BALL: Alright. And generally the higher the ratio, the better?

MR. WALLING: Right.

MR. BALL: Now, your report concluded that when you stressed the system with multiple contingencies, the short-circuit ratios were too low, is that --

MR. WALLING: That's correct.

MR. BALL: What generation did you assume in stressing the system?

MR. WALLING: Minimal generation in the Southwest Connecticut area, which is a realistic condition considering the general price points of those generators.

MR. BALL: Alright. You did not assume any

new generation, is that right?

MR. WALLING: That's correct.

MR. BALL: And when you say minimal generation, can you be a little more specific?

MR. WALLING: I don't have a list before me of exactly what generation was on, but it was very close to no generation other than I believe there's a refuse burning plant in Southwest Connecticut.

MR. BALL: Alright. The more generation one would assume in your studies --

MR. WALLING: Correct --

MR. BALL: -- the better the ratios would be?

MR. WALLING: That's correct.

MR. BALL: Okay.

MR. WALLING: But we do have generation dispatched on a market basis. And when units are not -- basically, when the overall New England system load is low, there are plenty of more efficient lower-cost units elsewhere in New England and they're going to tend to be the ones operating.

MR. BALL: Alright. Now in your report on page 3, you make a number of comments about the short-circuit ratios and I want to ask you about one of them.

MR. WALLING: Okay.

MR. BALL: In the third bullet point --

MR. WALLING: Okay --

MR. BALL: -- the second sentence says in addition to the dynamic interactions with the AC system impedance that slow recovery, HVDC controls in weak system applications are often programmed to recover slowly to avoid commutation failure during recovery. Can you describe what this means?

MR. WALLING: Basically, the controls are programmed so that the DC does not leap back into full operation, it slowly over a period of time creeps back up into the operation. And the idea there is so that the operation does not overshoot the desired operating point, because a DC -- a conventional DC system is operating very close to the point where its commutation fails, which means that it no longer successfully transfers power into the system and it's sort of an abrupt termination of power transfer and the voltage collapses in the DC system.

MR. BALL: Alright. Now -- I suppose my question is whether there are ways of programming the HVDC controls to address the low short-circuit ratios that you've identified?

MR. WALLING: You -- there's a compromise

between performance, short-circuit ratio, and how the controls are designed. You cannot have a fast responding DC system in a weak system.

MR. BALL: But through the controls is it possible to use those controls to avoid significant problems when you have low short-circuit ratios, is that a fair statement?

MR. WALLING: No, that's not a fair statement because basically the controls can avoid gross miss-operation of the system to some degree. They can do the best they can, but the overall performance of the system will be seriously degraded.

MR. BALL: You submitted a table on page 4 of your report showing the results of your short-circuit ratio analysis?

MR. WALLING: That's correct.

MR. BALL: Did you assume conventional HVDC technology for the figures listed on Table 1 of your report?

MR. WALLING: The calculation for short-circuit ratio is independent of DC technology. However, the importance of the short-circuit ratio is different, meaning that conventional DC is very susceptible to problems with low short-circuit ratio and the voltage

source converter DC is much more able to operate in low or very low short-circuit ratio level systems.

MR. BALL: Alright. So that's -- what you just said is consistent with one of the conclusions in your report, which is that DC Light technology is less sensitive to short-circuit ration limitations than conventional HVDC --

MR. WALLING: Right --

MR. BALL: -- so from a short-circuit perspective, it would make more sense to consider DC Light technology if you were --

MR. WALLING: I would tend to think --

MR. BALL: -- developing the system?

MR. WALLING: -- that for the scenario or for the configuration studied here that a conventional DC is pretty close to -- technically infeasible and the voltage source converter technology has -- it may be capable of adequate performance, but there's other issues though that are important --

MR. BALL: Okay --

MR. WALLING: -- for example, losses and so forth.

MR. BALL: Alright, let me --

CHAIRMAN KATZ: Mr. Ball --

MR. BALL: Yes?

CHAIRMAN KATZ: -- while he -- can we have him elaborate on that last point?

MR. BALL: Sure.

MR. WALLING: On the losses?

CHAIRMAN KATZ: You said there were other factors that made it --

MR. WALLING: Well, there's the factor of -- that Mr. -- that Dr. Savitz has mentioned previously about the ability to respond to the AC system, the ability to meet overloads is different for DC. But I think one of the biggest factors that I wanted to bring out was the power loss. When you go through the conversion process from AC to DC and DC to AC, there is loss in both conventional DC and in voltage source converter DC. However, the two technologies differ greatly in the amount of loss. The loss for voltage source converter DC is on the approximate order of about two and a half percent for each conversion step. So from end to end -- from AC system to AC system we're talking about five percent losses in just conversion. The end to end losses in a conventional DC might be one and a half percent. And -- I mean when you work that through, that's a lot of energy going up as heat into the -- you know, into the air.

CHAIRMAN KATZ: So are you saying that it works, but it generates less power?

MR. WALLING: It works and it will cost the ratepayers in New England or how it's apportioned more for their energy because more energy is going to be lost.

CHAIRMAN KATZ: And how would you overcome that hurdle?

MR. WALLING: Technology -- this is reflecting current technology. The conventional DC technology is quite mature, loss levels are probably not going to decrease much for conventional DC. And for -- the voltage source converter DC is quite immature technology. Whether there will be some breakthroughs in semi-conductor technology that might lower it, there's been talk of new exotic devices, but dealing with the kind of devices and transistors we have today, it's an inherent nature of the device.

CHAIRMAN KATZ: Thank you.

MR. BALL: Alright, let me, Mr. Walling, ask you about voltage stability issues that's also referenced in your report. Is it fair to say you have not done any detailed studies on the impact of DC lines on voltage stability?

MR. WALLING: That's correct.

MR. BALL: Okay. The problem with voltage stability is a bigger problem when you use conventional HVDC technology as opposed to DC Light, is that accurate?

MR. WALLING: Very much so.

MR. BALL: Why is that?

MR. WALLING: Conventional DC technology has no direct way to regulate the AC voltage. It's actually a large consumer of reactive power. There's a small degree of controllability of that reactive power demand, but not very much. And then basically switch capacitor and filter banks have to be used to compensate for that. And those switch banks cannot be switched very quickly. They can be switched off quickly, but they can't be switched on right away unless special measures are taken. The -- also, the nature of the way that reactive power changes for a conventional DC system when the DC voltage changes is generally adverse to the system's needs, so that further compounds the problem.

MR. BALL: Alright. I want to just direct your attention -- on page 5 of your report you make a comment about DC Light technology. You say VSC HVDC has the inherent capability to provide highly controllable reactive support, acting as a virtual STATCOM. In addition to the power transfer function, this capability

might be used to mitigate the voltage stability impacts of weakening Southwest Connecticut relative to the AC option from an AC voltage stability standpoint. Can you explain what a STATCOM is?

MR. WALLING: STATCOM is basically a -- well, it's a -- static compensator is one interpretation. And for awhile it was called STATCON by the industry, which meant STATic Synchronous CONdenser. A synchronous condenser is like a generator with no turbine to turn it, it -- or -- and it basically can create reactive power and strengthen a system. The idea is that a voltage source converter can provide similar functionality into the system. Because it actually is synthesizing a voltage, it can act sort of like a generator in regard to reactive power.

MR. BALL: Alright. So it's fair to say that a STATCOM operates to stabilize the system?

MR. WALLING: That's right.

MR. BALL: From -- in terms of voltage issues?

MR. WALLING: That's -- it helps. It has limitations though. I mean whereas a generator under fault conditions will put out a huge overload of short-circuit current, the -- which can be a detriment or an

advantage to the system depending on the situation, the power electronic devices tend to be rather limited in their output. When they get to a certain level, they are not -- they're blocked from putting out more -- more than that.

MR. BALL: Alright. But just so that I understand it, and correct me if I'm wrong, what I think you're saying is that the DC Light technology in and of itself can help to mitigate voltage stability problems, is that right?

MR. WALLING: Well, replacing the AC lines with DC removes strength from the system which works adversely to voltage stability issues. Putting compensation ability on the converters replaces some of that. So it's -- it counters --

MR. BALL: It mitigates the problem --

MR. WALLING: It mitigates the negative impact.

MR. BALL: Okay. Now, HVDC lines have been in operation for over 30 years -- how many year?

MR. WALLING: Uh -- well, actually GE built the first one -- it doesn't like to recognize it, but it was built up near Schenectady, New York in the 1930's. There was -- the early 50's the first really commercial DC

lines were built.

MR. ASHTON: Mr. Walling, do you recall that Mr. Edison's first station --

MR. WALLING: Oh, okay --

MR. ASHTON: -- in 1882 --

MR. WALLING: Well, that was --

MR. ASHTON: -- was DC --

MR. WALLING: That was LVDC though --

MR. TAIT: Phil remembers -- (laughter) --

MR. BALL: Did he work for ABB?

A VOICE: Phil worked with Tom Edison --

(Laughter)

MR. ASHTON: The white hairs are not from fright.

MR. BALL: It's fair to say that -- there's no question that the technology itself has proven to be reliable --

MR. WALLING: Conventional DC technology is quite mature now.

MR. BALL: Alright.

MR. WALLING: The voltage source converter technology is drastically different. I mean it moves power by direct current, but the whole conversion technology is substantially different. That technology

has a degree of maturity only in its application for industrial motor drives down on the, you know, 1-megawatt kind of level -- a few megawatt kind of level. The use of voltage source converter technology at transmission voltages and power levels is relatively recent.

MR. BALL: Okay. Now, is it fair to say one of the advantages of a DC system is the ability to transmit large amounts of power in general? Is that --

MR. WALLING: The usual applications of DC transmission have been -- there's three main applications. There's the transmitting power through an asynchronous interface between systems --

MR. ASHTON: What does that mean?

MR. WALLING: Okay, certain power --

A VOICE: Thank you, Phil.

MR. WALLING: Okay, for example, the -- the eastern U.S. system east of Colorado and the western U.S. system west of Colorado are not in synchronism, they do not -- the 60-cycle voltage does not necessarily come to the peak at the same time. They're drifting with respect to each other. Also, the Quebec system is separate. And our Texas system -- not to draw parallels between Quebec and Texas, but is also separate. And the only way to move power across those interfaces is with DC technology.

That's one application, the asynchronous tie.

MR. ASHTON: In other words, asynchronous means that you're not tying or trying to synchronize precisely --

MR. WALLING: Right --

MR. ASHTON: -- two systems which may have similar operating characteristics?

MR. WALLING: That's correct.

MR. BALL: So it's --

MR. ASHTON: And would the -- there used to be, as I recall, a station outside of Tokyo that converted from the northern system to the southern system --

MR. WALLING: Fifty and sixty hertz --

MR. ASHTON: So that's two systems that operate at different frequencies. And that's again a way of not polluting, my word, one frequency or one system with the characteristics of another --

MR. WALLING: That's correct --

MR. ASHTON: -- is that fair to say?

MR. WALLING: That's correct.

MR. ASHTON: Thank you.

MR. WALLING: Another -- the traditional -- another application is for long distance, high power transmission. For example, the Cole (phonetic) by wire

projects in North Dakota to Minnesota where you're dealing with very long overhead transmission lines, it becomes economic to do DC because the line cost -- the overhead line costs are somewhat less, which over a very long distance can counteract the cost of conversion.

The third application has been underwater ties. Because of technical limitations, AC power can't be transmitted under water for more than about 20 or 30 miles. So there's a number of projects like underneath the English Channel, between Shikoku and the main island of Japan, which is a project that I worked on a few years ago, which are all underwater ties --

MR. BALL: Alright --

MR. WALLING: -- but it's never been applied in the heart of a transmission -- of a dense transmission system on a short distance basis.

MR. BALL: Okay. Now, I'd like to ask you a question on page 7 of your report, the last two sentences --

CHAIRMAN KATZ: Before you do that, can you quantify short?

MR. WALLING: Anything -- I've never seen a transmission system that was not crossing water or an asynchronous interface that's been shorter than several

hundred miles.

CHAIRMAN KATZ: Thank you.

MR. BALL: On page 7 of your report you mention the fact that use of a 1200 megawatt HVDC tie results in less load carrying capacity for the system than of nominally rated 1200-megawatt AC ties used for the same tie. And you say to overcome this limitation extra capacity would be needed to be designed into the HVDC line. Is that something that is possible to do in the design phase, which is to --

MR. WALLING: Yes --

MR. BALL: -- add in capacity --

MR. WALLING: Yes. When you get into discussions of capacity and overload capabilities, it's really most appropriate to start with a functional requirement; I need to move this much power most of the time and occasionally I need to move this much power for whatever amount of time. And from that point both an AC and a DC system can be specified that will be meet that performance objective. They might come out with a different nominal nameplate, but a nominal -- nominal capacity is a loose measure. So there are a lot of problems in comparing systems based on their nominal capabilities. We really have to go with a performance

specification and work back.

MR. BALL: Alright. But it's fair to say that increasing the capacity when you design the DC line is one way to help mitigate the risks of dealing with overloads, is that a fair statement?

MR. WALLING: Yes.

MR. BALL: Okay. The -- what would be the optimal line capacity if you were to have a segment of this line between Devon and Beseck --

MR. WALLING: That requires load flow type studies that I have not been associated with.

MR. BALL: Okay. Mr. Kowalski, do you know the answer to that question, what the optimal line capacity would be if we were to have a segment of the proposed line between Devon and Beseck as a DC line?

MR. KOWALSKI: I could not say what the optimal -- from the standpoint of maximizing the utilization of the particular technology would be or relative to the demands of the system

MR. ASHTON: Mr. Kowalski, would -- if I could help Mr. Ball out a second -- isn't it fair to say though that it's something in the range of 1200 megawatts? You know, it's 1213, 1100, or something like that?

MR. KOWALSKI: It would have to be at least

in that range.

MR. ASHTON: Yeah.

MR. BALL: Yeah, I guess -- I suppose my question is it is --

MR. ASHTON: That's a separate -- optimization of the capacity would be a separate study in its own right, wouldn't it?

MR. KOWALSKI: Yes, it would.

MR. BALL: But is that a study ISO has done yet?

A VOICE: No --

MR. KOWALSKI: No, we have not.

MR. BALL: Alright. But to answer the question, it is possible to come up with that figure, to design it such that you identify what the optimal line capacity is? Capable of being determined?

MR. KOWALSKI: There are two different perspectives. Optimal from the application of the technology, that is if I were to apply HVDC, what would be the most that I could get out of it, versus optimal from what does the system need. So, I guess in theory, sure, you could -- you could probably try and identify the maximum achievable out of that type of technology.

MR. BALL: Well --

MR. ZAKLUKIEWICZ: And I think it's important also, Mr. Ball, to recognize that when we're doing these optimum studies, you need to take into account how you're operating the DC terminal. And I say that only because the DC terminal, especially the VSC technology has limitations on whether this terminal is being used to either absorb VARs or provide VARs, and similar to a generator, which is capable of providing watts. And this would be the watts in the DC terminal of going from point A to point B. As soon as you start using the VSC converter terminal to either absorb VARs off the system, you end up having distinct curves where the watt capability of a DC converter terminal goes down significantly. If I look at some of the curves provided by ABB, when I'm operating the system and I'm either absorbing or providing 150 mega VARs, the 330-megawatt capability of that terminal drops to 150 megawatts. So, I've -- I've reduced the watt transfer from point A to point B from 330 down to 150 while I'm doing one of these other functions that Mr. Walling spoke about where I am either observed -- absorbing VARs or providing VARs to increase the stability of the system.

So just a word of caution here, you know, when we say we're going to have 1200-megawatt capability,

I think we also need a preface here that is what at that time are going to be the requirements on the HVDC converter terminals to either absorb or provide some quantity of VARs at the same time. And it's a fine point --

MR. BALL: Fine --

MR. ZAKLUKIEWICZ: -- which just like moving on AC systems, it's not only the amperes of the watts, it's the amperes that neither get factored into providing the VAR support for the watts being transferred. So, I just want to make that fine point.

MR. BALL: I appreciate that. My question -- my follow-up question on that is isn't that just -- isn't that another assumption that one can make --

MR. ZAKLUKIEWICZ: Sure --

MR. BALL: -- in determining what the optimum capacity ought to be?

MR. ZAKLUKIEWICZ: You need to factor that in of how -- and you need to account for it because I mean these are significant reductions in the watt transfers. And all I want to do is make certain everyone understands that, because it's -- comments have been made well we can do all of these extra things with a converter, and we need to recognize those extra things are moving current whether

it's in phase with the watts or out of phase or in phase with the VARs 90 degrees out, it's still an amp going through the system and you need to account for it.

MR. BALL: And as we sit here, those studies with those assumptions have not yet been done?

MR. ZAKLUKIEWICZ: Correct.

MR. BALL: Okay.

MR. KOWALSKI: And just a clarification of what I was saying before, what I really mean is what you may find is the optimum employment of the technology when you consider the range of operating conditions may be quite low, and that is you may only be able to employ an HVDC technology. When you look at all of the range of how the system has to operate, that is small relative to what the demands of the system are, so --

MR. BALL: Well --

MR. KOWALSKI: -- just to clarify what --

MR. BALL: Alright. Mr. Kowalski, while -- let me stick with you and ask you about your testimony. You mentioned that you performed thermal voltage and transfer limit analyses?

MR. KOWALSKI: Yes.

MR. BALL: Now, have you provided the Council or anyone else with the reports from these

studies?

MR. KOWALSKI: No, I'm sorry, we haven't. It was preliminary analysis, but we have not yet done that.

MR. BALL: Alright. This is something that you will be producing in this docket?

MR. KOWALSKI: We -- we can produce it.

MR. BALL: Okay.

CHAIRMAN KATZ: Well, can -- can we pause there --

MR. BALL: Yes.

CHAIRMAN KATZ: Do we need to formally ask you? How do we do this?

MR. MACLEOD: I wonder -- Madam Chair, I wonder if it would be more appropriate to ask whether these are really reports or whether these are -- you know, just how much has gone into this? I mean I don't think that formal studies have been produced. I think that the answer to that sort of a question might indicate that, you know, it's more kind of a routine type analysis that's done without any generation of formality.

CHAIRMAN KATZ: Perhaps a witness can elaborate then.

MR. KOWALSKI: That's -- what Mr. MacLeod

pointed out is correct. We've done some analyses that are in a fairly raw form, but there is no formal reporting or document that summarizes those reports, and then some tabulations that we've put together just for reviewing the raw results.

MR. MACLEOD: We can put something together, but there's nothing that exists right now.

CHAIRMAN KATZ: What I'd like to do is over the lunch break consult with KEMA and get back to you on that.

MR. MACLEOD: Thank you.

MR. BALL: I -- I do think in the least we would -- our experts would probably want to at least have the underlying data if that could be produced, even if it's not in a formal report form.

MR. WALLING: The follow-up question you asked before regarding did we look an all DC system, we did not, for example, in a residence. However, we did do a preliminary analysis and I calculated what kind of losses you might expect from such a system. And basically, the loss consumption, power lost in a system like that might be on the order of the total energy consumed by 10 to 20,000 families to put it in a relatively understandable context. So a reasonable -- so

it would equal the energy consumption of a moderate size city in terms of losses, but particularly I come out to 116 megawatts peak or 200 million kilowatt hours per year.

MR. O'NEILL: And that power loss consumption would be unacceptable to ISO and their standards, isn't that correct?

MR. KOWALSKI: It would certainly raise an issue. I don't know if -- that translates very much into demand for additional capacity as well as energy, so it --

MR. ASHTON: Suppose -- well, let me back up -- as I understand the present situation, a facility which is approved and in place by 2007, I think it is, would be underwritten by socialized costs throughout New England. Insofar as -- there's a little bit of a caveat there, I guess, that insofar as the facilities are deemed to be above what is prudent, then there is -- there could be a come-back on the cost to Connecticut ratepayers. Would that include something that -- where there's a technological alternative that is deemed to be imprudent?

MR. KOWALSKI: I would say that's definitely a risk.

MR. ASHTON: Thank you.

CHAIRMAN KATZ: Perhaps at this point, Mr. Kowalski, you could sort of tell us how -- if the

Applicants come up with an HVDC solution they feel that will work and the Council likes, how does ISO -- what criteria does ISO use to evaluate, whether they will bless off on this -- well first, do you have to bless off on this or if it's -- if they can prove it's reliable within a certain, that's enough? Can you elaborate a little on ISO's role in this?

MR. KOWALSKI: In determining the cost recovery?

CHAIRMAN KATZ: Well, we'll go there in a minute --

MR. KOWALSKI: Okay --

CHAIRMAN KATZ: -- let's start --

A VOICE: Reliability --

CHAIRMAN KATZ: Accepting it into the system?

MR. TAIT: Reliability.

MR. KOWALSKI: From a reliability standpoint, certainly if we can demonstrate that it meets all of the reliability needs consistent with the objectives and demands of the system, it would be reasonable.

CHAIRMAN KATZ: Okay. For example, like harmonics and --

MR. KOWALSKI: Harmonics, the basic operating and planning criteria. Certainly if it can be made to work and doesn't raise any issues, we would have --

CHAIRMAN KATZ: Okay, let's go to the second issue you brought up, cost recovery, what's ISO's role in that? Let's say it cost more than a traditional AC line --

COURT REPORTER: One moment please. (Pause). Okay.

CHAIRMAN KATZ: -- but the Council orders it?

MR. KOWALSKI: Okay. Pursuant to the -- I believe it's the 100th Amendment of the NEPOOL agreement and tariff, just -- there were some -- not really a change, but just more of a clarification on cost recovery, that is for which of the costs are determined to be regional benefit upgrades versus those which were not. The basic regional planning process identifies the facilities that are really necessary to achieve design objectives, which was done through the New England Regional Transmission Expansion process. Beyond that, if there are any additional costs that are incurred, the applicant basically needs to make a case that they are not

excessive beyond regional needs. And there is a procedure, a NEPOOL procedure that highlights these. That's done to a NEPOOL committee and -- who reviews that and makes a recommendation to ISO. And ISO makes a final determination, but certainly weighing -- placing considerable value on the weight of the recommendation of the NEPOOL committee.

CHAIRMAN KATZ: Would part of that be -- the timing that it's done, completed by 2007, would that be part of the decision-making on whether a DC cable would be socialized?

MR. KOWALSKI: I can't say really how that would play into it.

CHAIRMAN KATZ: Is the fact that this Siting Council orders it carry any weight with ISO?

MR. MACLEOD: I don't know that Mr. Kowalski is the appropriate witness to answer that, Madam Chair.

CHAIRMAN KATZ: Okay. At some point we might need to have that witness, not today.

MR. MACLEOD: Understood.

CHAIRMAN KATZ: Mr. Emerick.

MR. BRIAN EMERICK: In terms of accepting a DC system -- a DC line into the system, you indicated so

long as it met the reliability criteria it would be accepted. From a scheduling or timing perspective, when would we know that? I mean --

MR. KOWALSKI: I --

MR. EMERICK: -- I assume that such a proposal would come through the ROC. ISO is a member of the ROC. So if it came forward -- and again, all I'm trying to anticipate -- avoiding the last determination by ISO well into the process. And I'm trying to get a sense of when would you make that determination?

MR. KOWALSKI: Well, we're currently trying to perform the evaluation of the proposed alternatives through the ROC committee so that we can work together concurrently trying to address as many of these issues so that everyone is aware of what's going on, what problems are emerging, and what some of the functional issues are.

CHAIRMAN KATZ: So if DC comes out of the ROC, that means ISO has bought onto it?

MR. MACLEOD: Again, Madam Chair --

CHAIRMAN KATZ: Okay --

MR. MACLEOD: -- I think the ROC has, you know, certain criteria --

CHAIRMAN KATZ: I'm saying if.

MR. MACLEOD: I understand, but I think

that Mr. Kowalski probably has to report up the chain --

CHAIRMAN KATZ: Okay --

MR. MACLEOD: -- to various people who are not here today.

CHAIRMAN KATZ: Okay. I'm going to ask that the August 16th ROC report gives the Council some indication of what the buy-in of the participants is, so that if --

MR. ASHTON: (Indiscernible) -- and means --

CHAIRMAN KATZ: Hmm?

MR. ASHTON: (Indiscernible) -- and means --

CHAIRMAN KATZ: Buy-in and means, thank you, Mr. Ashton. So that we have -- so we have a comfort level of how far we can take that report. If we take that report and then it gets shot down by some other entity, then we're going to -- you know, at a later date, then we need to know that --

MR. KOWALSKI: Well, I guess --

CHAIRMAN KATZ: -- so that is my request.

MR. KOWALSKI: Okay. I mean for clarification of the testimony, I think -- I think we want to make sure we're coming across very clearly as saying

we've -- we've identified some serious shortcomings with HVDC.

CHAIRMAN KATZ: Okay.

MR. KOWALSKI: And you know, we certainly never want to shut the door, we always want to keep exploring, okay, either alternatives and other things, but we're definitely -- you know, we'll say it right now to be perfectly clear, is we're seeing some real shortcomings in the employment of HVDC technology.

CHAIRMAN KATZ: But my understanding also is that the ROC is looking at DC and looking at possible fixes --

MR. KOWALSKI: Yeah --

CHAIRMAN KATZ: -- to those shortcomings?

MR. KOWALSKI: Right.

CHAIRMAN KATZ: So that's why we need to know once -- if something comes out of this ROC that says DC will work, we need to know who's buying in at what level and the means.

MR. MACLEOD: Right --

MR. ASHTON: Mr. Kowalski, you mentioned you're seeing shortcomings. I can see two kinds of shortcomings. One is the state of technology today and the other is in the inherent technology of DC. In other

words, because of equipment development, the VSC technology is a little bit constrained, it hasn't been, as Mr. Walling indicated, extrapolated to the thousand megawatt range from its present megawatt range. That's something that, you know, maybe we can wrestle with and adjudicate, resolve. The other is the kind of technological -- the technology inherent in DC. And I want to make a differentiation between that. There are some characteristics of DC that are just -- that exist because of its DC, nothing to do with the specific nuts and bolts that you apply to it.

MR. KOWALSKI: Okay, and --

MR. ASHTON: And I want to make sure we understand the difference and segregate and identify those differences when we get -- as we get down the road.

MR. KOWALSKI: Very good. And I guess I'd like to add another dimension to that, and that is from the perspective that ISO views these things -- and it's not the -- not -- there's certainly issues with individual technologies and their individual reliability, that's one issue, but our perspective is more the broader, is looking at the holistic network and how does this -- how does this network behave. And now I'm --

MR. ASHTON: That's fine --

MR. KOWALSKI: -- I'm proposing a modification in this network and how does -- how does the overall network now function and can it achieve its reliability objectives --

MR. ASHTON: And that behavior may -- again may be limited by (a) technology, and (b) also the inherent nature --

MR. KOWALSKI: Yes --

MR. ASHTON: -- of DC?

MR. KOWALSKI: Yes.

CHAIRMAN KATZ: Mr. Emerick.

MR. EMERICK: I think -- Mr. Kowalski, I read your testimony, as I think you just stated, with caution. And I guess I read that testimony not -- well in a similar vein as I did your testimony back in March in terms of what was proposed. And all I'm trying to do is avoid an outcome like we had in June.

MR. KOWALSKI: I understand.

MR. BALL: Mr. Walling, in the studies that you ran, did you assume a 1200-megawatt DC line? Was that the assumption?

MR. WALLING: For the resonance studies, yes.

MR. BALL: Okay. Mr. Kowalski, you

conducted transfer limit analysis?

MR. KOWALSKI: Yes.

MR. BALL: Is the load carried by the proposed line relevant to that analysis?

MR. KOWALSKI: Yes, it is.

MR. BALL: Alright. Now, your testimony refers to a 1,000-megawatt HVDC line --

MR. KOWALSKI: Um-hmm --

MR. BALL: -- and Mr. Walling just testified that he was assuming a 1200-megawatt DC line. So you were studying a different line than the Applicants?

MR. KOWALSKI: A small difference, yes.

MR. BALL: Alright -- well --

MR. WALLING: I'd like to clarify too that for the VSC technology, the way we approximate it, it really doesn't matter what the line capacity was --

MR. BALL: Okay --

MR. WALLING: For the conventional DC, it only matters from the standpoint of the assumption of capacitors and filters.

MR. BALL: I appreciate that. Mr. Kowalski, in terms of a transfer limit analysis, wouldn't the results of the study have been better if you had studied a 1200-megawatt line?

MR. KOWALSKI: Possibly not.

MR. BALL: Uh -- possibly not, okay. Do you intend to do a transfer limit analysis with the higher capacity on the line?

MR. KOWALSKI: No, we do not have plans to do that. Interconnecting a DC line is more like interconnecting a generator, it just sits there starting at a very high loading and it's more -- it can create more problems at a high level.

MR. BALL: Alright. Now, you conducted thermal analyses. Is that a load flow analysis?

MR. KOWALSKI: Yes.

MR. BALL: Okay. Can you describe the configuration that you assumed in your load flow analysis?

MR. KOWALSKI: Yes. The configuration we examined was I believe very similar to what Mr. Walling did. The Beseck -- we replaced the Beseck to East Devon AC section with a Beseck to East Devon DC line.

MR. BALL: Alright. So you assumed that segment was DC. Did you -- what other assumption did you make? Did you assume a new substation in Beseck with lines going in and out of Beseck?

MR. KOWALSKI: Yes, the same -- the same basic system configuration, just replacing the Beseck to

East Devon AC section with a DC line.

MR. BALL: Alright. Did you assume an overhead or underground DC line, the same question I asked Mr. Walling, does it not matter?

MR. KOWALSKI: Irrelevant to --

MR. BALL: For a load flow study, it doesn't make a difference. What scenarios did you assume with respect to generation?

MR. KOWALSKI: With the transfer limit analysis, the generation -- we looked at a range of generating conditions, but it's not very significant.

MR. BALL: It's stressing the system again?

MR. KOWALSKI: Yes.

MR. BALL: Okay. You didn't assume any new generation in Southwest Connecticut in your analysis, correct?

MR. KOWALSKI: No. And it would have been irrelevant.

MR. BALL: What level of load did you assume for New England?

MR. KOWALSKI: I believe in this analysis we examined the 30,000-megawatt load level for New England.

MR. BALL: Alright. And in the ROC -- I

think we know that many of the studies are being run at 30-gigawatts, correct?

MR. KOWALSKI: Yes.

MR. BALL: Isn't that an unnecessarily aggressive load figure to assume?

MR. KOWALSKI: For long-term planning --

CHAIRMAN KATZ: We can't win on that one.

MR. KOWALSKI: For load level -- for a load level that we're anticipating to occur in 2010, I don't think it's -- I think it's very conservative --

MR. BALL: Alright, so --

MR. KOWALSKI: -- very, very optimistic --

MR. BALL: So in 2010 we're going to hit 30 gigawatts, is that possible?

MR. KOWALSKI: From the current projections, I believe yes.

MR. BALL: Alright. How far out do you project, how many years into the future?

MR. KOWALSKI: I think our current load forecasting is -- I think we do a 10-year forecast.

MR. BALL: Do you -- what is your projection for what the New England wide load will be in 2014?

MR. KOWALSKI: I don't know offhand.

MR. BALL: Okay -- approximately?

MR. KOWALSKI: I just -- I just can't recall. New England grows at about five or 600 megawatts a year, so by 2014 add another 2,000 megawatts onto that, but that -- that's an approximation.

MR. BALL: Okay. Now in your testimony you say that you found three overloads with the HVDC technology that you didn't find with the Applicants' AC proposal --

MR. KOWALSKI: Um-hmm --

MR. BALL: -- and one overload on the Applicants' proposal that didn't appear with the HVDC technology, correct?

MR. KOWALSKI: Yes.

MR. BALL: If you design the line, the DC line assuming extra capacity, wouldn't the thermal results be improved?

MR. KOWALSKI: Not necessarily.

MR. BALL: Did you look at conventional HVDC --

CHAIRMAN KATZ: Mr. -- Mr. Ball, you keep leaving the shoe dangling on the toe here.

MR. BALL: Why not?

MR. KOWALSKI: We really need to look at

the situation that was driving the problem. If -- if the problem could be relieved by increasing the capacity of the DC line by offloading the underlying system, it would help. If it would aggravate a problem by increasing the base loading on the DC facility, it would make things worse.

MR. BALL: Okay. In your load flow studies did you assume DC Light technology or conventional HVDC technology?

MR. KOWALSKI: For this analysis it really didn't matter.

MR. BALL: It doesn't make a difference?

MR. KOWALSKI: Basically, we assumed a DC Light technology relative to voltage performance, so --

MR. BALL: Okay. Now, you also said that you performed a voltage analysis. Can you describe what a voltage analysis is?

MR. KOWALSKI: The same thing, looking at the load flow analysis.

MR. BALL: And the results you describe as acceptable results with the DC line?

MR. KOWALSKI: Yes.

MR. BALL: Okay. You identify resonance and harmonics as a problem with DC lines, correct?

MR. KOWALSKI: Based on the General Electric report, yes.

MR. BALL: Alright. Now, your position in this docket is that the 3rd harmonic is a threshold below which the system can't operate reliably, is that fair to say?

MR. KOWALSKI: It is definite -- it's a threshold beyond which we have significant concerns about designing to.

MR. BALL: Um-hmm. Now, you -- ISO participated in Docket 217, correct?

MR. KOWALSKI: That's correct.

MR. BALL: You testified in that docket, correct?

MR. KOWALSKI: Correct.

MR. BALL: You're aware that the Council approved ultimately more than nine miles of undergrounding with HPFF lines and two miles of XLPE lines in Bethel, that was part of what was ultimately certified by this Council, correct?

MR. KOWALSKI: To my knowledge.

MR. BALL: Eventually that configuration was submitted to ISO for 18.4 approval, right?

MR. MACLEOD: I'm going to object, Madam --

I'm going to object, Madam Chair. I don't know where this is going and we're in 272 examining DC technology today. I don't know what the 18.4 process that was going through with respect to Phase 1 has to do with today's examination. And there's no indication in the testimony provided by Mr. Kowalski that would give rise to these sorts of questions, so it's definitely beyond the scope of --

MR. BALL: If I may --

MR. MACLEOD: -- the prefiled testimony.

MR. BALL: If I may, the prefiled testimony identifies resonance as a problem, both in the Applicants' testimony and ISO's. I don't believe there is or has been any opportunity to cross-examine ISO on the standard for harmonics. We cut off the examination the last time and I would just like to pursue it to try to understand so that we all know exactly what the standard is and why.

MR. MACLEOD: Madam Chair, today is not the day for doing that. There's nothing in here that indicates that we're going to go through standards for underground technology or for harmonic resonances. There's an indication in the prefiled testimony that this may exacerbate -- and I don't want to put words in anybody's mouth, but there's an indication that it may

exacerbate harmonic resonance issues, but this is not an indication as to where the standard should be set, how it should be set, or anything else.

And I'd also like to correct Mr. Ball in the sense that he said that we cut off testimony in this regard the last time. I think what happened is that we ran out of time. And I think this is going to come up again on a later date. And at that time I think his questions will be appropriate, but today they are not.

CHAIRMAN KATZ: Mr. Ball, first I'm concerned you're asking questions about 217 --

MR. BALL: Well --

CHAIRMAN KATZ: -- and secondly, I'm wondering if you should go to the telephone and call the First Selectman of Weston and tell him -- ask -- tell him what you're about to ask this witness.

MR. BALL: I -- I think it's perfectly legitimate to try to understand in this docket what the standard is. That's -- that's where I was headed. If we want to have a hearing down the road and ISO witnesses are going to be brought back, I'm happy to explore it at that time.

CHAIRMAN KATZ: I'd like to think about this and we'll perhaps take this up after lunch. If you

want to pursue another avenue at this time --

MR. BALL: That's all the questions that I have at this time.

CHAIRMAN KATZ: Okay. Mr. O'Neill.

MR. O'NEILL: Madam Chairman, I was going to suggest perhaps he could just address the harmonics in a general sense since that was a subject of discussion.

CHAIRMAN KATZ: Do you have a general question on harmonics you'd like to ask?

MR. BALL: I was going to ask about what the standard is as we sit here.

CHAIRMAN KATZ: Let's -- let's -- we'll leave this --

MR. BALL: We can hold off on that for a future --

CHAIRMAN KATZ: We'll hold off on it. Okay, Mr. Wertheimer, about how long do you have? Would you have more than 15 minutes?

MR. MICHAEL WERTHEIMER: I do, but not much longer than 15 minutes.

CHAIRMAN KATZ: Would you like to start now or would you like to -- does the Council have a preference? We'll continue, Mr. Wertheimer, if you want to come up.

(Pause)

MR. WERTHEIMER: Good morning, Michael Wertheimer for the Office of the Attorney General.

A couple of questions just to try to put these studies that you submitted into context for my benefit. Mr. Kowalski, you mentioned today that the study that you're testifying to -- or your testimony that you provided today expresses some caution about DC technology, is that a fair characterization?

MR. KOWALSKI: Yes, that's correct.

MR. WERTHEIMER: And Mr. Zaklukiewicz, your testimony indicates you're initially -- the company initially rejected DC technology for a variety of reasons and basically you're unsure if those reasons can be overcome in this case, is that fair to say?

MR. ZAKLUKIEWICZ: That was my testimony.

MR. WERTHEIMER: Okay. And Mr. Walling, your testimony was, essentially, that HVDC appears technologically inadvisable? That's essentially --

MR. WALLING: I said conventional --

MR. WERTHEIMER: Okay --

MR. WALLING: -- conventional DC technology for the -- would be inadvisable.

MR. WERTHEIMER: But as -- as was pointed

out during Attorney Ball's examination, that the Reliability and Operability Committee is examining various applications of DC in this Phase 2 project, is that right?

MR. ZAKLUKIEWICZ: That is an accurate statement.

MR. WERTHEIMER: So the punch line here is that there's more to come on DC from both ISO and the Applicants on DC? This testimony provided is by no means the last word?

MR. ZAKLUKIEWICZ: That is correct.

MR. WERTHEIMER: Okay.

CHAIRMAN KATZ: Mr. Kowalski, can you explain the difference to the Siting Council between a caution by ISO and a go, no go? Following on Mr. Emerick's very good question on that, I don't think we got a definitive answer. What's the difference?

MR. KOWALSKI: Well, perhaps some of it is the engineer in us that, you know, we see some real yellow flags coming up. And you know, before we're ready to say it's really a red flag, we want to make sure that this can be made to work. I see kind of a yellow to pink/orange flag on the -- on both the harmonics and the conditions that we tested with lines out of service as being issues that I don't know offhand how they can be overcome. We're

still having discussions with people, with ABB. We may learn something. So, I -- I guess I'd framed it that way, is it doesn't look promising right now, but we're certainly open to somebody showing us something that we haven't seen before.

CHAIRMAN KATZ: Well, would it be reasonable to request that if ISO does get to -- you NASCAR people can help me here, what color --

A VOICE: Caution --

CHAIRMAN KATZ: Gets beyond caution to definitive go or no go, that we will learn that quickly, so that we don't proceed thinking that, oh, we have a caution but we don't have a stop?

MR. MACLEOD: I think we can certainly try to do that, Madam Chair. I guess one of the -- one of the problems that confronts all of us in this proceeding, the Applicants, the participants, and the Council is that we certainly want to examine as far as possible, you know, where we can go with different sorts of technology, how much can be put underground, etcetera, and so we want to be very thorough about that, and we don't want to foreclose the possibilities that maybe something can work. We don't want to be premature in saying, you know, it doesn't look good --

CHAIRMAN KATZ: Well, we -- and we applaud that and we encourage that, but at some point if ISO gets to the point where they are saying no way, no how, we need to know that --

MR. MACLEOD: I understand --

CHAIRMAN KATZ: -- so that we're not spinning our wheels, and if we need to shift direction, that we do it quickly.

MR. MACLEOD: I understand.

CHAIRMAN KATZ: Back to you, Mr. Wertheimer.

MR. WERTHEIMER: Thank you.

MR. ZAKLUKIEWICZ: Madam Chair --

MR. O'NEILL: Mr. Zak wanted to --

CHAIRMAN KATZ: Oh, Mr. Zak.

MR. ZAKLUKIEWICZ: I believe our intent, Madam Chair, is to complete those studies by August 16th. I think that's the intent of the ROC committee to turn around and provide everyone, including the committee itself, with a clearer understanding of what can and cannot be done. And what you see here was looking at the Beseck to East Devon link only at DC. I believe at Tuesday's conference we indicated that we were moving forward with studies to look at not only HVDC between

Beseck and East Devon, but to remove an additional 16 miles of AC cable and put in DC between Singer and Norwalk. And we will continue to look at other alternatives, including an all DC solution if it would be, and what else would need to be done to make something like that work.

I think we -- we hear clearly from you, the Siting Council, what our charge is. And we take it very seriously and we are moving forward as quickly as we can, having those studies being conducted. And we heard clearly at yesterday's session money is no object. And we --

CHAIRMAN KATZ: I --

MR. ZAKLUKIEWICZ: -- we are looking at a solution that may or may not work, and I think that was our charge to come forward to you and to the entire Council and to everyone involved in this project with what we think is technically feasible.

CHAIRMAN KATZ: I think -- we appreciate that and we do applaud it, but I just want to make sure all the tires on the bus are moving in that direction.

MR. ZAKLUKIEWICZ: We're even changing the axles. (Laughter).

MR. KOWALSKI: We are trying to make it

work.

CHAIRMAN KATZ: Thank you.

MR. WERTHEIMER: A couple of quick questions about losses. One of you indicated the losses on the DC system I think for HVDC Light is about 6.5 percent compared to losses on conventional DC are about one and a half percent, is that right?

MR. WALLING: That's not an accurate comparison because you're comparing the DC Light including -- including line losses with the conventional DC for just conversion losses. So the total losses for this 1200-megawatt system between Beseck and East Devon is about 1.92 percent loss for conventional DC and about a 6.5 percent loss for voltage source converter DC, approximated.

MR. WERTHEIMER: Okay. Now, AC systems also have line losses, don't they?

MR. WALLING: That's correct.

MR. WERTHEIMER: And those would be about one and a half to two percent?

MR. WALLING: No, about -- my estimate was about 1.2 percent --

MR. WERTHEIMER: 1.2 percent.

MR. WALLING: -- for the same transmission

path.

MR. WERTHEIMER: Okay. So anytime that we see a DC line in application, like a shorter submarine route -- the Cross Sound Cable is DC, right?

MR. WALLING: It has a lot of loss, yeah.

MR. WERTHEIMER: And -- and the system has accepted the line losses? Whoever decided to put it in, that was something that was --

MR. WALLING: Well, actually in a longer distance -- conventional DC actually has less loss than an AC tie --

MR. WERTHEIMER: It depends on the distance --

MR. WALLING: -- for a very long distance, because typically the line loss is less --

MR. WERTHEIMER: How --

MR. WALLING: -- as my numbers show here, it's the conversion loss in a short distance that cuts into that --

MR. WERTHEIMER: And DC has been used in shorter applications, submarine, right?

MR. WALLING: Submarine applications and asynchronous ties where the economic drivers have been sufficient.

MR. WERTHEIMER: Okay.

MR. ZAKLUKIEWICZ: I think, Mr. Wertheimer, one of the reasons for the VSC technology on the link between New Haven and Shoreham in Long Island is that conventional HVDC would not work because of the weakness or the strength of the eastern LIPA or interconnection, that would not be a technology that was technically feasible. So with the development of VSC technology, one of the reasons you go to that technology is because HVDC does not work because of the weakness of the eastern LIPA facility and the AC technology is basically at a limit and will not work because of the 26 miles of AC cable that is -- you're pushing the limit, so -- just to clarify, that was a technology for which apparently LIPA made that economic decision of what is the cost of Long Island generation and what are the losses and what was the capital investment, and it was in their minds a prudent decision.

MR. WERTHEIMER: Fair enough. DC lines operate in two phases, is that right?

MR. WALLING: You could -- a conventional DC line you could look at it like being two phases. However, the VSC DC that ABB builds even though it operates with a positive/negative polarity, it's one

system, so it's not independently operable. So it depends -- phases have a certain meaning only in AC and it's not very relevant to convey that to DC.

MR. WERTHEIMER: How many lines run down the right-of-way?

MR. WALLING: Two.

MR. WERTHEIMER: That's what I thought. Does that mean -- are there different standards for right-of-way widths and heights given that you have two lines versus three for an AC?

MR. WALLING: For -- for underground I think the situation becomes the line loss, the heat put into the ground. For overhead, the right-of-way -- there's a number of factors that go into right-of-way and depending on what local restrictions are applied, so I'll let Mr. Zak cover --

MR. ZAKLUKIEWICZ: I believe the biggest driver, Mr. Wertheimer, on the right-of-way and the height of the structures would be at what voltage are we speaking. If we're talking conventional or traditional HVDC, which at a 1200-megawatt range, I believe the economics would drive you to a system that's operating at five or 550-kV, then the height and all of the towers would be appreciably higher. It would be like the 345-kV

structure as opposed to a 115-kV structure, if -- and you're probably in the ballpark of structures which are 100 to 110-foot tall with the two conductors on them and a shield wire on top. If you're talking 150-kV, which is the maximum voltage of a voltage source converter DC terminal, then we're into approximately a 70-foot high structure.

MR. WERTHEIMER: Let's talk about -- I just want to try to get an apples to apples comparison, the best you can --

MR. ZAKLUKIEWICZ: Okay --

MR. WERTHEIMER: -- we know what the right-of-width -- the right-of-way height and width restrictions are for a 345-kV AC system, that's what we've been looking at for months. If there was a DC portion of that line put into this system, set aside underground, just say it's overhead, does any of that change given what you'd require for this? And if you don't know, you can report back. I just think --

MR. ZAKLUKIEWICZ: I think -- I would like to report back. We've asked the questions can you put on the same monopole two conductors of HVDC on a monopole and then have three conductors of say 115-kV as proposed in some of the routes, say from Cook Hill down where we're

talking about some of those being a double-circuit tower on a common -- 345 on one side, 115 on the other side if you recall, Mr. Wertheimer --

MR. WERTHEIMER: Um-hmm.

MR. ZAKLUKIEWICZ: -- now if I replace that with DC where the three conductors are AC, what would be -- what would have to be the height of that tower, and would there -- would there be any change in the right-of-way width requirements? We've asked those questions --

MR. WERTHEIMER: Okay --

MR. ZAKLUKIEWICZ: -- my gut tells me that it will work, but I'm not -- since it's probably never been done before in the United States or maybe even in the world, I want to make certain I'm not saying yes and then having to come back here and eat my words.

CHAIRMAN KATZ: Mr. Walling, are you familiar with the Murray link DC cable in Australia?

MR. WALLING: Loosely familiar.

CHAIRMAN KATZ: Well, subject to check, wouldn't it be fair to say it's only -- it was like a four-foot wide trench along the side of the road where they laid two cables?

MR. WALLING: Yeah, it was a direct bury installation and so the -- the actual width occupied by

the cable, a single system's cable would be relatively narrow.

CHAIRMAN KATZ: And would that type of application be suitable in Connecticut?

MR. WALLING: Well, the difference here is when you're moving this amount of power, you would have to put a number of systems in parallel. And when the heat from one cable affects the carrying -- the current carrying ability of another cable, so you either have to, you know, greatly in size the -- increase the size of cables or you have to separate the cables. And somebody like Mr. Williams perhaps is a better one to discuss the cable and --

CHAIRMAN KATZ: Thank you --

MR. WALLING: -- aspects of this.

MR. ZAKLUKIEWICZ: Madam Chair, remember the -- the Murray link is a direct bury cable. I think we heard clearly from Conn-DOT and others that in order to direct bury anything in the streets, we're talking duct bank, we're not talking having a 3,000 or a 2500-foot opening at any given time to direct bury cables, so we're talking -- we're talking duct bank installation. And some of the comments being made here -- Murray link is a 220-megawatt transfer between points A and point B in a very

link -- here we're talking 1200. Recognize you could have converters at 330 and the cables that ABB presently makes are capable of transmitting 330 megawatts. So we're talking -- for the 1200 megawatts without any additional capability, we're talking four cables in some sort of a duct bank. And accounting for the heating of one cable onto the other in addition, which would have to be designed in as opposed to the Murray link, which was two conductors basically part of one 220-megawatt link.

CHAIRMAN KATZ: Thank you. Mr. Wertheimer, this would probably be a good time for our break.

MR. WERTHEIMER: Fine.

CHAIRMAN KATZ: We'll resume at 1:00 o'clock.

(Whereupon, a luncheon recess was taken.)

MR. TAIT: Continue your cross-examination of --

MR. MACLEOD: Professor Tait, if I may --

CHAIRMAN KATZ: Yes.

MR. MACLEOD: I think -- Mr. Kowalski had the opportunity to review something at lunch --

MR. TAIT: Okay --

MR. MACLEOD: -- which may result in a correction of some testimony that he gave earlier today,

so if -- and I don't know whether any of the other testimony might go in that direction today, but it might be helpful at this point just to get that correction on the record.

MR. TAIT: Is that okay with you, Mr. Wertheimer?

MR. WERTHEIMER: Fine.

MR. MACLEOD: Mr. testimony -- Mr. testimony -- (laughter) --

(Mic feedback)

A VOICE: That's Mr. Zak --

MR. MACLEOD: Mr. -- yes -- Mr. Kowalski, this morning I think you made reference to a load forecast and where you projected things might be in 2010 or 2013, or whatever. Have you had a chance to take a look during the lunch hour at the 2004 CELT report?

MR. KOWALSKI: Yes, I have.

MR. MACLEOD: Does it change your recollection as you testified this morning?

MR. KOWALSKI: Yes, it does. And perhaps it adds a clarification that should be made as well.

MR. MACLEOD: Okay, please go ahead.

MR. KOWALSKI: Alright. The question in regard to the time for occurrence of the 30,000-megawatt

load level, NEPOOL load level, based on the 2004 NEPOOL CELT report, which includes the load forecast that ISO puts together, in 2011 there's the so-called 90/10 load forecast of about 30,000 megawatts. And the significance of the 90/10 is it's a high weather -- a very -- a hot -- a very hot weather forecast that we use for transmission design and resource adequacy assessments. So it doesn't reflect, you know, a typical or average condition, it's far above it, but it still sets the bar for where we need to design. But again, based on our current forecast, that looks like that's about the 2011 timeframe.

CHAIRMAN KATZ: So how many days a year would a line be expected to hit this --

MR. KOWALSKI: It's more like --

CHAIRMAN KATZ: -- or a system?

MR. KOWALSKI: -- hours.

CHAIRMAN KATZ: Hours.

MR. KOWALSKI: Yeah.

CHAIRMAN KATZ: Okay.

MR. TAIT: How many hours?

CHAIRMAN KATZ: How many hours a year are we talking?

MR. KOWALSKI: We wouldn't -- in years where we've hit this extreme, it's only maybe several

hours for the whole year.

CHAIRMAN KATZ: Okay.

MR. MACLEOD: And is there also a 50/50 -- a so-called 50/50 --

MR. KOWALSKI: Yes --

MR. MACLEOD: -- forecast?

MR. KOWALSKI: Yeah. The forecast -- the peak forecast that many people frequently refer to is a 50/50 forecast and there's a 50 percent probability of its occurrence. And that 30,000-megawatt load level isn't -- I don't even have that. It's beyond 2014.

CHAIRMAN KATZ: Do we have the 50/50 for 2007?

MR. KOWALSKI: For -- the 50/50 for 2007 is twenty-six-eight and that's still a peak load forecast. A more average forecast is -- for 2007 is closer to 70 percent load level, which would be about 26,000 megawatts.

CHAIRMAN KATZ: Mr. Ball, do you want to be recognized?

MR. BALL: Thank you. Just one question if I might for Mr. Kowalski. Having reviewed the 2004 NEPOOL CELT report, what is the peak load forecast for 2014?

MR. MACLEOD: May I ask whether you're asking on a 90/10 or a --

MR. BALL: A 90/10.

MR. MACLEOD: Okay.

MR. KOWALSKI: The peak load for 2014, I don't have that, but it looks like -- the 2013 is 30,600, so the -- so 2014 would be above that.

MR. MACLEOD: Thank you, I have nothing further.

CHAIRMAN KATZ: Back to you, Mr. Wertheimer.

MR. WERTHEIMER: Thank you. A couple of quick questions about converter stations. Isn't it true that the size of converters stations -- the size requirements for converter stations varies by the type of technology used in stations?

MR. WALLING: The VSC DC technology generally has a substantially lower space requirement than conventional DC. Primarily, the biggest factor being the much more limited requirement in terms of filter banks, which are quite spacing.

CHAIRMAN KATZ: So if we wanted to put one in East Devon, how many acres would we need?

MR. WALLING: Mr. Zak should take that.

MR. ZAKLUKIEWICZ: With the conventional 330 --

CHAIRMAN KATZ: With the Light --

MR. ZAKLUKIEWICZ: With the --

A VOICE: (Indiscernible) -- conventional and --

CHAIRMAN KATZ: Both.

MR. ZAKLUKIEWICZ: Conventional would probably be 10 plus acres. With DC Light of stacking the 330-megawatt units, say if you put four of them into an area, it would probably be eight acres plus the AC interconnection, recognizing that each one of those terminals requires its own AC transformers.

CHAIRMAN KATZ: So how much more land would you have to acquire in the vicinity of East Devon?

MR. ZAKLUKIEWICZ: I think when we looked at Devon, we would need both parcels of property that we were previously looking at. It would be both the parcels to the west of where we were projecting for the proposed project, which was -- which was just to the north and the west of the Milford facility. And then there was another parcel -- if you recall it was much closer to the Housatonic River west of -- southwest of the property we were proposing to use --

CHAIRMAN KATZ: So the --

MR. ZAKLUKIEWICZ: You'd have to use both

of them.

CHAIRMAN KATZ: Okay. So there is land and it may be available?

MR. ZAKLUKIEWICZ: A correct statement.

MR. WERTHEIMER: Isn't there gas insulated technology for these converter stations that reduces the amount of size?

MR. WALLING: I do not believe that for actual -- for the actual converter units themselves that there is a gas insulated option. There are -- the AC bus work and so forth can be put into a gas insulated system, which slightly reduces the space. Transformers would still be the same and you'd still have the very large amount of cooling equipment. That's talking about the DC Light. If it was a conventional DC station, the relative change by using gas insulated technology would be larger because there's a lot more outdoor bus work in a conventional station.

MR. WERTHEIMER: How big is a converter station at the Cross Sound Cable -- at the end of the Cross Sound Cable in New Haven?

MR. WALLING: Mr. Zak has --

A VOICE: I had one picture -- here --

MR. ZAKLUKIEWICZ: The converter station

itself is excluded, and the AC connection piece is 90 meters by approximately 20 meters. And that's for a single 330-megawatt converter station.

CHAIRMAN KATZ: So we -- are we talking apples and oranges?

MR. ZAKLUKIEWICZ: Excuse me?

CHAIRMAN KATZ: Apples and oranges? We're talking much smaller capacity going across the Sound, correct?

MR. ZAKLUKIEWICZ: This is a 330-megawatt converter facility only. In other words, this is the building that houses the thyristors (phonetic) and does not include the filters that are on the 115 -- I mean on the 345-kV side, in addition to the transformers that interconnect with the 345-kV system --

CHAIRMAN KATZ: Okay --

MR. ZAKLUKIEWICZ: -- or the 138-kV system.

MR. ASHTON: Mr. Zak, that's simply the footprint dimensions of the buildings itself, is that correct?

MR. ZAKLUKIEWICZ: Basically, that is the footprint of the building itself, which includes the thyristors --

MR. ASHTON: Right --

MR. ZAKLUKIEWICZ: -- the coolers and some of the filters associated with the DC.

MR. ASHTON: No buffering that would go with an installation --

MR. ZAKLUKIEWICZ: That is correct --

MR. ASHTON: -- setback requirements, etcetera, etcetera?

MR. ZAKLUKIEWICZ: That is correct. That's just the footprint of the building within a fence line.

CHAIRMAN KATZ: Mr. Emerick.

MR. EMERICK: Yes. Mr. Zak, I think you mentioned if you were to use that design, you would stack it. I'm assuming we're looking at that facility in New Haven, but four times the height, or am I misinterpreting that?

MR. ZAKLUKIEWICZ: Stacking would be in the horizontal mode. In other words, you try to maximize the amount of facilities that you could put along -- one alongside each other to make up a 1200-megawatt terminal.

MR. EMERICK: I typically think of stacking the other way, but thank you, I appreciate it.

MR. ZAKLUKIEWICZ: Okay.

MR. WERTHEIMER: Have any of you studied EMFs from DC lines?

MR. WALLING: Not my area of specialty.

MR. ZAKLUKIEWICZ: We can have -- we can have someone -- they've already been sworn here, Gary -- Dr. Gary Johnson or Mr. Jay Williams, they were both sworn in previously, they can come up to the mic, and they're --

MR. WERTHEIMER: No, I was just asking about the testimony you have and that we're looking at. None of you are familiar -- can testify to that issue?

MR. WALLING: No.

MR. KOWALSKI: I cannot.

MR. WERTHEIMER: Mr. Kowalski, earlier before the lunch break, Mr. Ashton asked you a question or two about a 2007 date with respect to transmission cost allocation, do you recall that dialogue you had with him?

MR. KOWALSKI: Yes.

MR. WERTHEIMER: Okay. And I think, if my notes are correct, you talked about the 100th NEPOOL -- the 100th Amendment to the NEPOOL agreement RTEP process. And then you said that you could not say how 2007 plays into that process at this point, do you recall that answer?

MR. KOWALSKI: Yes.

MR. WERTHEIMER: Is the reason that you can't say how 2007 plays into the process because 2007 is no longer a significant date in terms of transmission cost

allocation decision-making?

MR. KOWALSKI: That's part of -- part of the issue. And --

MR. WERTHEIMER: The fact is that 2007 -- December 20, 2007 no longer bears any significance in determining how the cost of a loop through Southwest Connecticut will be allocated either regionally or localized, isn't that right?

MR. KOWALSKI: Well, I can -- I can speak to what was filed in terms of the 100th Amendment with respect to calling out the December 20, 2000 deadline versus the -- also what was proposed for a standard post-2007 --

MR. WERTHEIMER: Why don't we -- if you'll indulge me, why don't I try to take you through that and see if we can do it in a more orderly fashion. In September of 2002 the FERC ordered ISO New England to develop a transmission cost allocation mechanism, isn't that right?

MR. KOWALSKI: I forget the dates exactly, but that's --

MR. WERTHEIMER: And that was in the SMD, the Standard Market Design Order. Then on December 20th in that same docket or proceeding, the FERC established the

2007 deadline for guaranteed cost recovery of the Phase 1 and Phase 2 loops. They established a five-year window from December 20, 2002, which -- that's where we have the 2007 deadline, is that right?

MR. KOWALSKI: That's my understanding of the origin of the 2007 --

MR. WERTHEIMER: Sure --

MR. KOWALSKI: -- deadline.

MR. WERTHEIMER: And then subsequent to that in July of 2003, ISO submitted a transmission cost allocation proposal in response to the FERC's order. And that proposal did not include a 2007 cutoff or deadline for transmission cost allocation of projects in Southwest Connecticut, isn't that true?

MR. KOWALSKI: I don't know that that is wholly true because the filing contains a separate schedule, a Schedule 12-B that contains projects that were determined to be approved pursuant to that target deadline. So while the December 2007 is not explicitly called out, there are a number of facilities that are listed.

CHAIRMAN KATZ: Mr. Kowalski, we've been told in order to get the cost for this project socialized, it had to be completed by 2007. Is it your testimony

that's no longer true?

MR. KOWALSKI: I -- I -- I don't think that I can say that.

CHAIRMAN KATZ: Well, Mr. MacLeod, is -- can we get something -- if this is the case, can we get something in writing?

MR. MACLEOD: Yeah, I -- I think this is really an entirely legal thing. I know that we -- you can take administrative notice of all FERC orders and dockets. And in that regard, I would suggest that you can look at what's called the Transmission -- and we can look for you --

CHAIRMAN KATZ: Yes --

MR. MACLEOD: -- at what's called the Transmission Cost Allocation Order that came out I believe in December of 2003, and I may be wrong by a month or so --

MR. KOWALSKI: That's correct --

MR. MACLEOD: -- and we can advise as to what that says, but I do think it's perhaps a little bit unfair to ask Mr. Kowalski --

CHAIRMAN KATZ: No --

MR. MACLEOD: -- what the import of these orders are.

CHAIRMAN KATZ: I agree. As long as --

MR. WERTHEIMER: Chairman Katz, if I can be heard on this?

CHAIRMAN KATZ: Yes.

MR. WERTHEIMER: I'm -- to some extent it is a legal question and we will -- we will -- we do intend to brief it. The reason I thought it was appropriate to ask this witness is because Mr. Ashton asked a question and to my interpretation the answer perpetuated the understanding that 2007 was still the deadline. I don't believe so. I'm happy to give you the docket numbers --

CHAIRMAN KATZ: Yes --

MR. WERTHEIMER: -- now or at a later time of the decisions to take administrative notice. If you want to leave it to briefs, that's fine, but I didn't want that answer to that question hanging out there --

CHAIRMAN KATZ: Yes --

MR. WERTHEIMER: -- because from our perspective 2007 is longer -- bears the significance that I think some on the Council thinks it does.

CHAIRMAN KATZ: Yes, we did have that. And frankly, I'm perplexed why we have to hear this from you now that we've been running under this misconception --

MR. MACLEOD: Well, I'm -- are you talking

to Mr. -- you're looking at both of us and I'm not sure --

CHAIRMAN KATZ: I'm looking -- I'm talking to Mr. Wertheimer --

MR. WERTHEIMER: Okay --

CHAIRMAN KATZ: -- I have gratitude that he is bringing this up because we have been rolling along on this misconception that in order to have the costs subsidized for this phase, this work had to be completed by 2007.

MR. WERTHEIMER: Well, this has come up in this case. OCC had this same proposition in their prefiled testimony of Mr. Montalvo. I think Mr. -- or Attorney Golden asked Mr. Zak on -- I think it was June 1st in that hearing whether he agreed with that and he said he did. So, I think -- from my mind, I thought this issue was clear. Mr. Ashton's question today made me think maybe it wasn't. That's why I pursued it. However you wish to proceed on this is fine with me.

CHAIRMAN KATZ: I just want the record to accurately reflect -- I'm not -- I don't care what the source is, but accurately reflect what the story is now.

MR. ASHTON: If I may. I was certainly operating under the assumption of the December 2007 limit. However, that was not my -- not the key to my question --

MR. WERTHEIMER: I understand --

MR. ASHTON: -- the key was getting at what I will call my word goldplating and the impact of that and how that cost above what is perceived to be a reasonable cost by whoever is involved with it and how that plays out. But there's no question that implicit in my questioning was the fact of the 2007 deadline there --

MR. TAIT: Do --

MR. ASHTON: -- but that's not the focal point.

MR. TAIT: Do we have agreement that it no longer applies or is there disagreement?

MR. KOWALSKI: I don't know --

MR. TAIT: So that's my question.

MR. MACLEOD: I --

MR. TAIT: If we can agree, let's get on with it.

MR. MACLEOD: I would take a good look at the December -- 23rd?

MR. KOWALSKI: 18th.

MR. MACLEOD: 18th --

MR. TAIT: Well, I guess --

MR. MACLEOD: -- Transmission Cost Allocation Order --

MR. TAIT: I guess then we need briefs on it from the parties to tell us what their interpretation --

MR. MACLEOD: And I think -- I'm not even sure that it needs a brief --

MR. TAIT: Okay --

MR. MACLEOD: -- but we need to look at the order --

CHAIRMAN KATZ: Mr. Henebry or Miss Randell, do we have somebody who wants to -- on your panel who --

MR. TAIT: Could somebody look at it and get back to us if there's agreement or disagreement --

MR. ASHTON: Well, let ISO do it, that's the -- that's their relationship with FERC --

MS. RANDELL: (Indiscernible) --

CHAIRMAN KATZ: Just a second, hold it --

AUDIO TECHNICIAN: Hang on a second. (Pause). Go ahead please. I'm sorry, Miss Randell.

MS. RANDELL: That's okay. We'll review the transcript, but I can tell you that this panel is not the panel --

CHAIRMAN KATZ: Okay --

MS. RANDELL: -- that would testify on

this.

A VOICE: Right.

CHAIRMAN KATZ: Okay.

MS. RANDELL: I'll flag it as an issue.

CHAIRMAN KATZ: Thank you.

MR. WERTHEIMER: I'll share the decisions we have with Attorney MacLeod and I'm sure we can work this out.

MR. MACLEOD: I have the decisions.

CHAIRMAN KATZ: Thank you.

MR. WERTHEIMER: That's all I have.

CHAIRMAN KATZ: Thank you, Mr. Wertheimer.

MR. WERTHEIMER: Thank you.

CHAIRMAN KATZ: Any other party or intervenor before the Council does their cross-examination? Mr. Knapp. Do you want to come down?

Is there anyone after Mr. Knapp who wishes to cross-examine this panel? Can I have a show of hands. Okay, so after Mr. Knapp, we'll have Mr. Cunliffe and KEMA.

And let me just say this, if there are any other misconceptions that you think this Council may be operating under, this would be the time to tell us, not October.

MR. ERIC KNAPP: Actually most of my questions were taken up by Assistant Attorney General Wertheimer, who anticipated much of what I was going to ask. Actually, I have a surprise appearance by the First Selectman here who will join me for about a minute while I ask my one or two questions.

CHAIRMAN KATZ: Welcome, sir.

A VOICE: Thank you.

MR. KNAPP: I guess -- I would just start with some very basic technical levels because I don't quite --

CHAIRMAN KATZ: This is -- they usually say because I'm a lawyer, I'm going to start at the basic technical --

MR. KNAPP: Sure. I've looked through the testimony that's been submitted and -- well, part of it I didn't understand. Part of it is -- there's just some very basic technology levels that weren't set forth in the report I guess because they were assumed to be known. Let's just start with -- yeah, something that you testified to this morning, Mr. Zak, which is what is the interaction on the poles between the DC and the AC currents? I mean how close together can they be put? Can they be on the same pole? Are they separated out? I

guess -- you know, perhaps you can just start with -- start with some basic answers on that.

MR. ZAKLUKIEWICZ: Whether they can be placed on the same pole is a question that we're raising and we need to clarify both from an employee working clearance. On the adjacent -- on the 115-kV AC side of the pole if you had both DC and AC on the same pole, what are the working clearances for one, and secondly is there any interaction between the DC -- the two conductors associated with the DC, any interaction whatsoever with the AC. And those need to be totally resolved. They -- as I indicated before, they were not clearly clear in my mind, and I do not want to testify unless I know the correct answer.

MR. KNAPP: Okay, so the fact that I didn't see that information was simply because it hasn't been generated yet then, or --

A VOICE: Correct --

MR. ZAKLUKIEWICZ: That is correct.

MR. KNAPP: Okay. I'm glad I didn't miss anything then.

MR. WALLING: I can speak to the interaction between the systems. I have a published article from more than 10 or 15 years ago on that matter.

There is interaction between an AC and DC line, which at least in the context of conventional DC can cause some pretty significant issues. And those issues were recognized when we were doing studies prior to specification of the DC line that runs from Ayer, Massachusetts up to northern Quebec, which that line runs in parallel with AC lines for short percentages of that total line. That interaction required putting 60-hertz blocking filters on the DC system, which adds considerable cost and space requirements at the converter stations.

MR. ASHTON: Mr. Walling, what's a blocking filter -- what's a blocking filter?

MR. WALLING: A blocking filter basically is a parallel combination of the capacitance and inductance that causes a certain frequency not to want to go through. It makes high impedance to a certain impedant -- a frequency. In this case to 60-hertz, so that you don't get 60-hertz current induced by the magnetic field of the AC line from causing 60-hertz modulation on the DC side to flow, which --

MR. ASHTON: Screws up the works.

MR. WALLING: Screws up the works. (Laughter). That's the short answer. The long answer involves demodulation and side band components that

saturate the transformer and make the transformer howl in agony.

MR. TAIT: Mr. Knapp, you must have missed that lecture of the evidence in your class at law school.

A VOICE: Clearly.

MR. ZAKLUKIEWICZ: Mr. Knapp, I hope you appreciated my answer. (Laughter).

MR. KNAPP: Very much so. The blocking filter, is it the size of this table? How big is a blocking filter?

MR. WALLING: Oh, it's -- at Sandy Pond near Massachusetts, I -- I have not physically seen it, I've seen the electrical parameters for it, but I imagine for each pole -- there's two poles in that DC system -- I believe it's probably a couple of times the size of that stage area that the Council is sitting on.

MR. KNAPP: For each pole?

MR. WALLING: For each pole.

MR. KNAPP: Okay. That sounds kind of large and kind of expensive?

MR. WALLING: Yeah.

MR. KNAPP: Okay.

A VOICE: I like that answer.

MR. KNAPP: So are we potentially talking

about yet another right-of-way someplace to put this on?

MR. WALLING: Typically, it's placed in a converter station.

MR. KNAPP: I'm not sure that was responsive to what I was asking. I guess --

MR. WALLING: Well -- usually when I think of right-of-way, I think of something running along the line --

MR. KNAPP: Okay --

MR. WALLING: -- and this is a terminal -- a piece of terminal equipment --

MR. KNAPP: It's a terminal piece, okay. So it doesn't need to be on each pole along the right-of --

MR. WALLING: No, no, no --

MR. KNAPP: Okay --

MR. WALLING: -- no.

MR. KNAPP: -- that -- that clears up the issue I guess. If you have these blocking filters then, you're able to run on the same right-of-way with AC and DC without other issues then?

MR. WALLING: There are other related issues that the filters won't solve, which may or may not be significant, which will require specific engineering

analysis.

MR. KNAPP: Okay.

MR. WALLING: I'm trying to learn your language. (Laughter).

MR. KNAPP: And I'm trying my best to learn your language too. And we saw a wonderful film presentation Tuesday or Wednesday, I guess it was, showing that under certain circumstances you get lower levels of EMF for certain sort of flipping of lines for AC --

MR. WALLING: Um-hmm --

MR. KNAPP: -- can you achieve those effects with AC/DC or is that something that is out of the question?

MR. WALLING: That's something to be good to ask somebody else, like Mr. Johnson -- or Dr. Johnson.

CHAIRMAN KATZ: Are you referring to the parking lot lumber?

MR. KNAPP: The parking lot lumber issue, yes, to use the technical term for it.

MR. ZAKLUKIEWICZ: Attorney Knapp, I think we need to just make certain we understand here. All of the HVDC voltage source converter transmission lines to date have been placed underground. ABB has never installed a VSC HVDC link aboveground --

MR. KNAPP: Okay --

MR. ZAKLUKIEWICZ: -- and there's reasons for that. So to turn around and place a VSC link in place overhead would require I think extensive work between ourselves and ABB to ensure the filtering, which is not an issue with cables, okay --

MR. KNAPP: Okay --

MR. ZAKLUKIEWICZ: -- because the cable also has a sheath around it and so you get -- you don't have the promulgation that you do putting a dirty DC signal or current on an overhead conductor which is not shielded which acts as a 20-mile or 30-mile or 40-mile antenna --

MR. KNAPP: Um-hmm --

MR. ZAKLUKIEWICZ: -- promulgating all of the harmonics. So this would have to be a detail that would have to be worked out. These are some of the questions we've been raising with ABB regarding what else would have to be done to the their terminal equipment if, for instance, any one of these terminals was installed with an overhead line, so I don't -- I don't mean to convey the fact that we haven't studied some of this, just like employing 1200 megawatts, stacking, or in parallel for 330-megawatt converters, which have never -- have not

been done today, or to look at multi-terminal usage of HVDC technology, which is basically not been done, are all of these feasible, can they be done -- and I recall Representative Adinolfi's position that we can do anything, so -- I want to make certain that I'm not conveying I don't have the answer because it is -- a lot of technical issues have to get resolved.

MR. KNAPP: Okay. I understand that. My -- if it has never been done, that's a fair answer and I'm willing to accept that. I -- my knowledge of what has and hasn't been done is, obviously, not quite as great as yours.

I understand that there is -- maybe I don't understand, but it's my impression from what you said this morning and from what I've heard from some of the ROC phone calls, we're now looking at some combination of AC and DC along some of these routes, is that true or not the case?

MR. ZAKLUKIEWICZ: I think what the ROC group has indicated at the phone calls was to turn around and look at the DC technology and to what extent could that possibly be a solution --

MR. KNAPP: Okay --

MR. ZAKLUKIEWICZ: -- so what you have in

the study that was attached to my testimony was GE's high level look at a DC link between Beseck and East Devon. At Tuesday's session we said we were going further than that since the numbers were not -- the harmonic screening was not giving you the numbers ISO really wants, that we were then looking at a second link between Singer and Norwalk, in addition to the Beseck to East Devon link --

CHAIRMAN KATZ: Mr. Zak --

MR. ZAKLUKIEWICZ: -- and we'll keep going from there.

CHAIRMAN KATZ: Mr. Zak, while we have Middlefield up here, is one of the possible DC links from Scovill Rock to Black Pond Junction?

MR. ZAKLUKIEWICZ: We haven't gone in that area yet. We've been studying from Beseck --

CHAIRMAN KATZ: Understood. But is that on the list?

MR. ZAKLUKIEWICZ: We'll -- we'll see where it comes out with the other ones.

CHAIRMAN KATZ: Thank you. Mr. O'Neill --

MR. ZAKLUKIEWICZ: That --

MR. O'NEILL: Yeah --

MR. ZAKLUKIEWICZ: That has some major problems with it if we go there. And I think I've already

testified to that, that that is also the terminus for the connection into Millstone.

CHAIRMAN KATZ: Yes -- yes, you did say that. Thank you.

MR. ZAKLUKIEWICZ: And that is a major, major concern to the NRC licensing of Millstone --

CHAIRMAN KATZ: So --

MR. ZAKLUKIEWICZ: -- of taking that terminal, if you would, and converting it to DC.

CHAIRMAN KATZ: So is it your thinking at this point that if the DC can be made to work between Beseck and East Devon, north of Beseck might have to be overhead?

MR. ZAKLUKIEWICZ: Yes, unless we do some other substation work in that area.

CHAIRMAN KATZ: Thank you. Mr. O'Neill.

MR. O'NEILL: Yes. Mr. Walling, you made a passing reference to a Massachusetts DC installation?

MR. WALLING: Um-hmm.

MR. O'NEILL: Would you please elaborate upon that installation? What is the nature of that installation?

MR. WALLING: It's a 2,000-megawatt conventional DC system that starts up near the James Bay

area in northern Quebec. It has a terminal point in -- called Nicolet, which is near the St. Lawrence River in Quebec, and then continues on to Ayer, Massachusetts. It was built as a multi-terminal system. Actually, it had two additional terminals, which dates from the original system, one up in Cumberford, New Hampshire and another one up in Quebec. There are a lot of challenges to make it operate multi-terminal. The two smaller old terminals were found to just totally destroy the operating reliability of the system, they were decommissioned. And it's my understanding that the main three terminals are rarely -- or never operated in a true multi-terminal manner, but actually as point-to-point this point, or point-to-point that point.

MR. O'NEILL: So that's part of the Quebec interface then?

MR. WALLING: That's right.

MR. O'NEILL: Thank you.

MR. WALLING: And that was for -- I mean the application for that was both asynchronous boundary and long distance.

COURT REPORTER: One moment please --

MR. O'NEILL: How long --

(Pause)

MR. O'NEILL: You referenced a distance. How long is that line approximately?

MR. WALLING: On the order of about 800 miles I believe.

MR. O'NEILL: Thank you.

CHAIRMAN KATZ: Back to you, Mr. Knapp.

MR. KNAPP: Thank you. I guess coming back to a variety of the question I asked earlier, is it possible to run say a 115 from Beseck to Devon and also a DC cable or are they sort of exclusive? You know, there's issues of reliability and things in your report there. Can you do both at some level?

MR. ZAKLUKIEWICZ: I think I already answered that. We've got to look at that especially if we're planning on putting both of those circuits on a single monopole or within a single lattice tower of some sort.

MR. KNAPP: Okay, that was -- I guess getting back to the question I asked a moment ago was -- that is being studied then?

MR. ZAKLUKIEWICZ: We are looking at that.

MR. KNAPP: Okay.

MR. ZAKLUKIEWICZ: To my knowledge, it has never been done before in the world.

MR. KNAPP: Okay. Presumably you could if -- cost is no object as we've heard -- run the 115 and then the DC underground and just spend the money to do both, one monopole and one underground trench then?

MR. ZAKLUKIEWICZ: The answer to that would be money is no object, yes. (Laughter).

MR. KNAPP: Well -- uh -- I guess at this point I have no further questions then, thank you.

CHAIRMAN KATZ: Thank you, Mr. Knapp. Any other party or intervenor before we have the Council? Seeing none, Mr. Cunliffe.

MR. FRED O. CUNLIFFE: I'd just like to introduce Johan Enslin with KEMA, he'll be doing the cross-examination on the HVDC.

MR. JOHAN ENSLIN: Thank you very much. Johan Enslin from KEMA.

Maybe my first question goes to Mr. Walling on a report he did for -- the GE report he did on the HVDC connection. It was indicated that the HVDC and the voltage source HVDC systems would weaken the network with limited generation on the system. Now, first of all, the question of minimum generation comes up every time. How practical is that in a real system? Furthermore, will the system with an HVDC link --

A VOICE: (Indiscernible) --

CHAIRMAN KATZ: We're going to ask you to sort of break it up --

MR. ENSLIN: Okay --

CHAIRMAN KATZ: -- the questions --

MR. ENSLIN: No, it's the same question.

CHAIRMAN KATZ: Okay.

MR. ENSLIN: So, I just want to stop there a bit and we can come back to it. Will the system with an HVDC link be weaker than the currently installed Connecticut system under the same conditions? So if we take the system as it is right now and we check the system strength and we install the HVDC, will it be weaker or stronger?

MR. WALLING: Than compared to today, no, it would not be weaker than --

MR. ENSLIN: It would be a stronger system?

MR. WALLING: Not measurably stronger, no.

MR. ENSLIN: That I don't understand, because if I have an HVDC link in my system, I strengthen the system.

MR. WALLING: I don't agree with that.

CHAIRMAN KATZ: Just --

MR. WALLING: Usually an HVDC system is not

considered a short-circuit provider. A conventional DC system definitely is not a provider of short-circuit strength to the system. If you get to a VSC DC, then it becomes very much dependent on what frequency range you're talking about. At the fundamental frequency it's controlled as a current source, which becomes a non-provider of strength, it's an ideal current source.

MR. ENSLIN: So in general, then why do we install DC systems?

MR. WALLING: To transmit power.

MR. ENSLIN: So to strengthen our system?

MR. WALLING: I do not agree. From a short-circuit -- from the standpoint of theavenan (phonetic) impedance of the system, the DC -- conventional DC does nothing, voltage source DC does little to nothing depending on the frequency range in which you're speaking.

MR. ENSLIN: It does not -- yeah, you're right it does not include the short-circuit current, but it does strengthen the total system in power flow --

MR. WALLING: We're talking about resonant phenomenon. We're talking about the theavenan impedance of the system in lower harmonic range. It -- it does little to nothing. It actually can aggravate the system depending on the response of the controls. You're in the

crossover -- in the lower order of frequency range or harmonic range, you're in the crossover of the converter controls between a true constant current capability to effectively a voltage behind reactance. And as you should know, that controls when you reach the end of their band width, you start getting phase lag and it gets very complex at that point.

MR. ENSLIN: I can come back to that. The -- the -- furthermore, so the system as we -- if we install the DC, I think will be a stronger and a more interconnected system. You have basically two generators on both sides --

MR. WALLING: Is that a question? Is that a question --

CHAIRMAN KATZ: Just --

MR. WALLING: -- or a statement?

MR. ENSLIN: Yes -- yes --

CHAIRMAN KATZ: We --

MR. WALLING: If that's a question, no, it does not -- I do not agree. It does not strengthen the system from the standpoint of theavenan impedance.

CHAIRMAN KATZ: Okay, just -- I'm going to ask you to just give him a little latitude --

MR. WALLING: Okay --

CHAIRMAN KATZ: -- he's going to give you a little background and then he's going to ask you a question.

MR. WALLING: Okay.

MS. RANDELL: We won't object to that -- are we on? We won't object to that provided that Mr. Walling can continue to say I don't agree with that statement.

CHAIRMAN KATZ: Correct. We -- we would appreciate -- we appreciate the level of this dialogue. And I just want both sides to allow the other --

MS. RANDELL: We'll just sit back and watch. (Laughter).

MR. ZAKLUKIEWICZ: That will be a first. (Laughter).

MR. WALLING: My -- my apologies to the Council for the technical level that this interchange is heading towards. Maybe we need to stop from time to time and interpret --

A VOICE: No, that's fine.

A VOICE: (Indiscernible) --

(Pause)

CHAIRMAN KATZ: Okay. I'm sorry, where are we?

MR. ENSLIN: Okay, just -- the following question, why do we have a lower resonance frequency with voltage source converter HVDC compared with an AC cable option?

MR. ZAKLUKIEWICZ: I'm not certain I understood the question.

MR. ENSLIN: Basically, if we take the AC cable or the AC overhead line and we replace it with a DC system, suddenly we have a lower resonance frequency?

MR. WALLING: The study that you're referring to, the feasibility study we looked at had the AC cable still in place between East Devon and Norwalk, so you still have a substantial amount of cable capacitance there, and you're cutting off the primary source of short-circuit strength, which is from the Beseck direction, so you're weakening the system, you're taking out a small amount of -- or not a small, but an amount of the charging, a partial reduction of the capacitance, but you still have a large amount of capacitance left, but the -- so that's kind -- that's the opposing effect to the weakening of the system, but the weakening of the system is the dominant factor there, and it -- the study results clearly indicate they get low in the resonant frequency if you leave that East Devon to Norwalk section of AC cable

virtually stranded from the standpoint of strength. It's -- with the line between Plumtree, Bethel to Norwalk, when that's on outage, you basically have the only -- the 115-kV system providing strength to that cable.

MR. ZAKLUKIEWICZ: Mr. Enslin, I think one of the areas that we are trying to wrestle with is the area -- if you have an all DC solution, you basically, in my mind, have precluded any additional generation ever being installed between Beseck and Norwalk.

The reason I say that is this is not a regulated entity any longer, this is competitiveness. And if every generator now has to install a DC terminal to interconnect with the transmission system, it basically takes 350, 450-million-dollar generation project and makes it a 450 or 500-million-dollar project. Those capital dollars have to be recovered. And they're recovered only if -- hour to hour in the system I can operate. And when I need to set my clearing price at a price that overcomes the fact that every other generator either in New York or New England does not have a hundred-million dollar DC interconnection, plus does not have to deal with the fact that I've got a one percent unavailability scheduled for DC converter out of service, and then on top of that I've got a one to a one and a half percent availability for

scheduled maintenance, I'm looking at 10 days of the year I can't operate my generator because I've either got scheduled HVDC maintenance or unscheduled maintenance where the AC interconnection doesn't have that. It may have a GSU, a generator step-up transformer that needs maintenance once every five years, and the percentage of availability then goes down, besides that I need to install a converter station to tap onto this if you will transmission corridor from Beseck to Norwalk.

So we need to keep that in mind. If we're saying we're going to go forward with the technology that basically prohibits or makes it extremely cost ineffective, unless the State is going to subsidize the cost of the DC terminals for all of these generators that we really need as we move forward, then it turns around and it makes it cost ineffective later on for the free market, not the regulated market, but the free market, and that's what's been passed by the legislators, competitive market to live and exist in Connecticut.

And we already realize the older generating units are basically bidding out of the market today. We've got the Devon units who can't compete. And no bank or lender with any understanding of the utility business is going to turn around and say show me your cash flow and

then show me how you're going to recover your capital investment, maintain this equipment, such that later on you still have a cash flow coming in because people are going to just want to walk away from that investment if you can convince someone to put up the money for it to begin with.

So, I think those are one of the items that we're -- when we looked at an alternative, we said, okay, let's look at DC from Beseck to East Devon, but that allowed generation to tie on to the AC system between East Devon, Bridgeport, and Norwalk. Once we turn around and put in a second DC link now from Singer to Norwalk, you're basically saying okay any future generation now can tie onto the AC system east of Bridgeport, west of East Devon, because any place between Singer and Norwalk now they're going to have to turn around and install a DC converter, and --

CHAIRMAN KATZ: I guess I don't understand, Mr. Zak, why if -- for example, if Norwalk Harbor got repowered, why you couldn't plug it in AC wise at the Norwalk Substation?

MR. ZAKLUKIEWICZ: You could -- you could there, but if you turn it around and say, okay, somewheres closer to Bridgeport, am I going to now have to pay for 16

miles of AC transmission to get to Norwalk, those dollars are going to be basically borne by the generating plant. And that 10-million dollars a mile, that is -- that is a big financial burden.

CHAIRMAN KATZ: But the Singer Substation -- even if you did DC as far as Bridgeport, the Singer Substation wouldn't be exclusively a DC facility, would it --

MR. ZAKLUKIEWICZ: We would --

CHAIRMAN KATZ: -- wouldn't you want to have both AC and DC there?

MR. ZAKLUKIEWICZ: You'd have to tie -- our proposal if it went all DC, would be to put Bridgeport directly onto the DC. In other words, you'd have converter stations dedicated to the Bridgeport Energy facility --

CHAIRMAN KATZ: Okay --

MR. ZAKLUKIEWICZ: -- and if you put another generator there, it would have its own DC converter because we've already said we can't put additional generation onto the 115-kV system because of the fault duty issues.

CHAIRMAN KATZ: So from your point of view, it makes sense if the DC is doable, to only do it as far

as East Devon and keep the traditional underground AC line from East Devon to --

MR. ZAKLUKIEWICZ: All I'm trying to do is convey to you what our logic was and the thought process of going down the road. No, I will not agree with you, with your statement, because then I won't be thinking out of the box. Our goal is to make this thing underground, okay --

CHAIRMAN KATZ: Yes, but I'm saying --

MR. ZAKLUKIEWICZ: -- and we will try to do that --

CHAIRMAN KATZ: Yeah --

MR. ZAKLUKIEWICZ: -- but I just wanted to point out one of the technical issues --

CHAIRMAN KATZ: My premise -- yeah -- my premise was underground. My premise was it sounds like it doesn't make sense to do underground DC past East Devon, it makes more sense to do underground AC past East Devon because the generation that's south of East Devon?

MR. ZAKLUKIEWICZ: We -- we may come to you, but we may point out that this would be one of the negatives of such a plan, that we could do it technically, we could do it to begin with, but be aware.

CHAIRMAN KATZ: Thank you.

MR. ZAKLUKIEWICZ: Okay.

MR. ENSLIN: To continue --

MR. ZAKLUKIEWICZ: Sorry to interrupt you, I apologize.

MR. ENSLIN: Coming back to the technical issue, by keeping the capacitors -- back to Mr. Walling if it's possible -- by keeping the capacitors -- the 115-kV capacitors in operation, especially under low load conditions with all the generators turned off, do you think that is a standard operating condition to study a system like this?

MR. WALLING: The fact that the generators are off increases the need for the capacitors for voltage support in that system.

MR. ENSLIN: At low load conditions?

MR. WALLING: The guidance on that came from Northeast Utilities planning staff. And we didn't -- this is not necessarily a low load condition. This is a condition where the load in overall New England is not high enough to drive the price up, the clearing price up to where the generators in that area would be dispatched. You do not have to be at below load or very light load for that to be the case.

MR. KOWALSKI: Just to follow up on that

comment, this is a system that has to operate not just at peak load but over a wide range of operating conditions. And as Mr. Walling eluded to, it's very much conceivable, particularly as we're trying to design a system that can allow extended outages of plants for either outright retirement or repowering, that in combination with normal forced outages, anticipated maintenance outages, particularly in the shoulder peak seasons, fall, summer, where you've got virtually no generation on in the area yet you're still trying to maximum the power imports, and you would have a large amount of capacitance on either for power factor correction or just transmission VAR compensation at the 115-kV level, so it's -- it's not an unreasonable condition.

MR. ENSLIN: But it is really a worst case condition, which is not a standard operating condition I guess?

MR. KOWALSKI: Well, I guess -- I don't know that there is such a thing as a standard operating condition. I mean a standard operating condition is can I operate the system through the load cycle from the middle of the night one day through the peak of the next and into the middle of the night the next day, and can I do that season to season.

MR. WALLING: And also operate in a deregulated degeneration environment where the utility -- the transmission operating entity does not have control as to units unless it becomes a must run situation.

MR. ENSLIN: Is that the current condition as well before we do DC link connection? Would this low resonance be the current condition as well?

MR. ZAKLUKIEWICZ: I believe when you look at where are the harmonics in the current system, I believe the range is today somewheres between 2.9 and 8.8 or in that ballpark -- and I believe we testified to this earlier -- the 2.9 condition is driven by the same generation dispatch with the capacitors on. So we -- we're not -- we're not differentiating in any study, we're looking at basically the same difficult conditions with the system that we have in place today with the system that we're looking at in evaluating with these other scenarios of possible solutions. So yes, the answer is, yes, it is.

MR. ENSLIN: So in general if a DC link as an option, it won't worsen the system much worse than it is right now?

MR. ZAKLUKIEWICZ: If you're saying would DC, meaning voltage source converter DC, I would agree

with you. If you're talking traditional or conventional HVDC, I disagree.

MR. WALLING: We need to further clarify, if you're going all the way with the voltage source converter DC, you'd be roughly where you are now. If you go only as far as East Devon and leave AC 345-kV cable from there to Norwalk, you're much worse than you are now.

MR. ENSLIN: Because of the cable not of a DC?

MR. WALLING: Because --

MR. ENSLIN: Of the AC cable not of a DC cable --

MR. WALLING: Well, the combination. The combination of the DC weakening the system as compared to an AC option for that Beseck to East Devon route and the capacitance provided by the cable -- the AC cable.

MR. ENSLIN: Coming back to some of the assumptions. Looking at your report, I didn't see any references of specific installations and so on. So that's my question. You indicated the losses shown in Table 5. And I personally feel them as on the high side for a DC option. You indicated 1.9 percent for a classical solution and 6.5 percent for HVDC Light or a voltage source converter option. Do you have references of these

installations? Where did you base these results on or did you do your own calculations?

MR. WALLING: I did my own approximations for line losses for the conversion losses. For conventional DC, the EPRI, the HVDC reference book has some typical numbers, plus numbers that we commonly use in specification, VSC HVDC from -- basically based on what's publicly known from Cross Sound Cable.

MR. ASHTON: Mr. Walling, you used the term EPRI. What's EPRI?

MR. WALLING: Electric Power Research Institute.

MR. ASHTON: And what are they?

MR. WALLING: It is a not-for-profit corporation that some utilities participate in -- a fairly large number of utilities participate in -- it used to be virtually all -- that finances R&D efforts for power generation, transmission, and utilization.

MR. ASHTON: Thank you.

CHAIRMAN KATZ: We should remind you of our acronym rule.

MR. WALLING: I -- I did spell it out previously. I thought maybe the once per day was enough, but -- okay.

MR. ENSLIN: So on this specific line did you do this calculation based on those parameters or --

MR. WALLING: Well, the -- for the VSC, I -- the conversion losses are based on experience, line losses for an approximation for this line. For the conventional DC, based on accepted norms and some calculation on the line. And for AC was also a calculation. I would not claim that these numbers are precise to the 10 percent plan or anything, they're approximate numbers. But the point here is that voltage source converter DC has substantially large -- larger losses than either AC or conventional DC, and -- to the point that it becomes a very significant power loss.

MR. ENSLIN: What we basically saw in your report is on the negative side on HVDC. We haven't seen any positive side of what a HVDC link can bring to a system in this region. Can you perhaps mention a few for us? And I'm thinking of looking at islanding (phonetic) for instance, first islanding (phonetic) under blackout conditions. If some of these positive effects --

MR. WALLING: Well, that would be a very substantial negative effect I would think, particularly the conventional DC. Conventional DC you cannot work into it, you can't restart a black starter system using --

MR. FITZGERALD: Excuse me. He was actually -- he limited his question to HV -- to --

MR. WALLING: Voltage source converter?

MR. FITZGERALD: -- to DC Light, yeah.

MR. WALLING: Okay. I'm sorry. I didn't catch that. I don't know of any particular advantage that that would give over an AC line. The fact that you can use voltage source converter DC to black start a system is an advantage over conventional DC. I don't see that as a particular advantage over a conventional AC line.

MR. ENSLIN: If you look at first islanding before a blackout even starts, have that been considered? Is that a possible --

MR. WALLING: You mean -- oh, separating a segment of the system?

MR. ENSLIN: Yeah, sure.

MR. WALLING: When we consider that this is not a -- this line I don't think falls in a -- it's situated topologically in a system where you'd want to do such a first islanding. There's likely to be very little or no generation resources in the area, so -- it's not clear what -- unlike a tie between let's say New England and New York where that would be a great advantage -- in the case of a blackout, you're basically talking about a

tie within an area. You also have a fairly extensive network of 115-kV. I don't see the -- although I understand what you mean, I don't think that this line is in the right place to do any -- to be of any value in that regard.

MR. ENSLIN: You indicated this morning that using the HVDC Light terminal as a STATCOM can mitigate some of the negative aspects of a lower harmonic resonance. And you also indicated that hasn't been done before?

MR. WALLING: On a large scale basis.

MR. ENSLIN: On a large scale basis. But STATCOMs have been used to do flicker and harmonic compensation in the past, in Europe especially.

MR. WALLING: For harmonic compensation?

MR. ENSLIN: Uh --

MR. WALLING: You mean after filtering?

MR. ENSLIN: Yep.

MR. WALLING: To what degree? When I say large scale, I mean over a hundred mVa. Do you know of any situation over a hundred mVa --

MR. ENSLIN: At least 50 mVa a few years back --

MR. WALLING: Okay --

MR. ENSLIN: -- so scaling that up.

MR. WALLING: Okay. It's still -- it's still an order of magnitude different than what we're talking about here.

MR. ASHTON: Mr. Zaklukiewicz, do we -- does Connecticut have any STATCOM installations?

MR. ZAKLUKIEWICZ: We do now.

MR. ASHTON: And how large is that?

MR. ZAKLUKIEWICZ: That is plus or minus 150-k VAR at Glenbrook.

MR. ASHTON: k VAR or --

MR. ZAKLUKIEWICZ: I mean mega VAR --

MR. ASHTON: Mega VAR --

MR. ZAKLUKIEWICZ: Mega VAR at Glenbrook.

MR. ASHTON: Would that then, Mr. Walling, be of the size that you were just discussing?

MR. WALLING: You would -- that gets into the size where you probably can start having a significant local effect. You probably would need a number of such units. However, a STATCOM as normally applied does not necessarily provide this resonant mitigation. It -- the hardware is generally similar but the control would need to be different to do this function.

MR. ENSLIN: But it -- but it is possible,

especially if you increase the rating of the converter to a higher level to accommodate some of this mitigation functions?

MR. WALLING: Theoretically possible. You also have to consider that if you're doing this with a DC system, whether or not you're causing anything to propagate on the DC line and affect other terminals, so it's -- it's a development project both in terms of scale and application to do this. So it's not proven technology, but it's technology that has some order of magnitude smaller precedent that could be used as a basis for expansion.

MR. ENSLIN: This morning you also indicated that ABB is the sole supplier of HVDC Light technology. Is that true?

MR. WALLING: Well, HVDC Light is a trade name, so by default it has to be the sole provider by trademark laws.

MR. ENSLIN: Let's talk about voltage source converters --

MR. WALLING: Okay. Mr. Zak can illuminate further on this. Some -- a couple of years -- or a year or two ago I looked -- Seamans (phonetic) had been advertising their development of something called HVDC

Plus, which was virtually the same type of technology. Mr. Zak has some further information on where Seamans stands with that.

MR. ZAKLUKIEWICZ: Seamans on HVDC Plus, we looked at that in a joint venture with Seamans back approximately three years ago. They were in the development stage. My contact with them in the recent months has been they are basically not in the HVDC Plus market and would move forward if we were to guarantee them a number of terminals, but they are basically not in the business. Their concern is with other VSC purchases. When they look at the loss issue, it becomes substantial when you're talking that percentage of losses.

Now, I know you asked the question of Mr. Walling, when I look at the eighteen-four that was submitted for approval of the Cross-Sound Cable, the eighteen-four basically had at the East Shore terminal 352 megawatts for an output on the Long Island terminal at Shoreham of 330 megawatts. That basically tells me there was a 22-megawatt loss between the conversion and the cable to go from New Haven to Shoreham, 26 miles, and the output at Shoreham then for 330 required 352 megawatts, that comes out to 6.67 percent in losses. I think it's pretty close to the 6.5 percent number in the studies.

And this was an eighteen-four at the time Cross Sound submitted that data to the NEPOOL committee for approval of the Cross Sound Cable. So, I just pass that on for information.

MR. WALLING: I -- one thing I'd like to add also is that although ABB has heavily invested in this technology, that there has not been an HVDC Light transmission -- utility transmission project ordered since 2001. So basically this market that was predicted to be an expediential takeoff is sort of still on the runway, which raises some risk to the companies and to the electric users in the area of what if -- what if Seamans is right about the commercial value of this technology and ABB somewheres down the road just, you know, abandons the technology, what about the reliability of the system if it's totally dependent on -- you know, maybe ABB being a corporate citizen would stockpile spare parts and whatever else, but if you aren't maintaining the technology of people who understand it to fix it -- it's a very complicated system. So there's -- there's evidence that this has not been a breakthrough technology at this point it's still a -- it's still in the takeoff role. It's emerging, it's an immature technology.

MR. ENSLIN: The last two or three years of

power industry wasn't a good economy of scale, so I don't -- I wouldn't take that as a basis for --

MR. WALLING: But there have been a number -- there have been a number of conventional DC orders in that same period of time.

MR. ENSLIN: Now coming back to conventional HVDC systems, some of these systems were installed in very weak systems in the past. I mention China, Southern Africa and so on. And as -- some of these systems are running in parallel with AC systems, so it's not only point to point power transmission. So, I was quite surprised in your report that you say this would be a very impractical system in the Connecticut area with a very strong -- a relatively strong system compared to these weak systems in China and in Africa, so I was a bit surprised. Can you comment on this?

MR. WALLING: The -- well, the IEEE standard that I cited in there -- and I'd have to look up -- basically, it qualifies anything below a short-circuit ratio of two as being extremely weak. I, for one, worked on the design of the Cumberford HVDC converter, which was on the New England system. That terminal was since abandoned because of the weakness. That short-circuit ratio fell below two. It was very difficult from an

engineering standpoint.

And I'm not sure what you're talking about in China and Africa, what kind of short-circuit ratios are you talking about there?

MR. ENSLIN: I don't have it at my -- but to take -- tack onto your conditions again, all generations out, all capacitors in low load, so that --

MR. WALLING: No generation in --

MR. ENSLIN: Well --

MR. WALLING: Oh -- oh, you're saying --

MR. ENSLIN: In your system -- in your study --

MR. WALLING: Yeah --

MR. ENSLIN: -- you based it basically on a very weak system --

MR. WALLING: Well, I take offense to your indicating that we're just grasping at straws and putting together an unrealistic system. In a competitive market generators operate when the market dictates the generators to operate. Capacitors go on because of the system need. And the absence of generators being on is a reason for the capacitors to be on. You can have a fairly substantial load, maybe 80 percent load would be realistic, perhaps that none of these generators would even be dispatched.

Eighty percent load you surely are going to need capacitors on to compensate the power factor and allow that power to move into that system.

CHAIRMAN KATZ: You know, this --

MR. WALLING: You disagree with that.

CHAIRMAN KATZ: This might be a good -- this might be a good time for like a five-minute break. Why don't we do that now.

(Whereupon, a short recess was taken.)

CHAIRMAN KATZ: Back on the record, we're ready to resume. Miss Randell.

MS. RANDELL: Thank you. Mr. Walling has a clarification with respect to an answer to a question from Mr. Ball regarding how he modeled the Bethel to Norwalk line.

CHAIRMAN KATZ: Okay.

MS. RANDELL: Might he do that now?

CHAIRMAN KATZ: We can do that now.

MR. WALLING: Okay. In the studies of resonance -- (indiscernible) -- in the situation where we have a DC tie from Beseck --

AUDIO TECHNICIAN: Mr. Walling, I need you to -- would you start your answer over. I didn't have your microphone on and it won't be on the record --

MR. WALLING: Okay. Starting over again --

CHAIRMAN KATZ: And just -- and before you start, the whole City of Milford is cringing when you pronounce East Devon, so just -- if you could just do that, it will --

MR. WALLING: Devon -- Devon --

CHAIRMAN KATZ: Right --

MR. WALLING: -- I'll write it out here with a -- Devon, okay. Okay. Alright -- by the way, I'm assuming that I'm related to the founder of Wallingford, but -- (laughter) -- and I'd probably trace that lineage -- -

A VOICE: England or U.S.?

MR. WALLING: Well, it runs through Providence and up to Plymouth, but anyhow.

In the study of the DC alternative from Beseck to East Devon, we studied two alternatives for the AC cable running from East Devon west to Norwalk, one was HPFF and the other was cross-link polyethylene. And the question was in regards to the modeling of the Phase 1 cable from -- transmission from Bethel to Norwalk -- and actually what was modeled -- for the HPFF alternative we modeled that Bethel to Norwalk line as the composite of cross-link polyethylene for a short distance overhead line

and two HPFF cables, I believe it's 8.7 mile segments.

For the cross-link polyethylene option for the East Devon to Norwalk transmission system, we modified the Bethel to Norwalk system to be consistent with a lower capacitance approach where the physical structure was the same but one of the two HPFF cables was removed from service. So this answers -- I answered incorrectly Mr. Ball's question before and this sets the matter straight, and I believe it's consistent with what he was actually looking for.

CHAIRMAN KATZ: Mr. Ball, do you need to pursue this?

MR. BALL: Just -- just one additional question just so that I'm clear. You still assumed that all capacitor banks were in service in your configuration, correct?

MR. WALLING: Yes, the capacitor banks were in --

MR. BALL: Okay.

CHAIRMAN KATZ: Okay, thank you for that clarification. Let's go back to KEMA.

MR. ENSLIN: Basically, we have seen in the report two options, one is HVDC Light and HVDC conventional. Now, what we see up 'til now is it possible

to confine which option is reasonable and what is not reasonable?

MR. WALLING: Well, I think the -- well, there's another dimension to the optionality as well. There's the optionality of just Beseck to East Devon or the optionality of Beseck all the way to Norwalk. So that's a two-by-two --

MR. ENSLIN: Yeah --

MR. WALLING: -- choice there. I believe that any DC option from Beseck to East Devon has technical -- severe technical limitations. Conventional DC for that segment, I believe, is most impractical. And a VSC DC because of the weakening of the system and the fact that you have the capacitance still there, would become extremely challenging from an engineering standpoint. If we move on to a fully DC system from Beseck to Norwalk, then conventional DC would be infeasible because of weakness of the system, but VSC DC is a -- technically -- has the appearance of technical viability.

There are other issues I think that become bigger than the technical concerns. There's -- there's technical issues that have to be worked out. That system is beyond anything that has been built in terms of scale and complexity with multi-terminals, but I believe that

those are achievable technical goals. The thing that is probably not mitigatable in the foreseeable future is the extreme amount of losses.

There's also another factor of risk of being a commercial orphan, which is not really something that's going to be rectified by technical actions. There's a degree of technical immaturity to VSC DC, it's only been used for transmission for a relatively few years. It's been used on a large scale in any form, STATCOM or else, for only about a decade or so.

And the issue that Mr. Zak brought up about the barrier to competitive generation raised by requiring generation now to tap in on a DC level.

CHAIRMAN KATZ: Mr. Walling, what's a commercial orphan?

MR. WALLING: A commercial orphan is one where the manufacturer has built a new technology and then after that time has found an insufficient business to sustain that technology and exits the business and then owners of that equipment are going to be at some compromised level of technical support.

CHAIRMAN KATZ: And you feel that the HVDC Light is a potential commercial orphan?

MR. WALLING: I think any new technology

that's being forwarded by only one manufacturer has a certain degree of risk along that line.

CHAIRMAN KATZ: Didn't we get testimony that's the proprietary name of a technology that's fairly generic at this point?

MR. WALLING: No, there's -- DC Light is a trade name, VSC DC is a generic term. However, only ABB apparently, according to the testimony of Mr. Zak, is currently in the business. So it's a sole -- a sole source at this point, unless another manufacturer is attracted by the potential for 14 converters or something like that, that this project might pose, but --

CHAIRMAN KATZ: Mr. O'Neill, did you have a question?

MR. O'NEILL: Yes. Mr. Walling, to summarize the comments you just made, do you think that this DC option would meet the established reliability criteria within the ISO New England grid?

MR. WALLING: I've been out of planning for 23 years -- I used to be a planner in utility -- so, I'm not fully familiar with all of the details of ISO's reliability requirements. I -- I would say that there's reasonable grounds to predict that it has a reasonable chance of meeting that pending further engineering

analysis. So, I'm trying to give a beat around the brush, that I cannot say it will met it, I don't know of anything that would say that it could not meet it, but I don't pose to know all of the issues involved.

MR. O'NEILL: Mr. Kowalski, could you weigh in on this?

MR. KOWALSKI: Well, again we're talking about a generic technology and I think what becomes very very much important is exactly what are we talking about, again how is it integrated into the network. You know, with something like just replacing the Beseck to East Devon section of the proposed project, changing that from AC to a DC solution, that -- we've already seen some of the harmonics issues, and our testimony -- and my testimony raised some of the operability concerns. I'm hearing suggestions of a Beseck to Norwalk in a multi-terminal configuration. I would -- that would have to be very carefully examined. What may be interesting and achievable theoretically and on paper may be quite another thing to actually achieve in practice.

I'm often reminded of something a retired planner from Boston Edison told me a long time ago, and that is we planners can be very ingenious, but we can design a system that the operators cannot operate. And

that's something that I'm very much mindful of. And some of these theoretical postulations that I've heard is while given one snapshot in time it may look like I can do that, well I have to step back and think, okay, now what if that piece of equipment right there in the middle failed and you're two hours later. Those are the types of situations that really speak to how does the piece of equipment integrate into the system. And -- and it's really the heart of the issue that we're seeing, is when you embed a DC technology in the middle of an AC network, the DC really is very much a point source, it really doesn't add much to the robustness of the system. And while theoretically one could postulate well we may be able to create algorithms that make it kind of look like an AC system, again it's theoretical, it's possible. And if I were a system operator, I'd be pretty worried.

One of things we learned from the reviews of -- that the NERC committees did on the August 14th blackout is when things get too onerous for the people who actually have to operate the system to see, to understand, you really have an unreliable system. Tools -- the tools can -- and mathematical algorithms, simulation programs can be very helpful and good aids, but when the system gets so complicated that it's absolutely essential in

order to just make the system function, it's gone too far.

MR. O'NEILL: Do you see any benefit of incorporating a DC line into this plan?

MR. KOWALSKI: Again through the committee we're still exploring it. We're looking, poking, prodding, considering the options. We're very much aware of the directive to try and put as much underground. And we're continuing to see what can be done to that -- to that end.

CHAIRMAN KATZ: Thank you. Mr. Lynch.

MR. DANIEL P. LYNCH, JR.: Yeah, just one. I don't even know if it's a follow-up, but Mr. Walling, you hit on something that I think is of major importance, and that's the orphan technology. It's happening throughout the country in every industry. We're seeing it here in the Council with the telecommunication industry where analogue is being replaced by digital and no longer being supported. And if we get into DC technology and Mr. Zak said Seamans says yeah we'll do it but we need a player, and ABB says we're already here but down the road we may not make any money on this deal --

MR. WALLING: Well, that's speculation --

MR. LYNCH: No, but I'm just saying --

MR. WALLING: -- I don't want to be accused

of saying that --

MR. LYNCH: No, no -- no, but it's -- I'm not saying that you said it, I'm just saying it could happen. And that concerns me. If we get to a point if we do try to develop DC -- I think I said AC before -- but DC technology and it's not being supported or we can no longer -- the system now becomes unreliable. And I think that's -- to me that's a major point of what you've been discussing here. If we can't support it, it's going to be very difficult to put in.

MR. WALLING: There's a fundamental difference between when you expand an AC system -- let's say you're putting in a substation and cables as opposed to the DC system, a DC system is very much a system, they tend to be engineered closely, it's very closely coupled engineering. So that if a component in an AC substation fails or a circuit breaker fails and company X who made that breaker is no longer in business, then company Y's breaker will perform the same standard function, you maybe have to drill a bolt hole different to put it in. With a DC system there's a lot of special components in there that don't have a generic off-the-shelf I'll go to company Z and get something that plugs right in. There have been very -- very few instances where major HVDC components

have been replaced by other than the original builder. There was --

MR. LYNCH: And that's the concern I really have.

MR. WALLING: I mean GE orphaned a bunch of DC systems when we left the business in '87. And the company I used to work for, Minnesota Power, was caught with an HVDC system that GE supported, you know, for nearly 20 years with -- more than 20 years with spare parts and so forth. But it was getting to the point where it was getting harder and harder to get spare parts for the controls. And basically, Minnesota Power had ABB build a whole new control system, just rip out the old controls, throw them away and put in a whole new control system, which is a pretty substantial part of a whole DC system, you know, ripped out and replaced.

CHAIRMAN KATZ: Thank you.

MR. LYNCH: Thank you.

CHAIRMAN KATZ: Just to follow up, Mr. Zak, I get briefed on the ROC conference calls and my understanding is that the 12 cases involving AC have been disposed of and that the ROC group is now basically working on the DC option, is that -- can you correct me?

MR. ZAKLUKIEWICZ: At the -- at the last

session we incorporated cases 5A, 5B, 5C --

CHAIRMAN KATZ: Okay --

MR. ZAKLUKIEWICZ: -- 5D. And I believe Case 5D is an all under -- all DC solution --

CHAIRMAN KATZ: Okay --

MR. ZAKLUKIEWICZ: -- or it's the one with the two DC solutions. In other words, Beseck to Devon -- East Devon -- and then from Singer to Norwalk, subject to checking the exact one, but I believe that's 5D, and then we'll keep going from there.

CHAIRMAN KATZ: Okay. So both AC and DC are still on the working table, correct?

MR. ZAKLUKIEWICZ: That is correct.

CHAIRMAN KATZ: Okay.

MR. ZAKLUKIEWICZ: Going back to Mr. Lynch's question, I think I've already testified to that, that STATCOM solutions and other solutions with high technology in my mind have a very short life basically due to the manufacturer's support and the electronics of those control systems. When I first came into the company, we looked at protective relay systems being 25, 30-year solutions. Today basically you install it, 8 to 10 years later you're taking it out, putting it -- throwing it in the wastebasket and putting a new one in. They're just

not being supported any longer. As you know, digital technology is -- no one is supporting the old equipment. And this would be no different with an HVDC sophisticated control system. You would look to -- if something goes wrong with it, it's replaced in kind because those pots are no longer available irrespective --

A VOICE: (Indiscernible) --

MR. ZAKLUKIEWICZ: -- that electronic equipment is no longer being made.

MR. WALLING: I mean in all fairness, if the VSC DC technology were to take off and the other manufacturers entered the market and so forth, the situation would change. But the scarcity of new projects for the last three years, you know, raises some question. I mean you could attribute it to the economy or whatever else, but there have been conventional DC orders placed in that same period of time.

CHAIRMAN KATZ: Okay. Let's go back to KEMA at this point.

A VOICE: Just --

MR. ENSLIN: Yes. The proposal which was made just recently on the voltage source DC technology -- and I think on Monday there was a conference call on ISO New England indicating that there would be a possibility

of using synchronous condensers on some of the substations. How would this affect your report and study up 'til now, Mr. Walling?

MR. WALLING: If there were -- if you put enough synchronous condenser capacity into the system, you probably could use any of the technologies, any of the DC technologies in any of these configurations because you would solve the system strength issue and in so doing you would mitigate the resonance issue. There's a question of practicality of doing that and cost, which is --

MR. KOWALSKI: And additionally, you know, like some of the other things that have been proposed, there's a -- that's another double-edge sword. Again with this whole project there are numerous infrastructure deficiencies we're trying to address in Southwest Connecticut. And one of them is the very precarious short-circuit problem that we have down there. One of the down sides of synchronous condensers is they will contribute to short-circuit problems. So it's -- you know, is there -- in examining that particular solution, the question is, you know, is there a balance that's achievable that can substantially help the resonance problem without destroying the short-circuit benefit.

MR. ENSLIN: So don't you waste our time

going this way? What -- what is currently the, you know, status, because we have to go forward in this regard?

MR. ZAKLUKIEWICZ: GE right at this time is running those studies as we reported on Tuesday morning. And -- and we are going to study them, and -- and until they come back and say they can't possibly work or here are from the thermal studies, which are also the voltage studies, and looking at the short-circuit duty issues, we -- we -- I -- I do not want to project some of the negatives in some of our responses, that's not our intent. I think I said it before, we are out there to study it. And I personally have no preconceived it won't work attitude, my own self. We're going to study it, and if it works, we'll come forward. If it's not, it's not because we haven't looked and tried and tried alternatives on those alternatives and tried additional alternatives on those to make it work, so --

CHAIRMAN KATZ: Thank you. We -- we appreciate -- we'd like you to look at the glass at least half full and we appreciate that.

MR. ENSLIN: I think that -- that concluded my questions --

CHAIRMAN KATZ: Thank you --

MR. ENSLIN: -- Miss Chairman.

CHAIRMAN KATZ: Mr. Cunliffe, anything else?

MR. CUNLIFFE: In order for -- to meet the AC system design, you would need to put in, what, about four converter stations for the DC?

MR. WALLING: Which option are we speaking about?

MR. CUNLIFFE: VSC.

MR. WALLING: For a total DC option? You're probably talking about 14 converter stations --

MR. CUNLIFFE: Between --

MR. WALLING: -- 14 converter units, which would be located in four locations.

MR. CUNLIFFE: Alright, let's take a step back and make it just East Devon to Beseck.

MR. WALLING: Okay. Then we're talking about two locations, probably with eight 330-megawatt converter units.

MR. CUNLIFFE: What's the ability to control the flow on each one of those circuits?

MR. WALLING: Within their capacity constraints the flow is -- of DC is highly controllable.

MR. CUNLIFFE: And how much of a benefit does that provide to the system in whole?

MR. WALLING: That -- that becomes a planning question.

MR. KOWALSKI: That can be an advantage -- having fixed flow can be an advantage, it can be a disadvantage.

MR. CUNLIFFE: You don't see any upside to the --

MR. KOWALSKI: Well, the -- the upside is it behaves like a generator. And to the extent that that was the -- that's the only benefit you need, it's okay. And that's very much similar to how HVDC has been employed in integrating generation from remote areas into locations. And sure that's a good thing, but if that's not the only thing you really need in the way of the system reinforcements, then it's at most a partial benefit.

CHAIRMAN KATZ: Mr. Ashton.

MR. ASHTON: Mr. Kowalski, just exploring that benefit a little further, isn't it true that DC can be commanded, if you will, to load to a certain point so that you can force current which would normally divide by impedance in an AC into one leg of a loop as you wish for whatever reason?

MR. KOWALSKI: Yes. DC is very

controllable and it -- it is only controllable. That is it -- you set it to a particular point and that's --

MR. ASHTON: You set it for 550 amps, it's going to push 550 amps down that line come hell or high water?

MR. KOWALSKI: Yes, sir.

MR. ASHTON: Going back -- and you raised it, which struck me -- I forgot about it at the time -- the August blackout. Let me postulate an August blackout but with the loop in service, that is the Bethel/Norwalk, Singer/Devon/Beseck loop in service. In the first instance an AC loop, in the second instance a loop 345 with the Devon to Beseck as DC. In -- the system in August during the blackout had some pretty violent swings on it over the New York/Southington tie as I recall, in the order of several thousand amperes in either direction. Let me explore that. First of all, an AC system has several line ratings, doesn't it? It has a long-term steady state rating and it has a short-term rating, and then it has an emergency rating that you can take advantage of for seconds if not a couple of minutes, is that fair to say?

MR. KOWALSKI: More or less.

CHAIRMAN KATZ: (Indiscernible) -- getting

CEUs for this, don't you?

MR. ASHTON: Does the DC have anything like that?

MR. KOWALSKI: Well, DC terminals can be designed with an overload capability, but again, that's again a controlled thing.

MR. ASHTON: Okay. So that you're saying, if I understand it correctly, that whereas the AC system on its on volition without intervention by human operators absorbed those heavy swings for the short-term, a DC system, to use my example that's set for 550 amps, come hell or high water is just going to continue to push 550 amps, and if an operator needed to change it, to reverse the flow, to increase the flow, or what have you, there would have to be a manual intervention in that, is that correct?

MR. KOWALSKI: That -- that's correct. And that's been part of the point I've been trying to convey.

MR. ASHTON: And so that's one of the dilemmas, that it would require an operator intervention, which is most difficult during a stressful situation --

MR. KOWALSKI: Exactly --

MR. ASHTON: -- and that works to, I assume, a disadvantage of the DC, is that fair?

MR. KOWALSKI: That's -- that is correct.

CHAIRMAN KATZ: When we talk about an operator intervention, are we talking about a person in a control room --

MR. ASHTON: Yes --

CHAIRMAN KATZ: -- somewhere like CONVEX or are we talking about driving down and flipping a switch?

MR. KOWALSKI: It would be -- typically, these would be manned stations, but I think they can be remotely controlled as well.

CHAIRMAN KATZ: Okay.

MR. ASHTON: The ISO operates with a full SCADA system, doesn't it? A full -- 99 percent of the stations?

MR. KOWALSKI: The ISO operates with a SCADA system for monitoring. We don't do any direct switching --

MR. ASHTON: That's out of CONVEX?

MR. ZAKLUKIEWICZ: All switching is out of CONVEX --

MR. ASHTON: Okay --

MR. ZAKLUKIEWICZ: -- so these controls would have to be adjusted from CONVEX. I would assume these would all be PC controlled --

MR. ASHTON: Okay, so --

MR. ZAKLUKIEWICZ: -- out of CONVEX also --

MR. ASHTON: -- in my example ISO in the midst of a system perturbation would have to send a command down to CONVEX to do certain things if that was the case. And CONVEX through its SCADA system would then, if it's a DC link, have to adjust the setting on that DC line, is that right?

MR. KOWALSKI: You would -- you would need to be operating -- rather than relying on just the natural behavior of an AC network, you would have to be relying on two people on telephones with hands on the controls.

MR. ASHTON: Okay. Thank you.

MR. S. DEREK PHELPS: Madam Chair.

CHAIRMAN KATZ: Yes, Mr. Phelps.

MR. PHELPS: For the benefit of the court reporter, the SCADA acronym?

MR. ASHTON: Oh, thank you. Supervisory Control --

MR. ZAKLUKIEWICZ: Control --

MR. ASHTON: -- and Data Acquisition System. It's an I got'cha. Thank you.

MR. O'NEILL: As a follow-up, what would happen if one of those operators wasn't available to

manually control that situation?

MR. KOWALSKI: Well if we had such a situation and a piece of equipment would -- it would just require additional vigilance so such a situation didn't happen. Of course something that was very -- if the unexpected did happen, it just creates an additional risk because someone would have to take some action immediately. And that's why again in planning the system, we need to be very careful to not create such situations if at all possible, that -- if the operator doesn't take an action right away --

MR. O'NEILL: The system would shut down --

MR. KOWALSKI: -- you've got a very very serious problem.

CHAIRMAN KATZ: So when we talk about reliability, we're really talking about systems which can fix themselves automatically as opposed to systems which require a human looking at a screen to recognize a condition and fix it? Reliability is better when the fix is automatic or is that --

MR. KOWALSKI: I --

MR. ZAKLUKIEWICZ: Either that or it has to be --

CHAIRMAN KATZ: This is only --

MR. ZAKLUKIEWICZ: -- it has to be simple enough such that you can put in -- so the computer, the software system, the algorithms to do a self-correct. And make certain you have them all collected such that you're not driving the system in the opposite direction or I didn't take that one into consideration in the software because you didn't build it into the logic tree, if you will, all of these conditions. You can do some of that with an HVDC system. You've got to make certain I've got all the bases covered so I'm not driving the system in the wrong direction because I didn't include that decision tree in the software program --

CHAIRMAN KATZ: Thank you --

MR. ZAKLUKIEWICZ: -- so -- and the biggest issue, Mr. O'Neill, is not that the operator is not there, it's the operator having the think time and the computer screens in front of him to assist him in the decision-making, that I've got to make this decision and not go down the wrong path. That is -- that is the think time that's got to be there. And on the 14th of August last year there was no -- there was no think time and response time for anyone to take any action.

MR. ASHTON: Mr. Zak, wasn't it also true that in the first energy system there were too many things

happening at once, that the operators really were in a quandary as to what to do because they had everything going on at once -- or I shouldn't say everything, but an awful lot of things going on and they didn't have --

MR. ZAKLUKIEWICZ: I think at the very end that's a true statement. At the beginning they didn't take action quick enough.

MR. ASHTON: Okay.

CHAIRMAN KATZ: Okay --

MR. WALLING: With conventional DC, the large voltage variations during August 14th would probably have caused a conventional DC to have failed commutation and collapsed.

CHAIRMAN KATZ: Mr. Cunliffe, back to you.

MR. CUNLIFFE: Mr. Kowalski, you had -- in your testimony on page 4 you discussed about the integration of load stations and generation stations being a possible limitation on an HVDC system, is that correct?

MR. KOWALSKI: That's correct.

MR. CUNLIFFE: What is your knowledge of turbines that have an output of DC?

MR. KOWALSKI: I'm not aware of very many generators -- commercial generators that are being made that put out direct DC. You'd have to go through a DC

converter terminal at each generator site --

MR. CUNLIFFE: And that's -- that's the traditional engineering standard to operate an AC generator and then to convert to DC if you have a DC line?

MR. KOWALSKI: Yes, yes. The -- the installations that are integrating, to my knowledge -- large hydro complexes for example have AC generators converting through DC converter terminals, then transmitting through the DC lines.

MR. CUNLIFFE: Alright, thank you.

MR. WALLING: You -- you don't have the -- it's not practical to make a generator operate at that transmission voltage -- or the AC voltage be consistent with the transmission, so you need to transform. You can only transform with AC. So you transform the voltage and then convert.

MR. CUNLIFFE: Okay, thank you.

COURT REPORTER: One moment please.

(Pause).

MR. CUNLIFFE: And Mr. Zaklukiewicz, I believe that the integration of substations would also -- would be a limitation, right?

MR. ZAKLUKIEWICZ: I'm not certain I understand the question, Mr. Cunliffe. The integration of

--

MR. CUNLIFFE: Could you -- could you put a substation between East Devon and Beseck on a DC line?

MR. ZAKLUKIEWICZ: This would -- this would end up being a multiple multi-terminal line for which if we went with an all DC solution, we would have to go down that technology path that basically no one has gone down before. So there's two options. No. 1, you cut the line in two and you have basically a DC terminal for the line from Beseck to -- call it Section A. And then from Section A back to East Devon you have another one, or you turn around and tap that line, as you would today, an AC line, and make it a three terminal line with a DC converter at that midpoint.

MR. CUNLIFFE: And to your knowledge, you have not seen this application?

MR. ZAKLUKIEWICZ: I've not seen the application in HVDC VSC. And the only multi-terminal application we have really seen on traditional or conventional HVDC is the Hydro Quebec down to New England 2,000-megawatt interface for which to my understanding has never operated as a true multi-terminal line being able to take out and inject power at all three locations at will without having to shut down one of the terminals and

reconfigure to a point and then re-operate at a different mode.

MR. CUNLIFFE: Understood. Also -- give me a minute here, I lost my thought here --

MR. WALLING: I think it's safe to say that an integration of an intervening DC terminal like that would be a substantially longer project cycle. So if there was a load change, unanticipated need, you'd have to predict further in advance.

MR. CUNLIFFE: The proposal does not have any interconnection between Beseck or East Devon?

MR. ZAKLUKIEWICZ: The proposed line was a straight 345-kV AC line between Beseck and East Devon. And if you tapped another station into it, it would be like some of the existing 345-kV AC lines that we have. For instance, the interconnection --

MR. CUNLIFFE: Understood --

MR. ZAKLUKIEWICZ: Okay --

MR. CUNLIFFE: -- and then secondly, the forecast identifies substations. Is there any locations between East Devon and Beseck that is potentially to be developed?

MR. ZAKLUKIEWICZ: Not in the forecast that we submitted to the Council -- as far as the load forecast

hearings?

MR. CUNLIFFE: Right.

MR. ZAKLUKIEWICZ: There were none on this section of line.

MR. CUNLIFFE: Thank you. Those were my questions.

CHAIRMAN KATZ: Mr. Emerick.

MR. EMERICK: No questions.

CHAIRMAN KATZ: I guess mine is more of a comment. At the end of this exercise, this ROC exercise, what I'd -- I'm hoping that you people can testify that you've looked at all the options and so that we don't come back later and say, oh, you know, why didn't you look at that. So, I'm hoping that you will look at all of the options so that we can come back and say, yes, we looked at maximizing underground. So it's a request.

MR. ZAKLUKIEWICZ: I will -- I will make certain that at next Tuesday's meeting we reiterate that to everyone. And if somebody has -- who is on the conference call has an idea or a suggestion or a recommendation, to put it forth --

CHAIRMAN KATZ: Thank you --

MR. ZAKLUKIEWICZ: -- either on that conference call or e-mail it to us, or whatever.

CHAIRMAN KATZ: Thank you. Mr. Tait.

MR. TAIT: No questions.

CHAIRMAN KATZ: Mr. O'Neill.

MR. O'NEILL: No questions.

CHAIRMAN KATZ: Mr. Heffernan.

MR. HEFFERNAN: No questions.

CHAIRMAN KATZ: Mr. Wilensky.

MR. EDWARD S. WILENSKY: No questions.

CHAIRMAN KATZ: Mr. Lynch.

MR. LYNCH: No questions.

CHAIRMAN KATZ: And I think we are -- we'll take a moment in case -- Mr. Ashton -- (laughter) --

MR. TAIT: Take your chance while you have it.

A VOICE: Yeah.

CHAIRMAN KATZ: I know, I'll kick myself. Hmm?

AUDIO TECHNICIAN: Can we go off the record?

CHAIRMAN KATZ: Off the record.

(Off the record)

CHAIRMAN KATZ: We're on the record.

MR. ASHTON: Mr. Zak, on page 6 of your testimony you make reference to the estimated losses of

being 64 megawatts. I assume that could be worked out as 64 megawatts times certain hours. What kind of dollars per year penalty are we talking?

MR. ZAKLUKIEWICZ: I -- I did a quick one before for looking at a 700-megawatt average flow on this DC line. And using a five percent differential, meaning the losses on HVDC relative to the AC, and taking a look at the average price of the clearing price in the last 12-month period, we're looking at -- for an average 700-megawatt transfer, we're looking at between 14 and 20 million dollars a year --

MR. ASHTON: Okay --

MR. ZAKLUKIEWICZ: -- so that would be an annual fee. And if -- as the transfer increases, that number increases. And it would increase also as the clearing price for energy changes from hour to hour. But the range is 14 to 20 million dollars for that average 24 hours a day 700-megawatt transfer.

MR. ASHTON: Okay. Most of my questions, believe it or not, have already been covered one way or another, but I do have one more. I did raise the issue of overload capability of DC and I'd like to hear a little bit more as to what, Mr. Walling, your perception is of the overload capability. I know for a short time --

MR. WALLING: Well any -- any technology -- I mean a technology or a design has many dimensions of its capability and it's not just simply its capacity. So in it there's -- there is a -- for any device -- you build a certain system, it has a certain continuous capability. You might have a different capability under cold weather conditions. It might a different capability to be overloaded for a short period of time. And that might change if it was under-loaded prior to that point. So really what I wanted to stress before is you have to start with a functional requirement and work back. And you might come back with what might be called a different nominal system. But the nominal part is sort of irrelevant. It's -- it's what -- what equipment, what space, what cost is needed to meet a functional objective with different technology.

So DC does not generally have the time constant that allows -- for example, an AC cable if it's not pushed all the way to its limit can be -- because there's very long time constant to heating the earth, you can push that for quite a period of time. The time constance in a DC converter are rather short -- very short. So if you're being driven by short-term overload, you're going to get a different answer. So you might end

up putting a larger nominal capacity of DC in to meet the same objective. If your objective is strictly constant load kind of things, it will be different. So overload ability just comes down to how much equipment you have to put there. You can solve overload ability requirements by throwing material at the -- in the design.

MR. ASHTON: But that's equally true of an AC system too?

MR. WALLING: That's true. The --

MR. ASHTON: I'm just -- what I'm trying to --

MR. WALLING: The fundamental difference is the time constant.

MR. ASHTON: Well, that's what I'm trying to get at a little bit --

MR. WALLING: And the time constant for the DC cable and time constant for AC cable should be roughly the same. It's the fact that the converter terminals don't have a long time constant.

MR. ASHTON: Well, that's what I'm trying to poke at. I can understand the rough equivalence between DC/AC cables in terms of overload capability, but I have no real handle at all on the terminals --

MR. ZAKLUKIEWICZ: ABB's response to that

question -- and I -- I was going to say great minds think the same, but mine is not in your caliber, but --

MR. ASHTON: I'll pay you later for that -- (laughter) --

MR. ZAKLUKIEWICZ: -- raising that question, basically the DC terminal as say the cross-link system at full load, pre-load, basically operating at 330, recognizing that it's designed at 300 operating, and basically using the 10 percent fudge factor of the capability of the equipment, at 330 it basically has no overload. However, if you were to operate it pre-load at 75 percent of its rated power, which doing a quick calculation would probably be, what, 250 megawatts, as opposed to 330, it's got a -- ABB responded they believe it has a 40 percent overload for one hour --

MR. ASHTON: Okay --

MR. ZAKLUKIEWICZ: -- but when you're pre-loading it at 330 and it's been operated at that level for a good number of hours, it has no overload capability --

MR. ASHTON: Okay, thank you --

MR. ZAKLUKIEWICZ: -- it's all driven I believe by the cooling of the transistors and the equipment, they're basically operating close to the limits of the cooling system that is designed.

CHAIRMAN KATZ: Are we ready to wrap up here? Are there any -- Mr. Cunliffe.

MR. CUNLIFFE: In your modeling, Mr. Walling, on the DC line from East Devon to Beseck, how did you model the injection of power into the AC system at Devon?

MR. WALLING: I was doing a system resonance calculation and power flow as irrelevant to the study.

MR. CUNLIFFE: And did you assume the DC source was a current source with very high source impedance?

MR. WALLING: Yes.

MR. CUNLIFFE: Thank you.

CHAIRMAN KATZ: Okay. Mr. MacLeod or Mr. Fitzgerald, did you have any redirect?

MR. MACLEOD: I have a couple of questions, Madam Chair.

CHAIRMAN KATZ: Okay.

MR. MACLEOD: Mr. Zak, I believe you gave a financial reason or an economic-based reason why new generation might not connect to a DC system. Are there any technical reasons in your mind why new generation might be limited or prevented in connecting to a DC

system? I don't know if -- Mr. Walling or anybody on the panel who wants to respond.

MR. WALLING: Yeah. There's a -- not to make everybody's eyes droop, but there's another very technical phenomenon called sub-synchronous torsional interaction --

CHAIRMAN KATZ: Uh --

(Multiple voices in background, indiscernible)

MR. WALLING: Okay --

MR. MACLEOD: Could you say that slowly please.

MR. WALLING: Alright. Basically -- and this is a phenomenon that has resulted in near destruction of two major generating plants. It basically means that the interaction of the DC and its controls with the nearby generator can cause the machine to vibrate fast to the point where it can break the shaft of the machine.

And this phenomenon -- we -- on the Cross Sound Cable we took a look at that to -- we had -- there were -- we did the original research on the first near failure out in North Dakota back in the late 70's. And we came up for criteria of how closely coupled does a generator need to be to a DC -- to a conventional DC

system for this to occur. And basically if you have a generator directly connected to a DC, you're at the maximum possible coupling. You're totally coupled and yet your worst case. However, for VSC DC we had no answers. We did a study parallel to ABB's design that basically showed that VSC DC is about an order of magnitude more vulnerable to causing this situation.

This situation can be mitigated by proper design of the DC control. However, in one major incident in another near destruction of a plant out in Utah that was located at the end of a DC line, there was such a mitigation control installed, and when it was tested, it nearly destroyed the machine because there was a design error. So consequently, machines need a separate protection that detects the vibrations and trips the machine off so it's not a non-starter or it's not a complete technical obstacle. It is something that would be a dissuading element to a merchant generator to know that the viability of their machine is dependant on the proper control of -- the proper design of someone else's DC converter.

The other aspect -- I heard talk before of connecting the large nuke plant to a potential extension of the DC project. I just want to add, there I bet the

NRC would have something to say about the situation.

MR. MACLEOD: Mr. Kowalski, is that term that Mr. Walling just used, is that what you had in mind when you said something to the effect in your testimony about HVDC not being readily expandable or versatile in generation interconnection --

MR. KOWALSKI: Well, it --

MR. MACLEOD: -- what did you -- what did you have in mind?

MR. KOWALSKI: Well, it wasn't, but he reminded me of that particular issue, which we did have to deal with in the integration of the Cross Sound Cable.

The issue that I had more in mind was what you have is you have to integrate an HVDC converter terminal, which now means the dispatch control of the generator is complicated by the operation of the manual control of the HVDC terminal and, gee, can I get -- can we really get that to work in a multi-terminal DC system. Again, our experience in developing the tie with Hydro Quebec was -- the plan was to build a five-terminal DC line. Again, one of those things that looks great on paper, but as they worked through the design, it could not work. So it ended up being reduced to a three-terminal system, which most of the time only operates in two

terminals. So again, it's the issues of -- you know, of the added complexity of if you can get the multi-terminal really to operate that kind of a system by real people, real system operators. You really have a very complex system.

MR. WALLING: To put a positive spin on it, conceptually and ideally, voltage source DC is more amenable to a multi-terminal structure than conventional DC

MR. ZAKLUKIEWICZ: Mr. MacLeod, I'd just like to quote the response I got from basically an identical question I raised of ABB. ABB is confident that the installation of a 1200-megawatt plus or minus HVDC link at East Devon, which is in close proximity to a large generating station, and I've pointed out it was within a thousand feet of their Milford unit of which has got ABB gas turbines, they say it would not present an extraordinary sub-synchronous torsional interaction with the generating facilities at New Milford -- at the Milford generating plant. So, I raised that question with them also --

MR. WALLING: Basically --

MR. ZAKLUKIEWICZ: -- and that was their response that they could -- they could work out the

issues. And again, I'm thinking positively --

MR. WALLING: Basically, they have --

MR. ZAKLUKIEWICZ: -- Chairman Katz, of saying we'll get around that.

CHAIRMAN KATZ: Thank you. When I had a -- when I was a selectman, I had a cable TV show about town government and the cameraman used to do this. Do you know what that means?

MR. MACLEOD: I think I do. I get a sense. One more question and that's it -- I mean I can't control the answers, Madam Chairman -- (laughter) -- I'm just asking the questions.

MR. ZAKLUKIEWICZ: I'm younger, so I don't know. (Laughter).

MR. MACLEOD: In terms of time, there was reference to the time aspects. Mr. Kowalski, how much time is it going to -- do you -- would you typically have in a situation such as I believe Mr. Ashton raised in eighteen -- eight-fourteen scenario, where ISO has to identify a problem, communicate with CONVEX, and then both of them together somehow figure out what to do, how much time do you have to get all that done before you have a collapse?

MR. KOWALSKI: Well in the case of August

14th, I think it happened inside of -- when things started falling apart, inside of a couple of seconds.

MR. MACLEOD: I have no more questions.

CHAIRMAN KATZ: Thank you. Mr. Fitzgerald, do you have any questions?

MR. FITZGERALD: We have no questions. We have homework to turn in.

CHAIRMAN KATZ: Yes. Do you want to report on that now?

MR. FITZGERALD: Sure.

CHAIRMAN KATZ: Yes, okay.

MS. RANDELL: If that's okay?

CHAIRMAN KATZ: Yeah.

MR. FITZGERALD: Miss Bartosewicz.

MR. MACLEOD: Is the panel excused?

(Pause)

MS. ANN BARTOSEWICZ: You need them in front of you before I can address --

MR. MACLEOD: Are we excused, Madam Chair?

CHAIRMAN KATZ: Yes, thank you very much. Thank you, gentlemen.

MS. BARTOSEWICZ: Yesterday, Chairman, you asked the Company a question. You asked us about each cross-section, would we -- was the -- was the optimized

EMF -- (audio malfunction) -- did -- was each -- at each cross-section were we at or below existing?

CHAIRMAN KATZ: Yes.

MS. BARTOSEWICZ: Well since nothing is an easy yes or no answer, I've prepared this table for your use. And what I wanted to do is walk you through the table as soon as you have it in front of you.

CHAIRMAN KATZ: Okay. And that's getting passed out here?

(Pause)

MR. FITZGERALD: Could you --

CHAIRMAN KATZ: Is this -- I'm sorry, is this my no net increase question?

MR. FITZGERALD: Yes.

MS. BARTOSEWICZ: Yes.

CHAIRMAN KATZ: Yes. Thank you.

MR. FITZGERALD: Could we ask Mr. Cunliffe to give us a number for identification of the exhibit.

MR. CUNLIFFE: 140.

MR. FITZGERALD: Thank you.

(Whereupon, Applicants' Exhibit No. 140 was marked for identification.)

MS. BARTOSEWICZ: So if we look at this table, the column to the left that's cross-section, so

we've done this by individual cross-section from 1 to 8S. And these are the same designations in the presentation Tuesday. Let's move to the third column because the second column doesn't make any sense until you look at the third column. For each cross-section we determined whether or not the mitigation -- the optimized EMF was at or below existing -- calculated existing. And so you could see for a variety of cross-sections we say at or below, that means it is at or below. For those cross-sections that were not at at or below based on the optimized EMF, we decided to provide you with some information, one of which was what is the calculated amount, what was the increase. And that second column that says milligauss increase, that happens to be the increase for that typical cross-section.

The fourth column over, when we're not at or below, we decided to show you which statutory facility was not at or below. So we went and we looked at now -- now we're moving away from the typical cross-section and we're going to the actual -- the distance calculated statutory facility.

So let me take an example and I'll use the 6E as an example. You see that the at or below column is 4.1 milligauss and the milligauss increase is 3.9. That

means what the at or -- what the existing calculated number was is the difference between those two numbers. So it would have been a very small number. And it would have been zero point --

CHAIRMAN KATZ: Two --

MS. BARTOSEWICZ: -- two.

CHAIRMAN KATZ: We're good at that part.

MS. BARTOSEWICZ: Okay. The statutory facility identified in Dr. Bailey's Exhibit 2 for this particular cross-section is R14 and that the calculated low field option for that facility is 3.7. So we were trying to give you a big -- a big picture of the answer. Now this table --

CHAIRMAN KATZ: 3 -- 3.7 is not the increase. 3.7 is the milligausses at the edge of the right-of-way?

MS. BARTOSEWICZ: No, the 3.7 --

CHAIRMAN KATZ: Or at the structure?

MS. BARTOSEWICZ: At the statutory facility.

CHAIRMAN KATZ: Got it.

MS. BARTOSEWICZ: This is all based on the 15-gigawatt case and it's all data taken from Dr. Bailey's Exhibit 2.

CHAIRMAN KATZ: Okay.

MS. BARTOSEWICZ: And we -- again, we also split the edge of the right-of-way. So you see the first half of this table on the left is the southeast edge of the right-of-way where the right-hand side of this chart is the northwest edge, because it does make a difference, and the difference is basically how structures are arranged on the right-of-way. So on some sides you are at or below and on others you may not be. So it was meant to give you a full picture of what your question was.

CHAIRMAN KATZ: So if, hypothetically, our buffer zone was 3 milligausses --

MS. BARTOSEWICZ: Yes --

CHAIRMAN KATZ: -- under your definition of statutory facilities --

MS. BARTOSEWICZ: Yes --

CHAIRMAN KATZ: -- we only have one that is above 3.0?

MS. BARTOSEWICZ: You are correct. And I would add to that is should we want to endeavor to reduce that 3.7 to 3 --

CHAIRMAN KATZ: Thank you, that's my next question.

MS. BARTOSEWICZ: I thought it would be.

What we would do is we would have to look at increasing structure height. And we could go -- we can continue increasing structure height until we -- as much as we could to reduce the calculated field.

CHAIRMAN KATZ: Okay.

MR. TAIT: How high -- is the sky the limit? (Laughter). Is the sky the limit?

MS. BARTOSEWICZ: Well --

MR. TAIT: And if we can't, then what do we do?

MS. BARTOSEWICZ: Good question --

MR. TAIT: Yeah --

MS. BARTOSEWICZ: -- I mean -- and we would continue to go as high as -- we can continue to go high. I mean river crossing structures are 200 feet tall. Not that you would want one, but you might have to go --

MR. TAIT: If you -- could you do that configuration for that particular one just as an example, how high would you have to go to get that down?

MS. BARTOSEWICZ: Certainly, we can do that calculation for you.

MR. TAIT: Just as an example.

MS. BARTOSEWICZ: Yes, we can --

MR. TAIT: Or is it so high that you

wouldn't recommend it?

MS. BARTOSEWICZ: Well, what we'll do for this one because it's the one on here that is above that 3 milligauss level, let us go back and see --

MR. TAIT: How high --

MS. BARTOSEWICZ: -- if there's -- if there's anything we can do to get that to 3, if that helps --

MR. TAIT: Show us those options because this may come up in other portions as well.

MS. BARTOSEWICZ: Certainly.

MR. TAIT: Play with the options.

CHAIRMAN KATZ: Yeah -- unfortunately, the legislation gave us absolutely no definition for residential areas --

MS. BARTOSEWICZ: Correct.

CHAIRMAN KATZ: -- and you have used certain assumptions. But --

MR. FITZGERALD: But you have -- you do have an exhibit that gives you calculated fields out to 150 feet on either side of the right-of-way and you have scaled maps --

CHAIRMAN KATZ: Yes --

MR. FITZGERALD: -- with houses on them.

CHAIRMAN KATZ: Yes.

MS. BARTOSEWICZ: And one of our homework assignments is to do that one sheet for you --

CHAIRMAN KATZ: Yes --

MS. BARTOSEWICZ: -- which we are working on.

CHAIRMAN KATZ: Okay. Let's -- we'll have this discussion in the future after we have that one sheet. Mr. --

MR. TAIT: Doesn't -- doesn't the statutory definition --

MR. HEFFERNAN: Go ahead --

MR. TAIT: Doesn't the statutory definition say among other things?

MR. FITZGERALD: No -- no, it does not.

MR. TAIT: In some parts of the statute it does --

A VOICE: Yes, it does --

MR. TAIT: -- the map shall show --

MR. FITZGERALD: Oh, I'm sorry.

A VOICE: (Indiscernible) --

MR. FITZGERALD: No, no -- no, no, no -- the -- there are two provisions --

MR. TAIT: Yes --

MR. FITZGERALD: -- there is a -- what -- I was struck by the fact of the legislative history, they just -- they universally refer to it as the laundry list. And the laundry list --

MR. TAIT: Appears in a couple of places --

MR. FITZGERALD: -- appears in two places. In one place it is where buffer zones are required --

MR. TAIT: And --

MR. FITZGERALD: -- and the other -- the laundry list was added to a preexisting list that requires mapping of -- before parks, recreational facilities, scenic and historic areas --

MR. TAIT: So it's only in the mapping that the among other things comes in?

MS. RANDELL: The copy that -- are we on? Unless I have an old copy, the copy that I have does say in establishing such buffer zones --

MR. TAIT: Yes --

MS. RANDELL: -- the Council shall take into consideration among other things --

MR. TAIT: And the mapping --

MS. RANDELL: -- and then it gets to the list.

MR. TAIT: And the mapping does not include

among other things --

MR. FITZGERALD: Okay --

MR. TAIT: -- and the presumption does not include among other things, but the buffer zone does.

MS. RANDELL: Yes.

MR. TAIT: So this is -- this is a laundry --

MR. FITZGERALD: Well --

MR. TAIT: -- a very dirty laundry list --

MR. FITZGERALD: -- you know, I have to --

MR. TAIT: -- and I don't know where a dirty laundry list is going to come in--

MR. FITZGERALD: -- I have to say that the reason I answered the question the way I did was that I think when I read it before, among other things did not mean to me among other types of land uses --

MR. TAIT: That's why I suggest that we need --

MR. FITZGERALD: -- but -- but --

MR. TAIT: This --

MR. FITZGERALD: -- such things as --

MR. TAIT: Yes --

MR. FITZGERALD: -- the size of the field, proximity -- you know, you can -- you have a wide open

canvas, but you've got to consider these specific things.

CHAIRMAN KATZ: Okay --

MR. TAIT: But this is the start of that discussion of what the statute means.

CHAIRMAN KATZ: Yes.

MS. BARTOSEWICZ: I would -- I would like to clarify one thing on this chart. You see a designation of NA on the end columns, and they're only there on the columns that are not at or below, and they're there because based on our definition there were no statutory facilities.

CHAIRMAN KATZ: Understood. Mr. Frank, did you have a question on this exhibit?

MR. MONTE FRANK: I have an objection to the exhibit.

CHAIRMAN KATZ: Okay, we'll take that.

MR. FRANK: I would object to this exhibit coming into the record. I think it's misleading for a number of reasons. One is that it assumes a definition of residential areas that is extremely narrow.

CHAIRMAN KATZ: Right, and I've noted that.

MR. FRANK: And you've noted that. Secondly, it assumes the 15 gigawatt case.

CHAIRMAN KATZ: And we -- okay, we should

note that.

MR. FRANK: We should note that.

MS. BARTOSEWICZ: It is on the exhibit as 15 gigawatts.

MR. FRANK: And third, it assumes readings from certain areas that might -- that may or may not be the appropriate areas for those readings --

A VOICE: What?

CHAIRMAN KATZ: I think --

MR. FRANK: And fourth --

CHAIRMAN KATZ: -- they took the average cross-section. Didn't you? I mean that's what I asked for.

MS. BARTOSEWICZ: I -- the third column and the -- the third column in each section is the average cross-section.

CHAIRMAN KATZ: Yep.

MR. FRANK: Fourth, it's based on Mr. -- on Dr. Bailey's calculations or measurements. And if this exhibit is going to come in, Dr. Bailey should be here to identify the exhibit and be subject to cross-examination.

And finally, you know, it seems to be providing information on a no net increase standard, which the Town believes doesn't have any basis in the

legislation.

CHAIRMAN KATZ: Yes. I think -- we will note all those objections. We will take this in noting those objections and what it is and what it isn't. And -- and I think we're going to come back to this in the future.

MR. FRANK: And to be fair -- if you are going to take it in, I think that there ought to be a different exhibit or set of data that is provided that assumes the 27.7 case, the 30-gigawatt case, the 32-gigawatt case, so on and so forth, so that we can have -- compare apples and apples.

CHAIRMAN KATZ: No, I --

MR. FRANK: Thank you --

CHAIRMAN KATZ: -- yeah, and I think in fairness to you, we have not -- this is not the end of this issue --

MR. FRANK: Fair enough --

CHAIRMAN KATZ: -- but we -- we appreciate the homework assignment.

MR. O'NEILL: Madam Chairman.

CHAIRMAN KATZ: Yes, Mr. O'Neill.

MR. O'NEILL: I believe it would be helpful to add to any future charts references to Volume 9 and the

mapping that's used in that application --

CHAIRMAN KATZ: The segment of the map --

MR. O'NEILL: -- rather than have us go through needless cross-referencing to the general areas mentioned --

CHAIRMAN KATZ: For example, Cross-Section 1 might be segment so and so to so and so in Volume 9 --

MS. BARTOSEWICZ: I understand --

CHAIRMAN KATZ: -- so adding another column.

MS. BARTOSEWICZ: We can do -- so you -- okay, sure.

MR. ASHTON: With a footnote.

CHAIRMAN KATZ: Yes.

MR. FITZGERALD: In fact, we can -- we can redo the map.

MR. O'NEILL: Thank you.

MR. FITZGERALD: I mean the -- we can't redo the map, we can redo the chart.

MS. RANDELL: When we file the official one, would you like us to add that in?

CHAIRMAN KATZ: Yes.

MR. O'NEILL: It would be appreciated.

MS. RANDELL: Sure.

CHAIRMAN KATZ: So noting Mr. Frank's objection, is there any other objection to making this a full exhibit? (No audible reply). Thank you. We will make this a full exhibit and food for thought.

(Whereupon, Applicants' Exhibit No. 140 for identification was received into evidence as a full exhibit.)

CHAIRMAN KATZ: Any other homework to be -- we have some procedural matters, but before that, is there any other homework assignments or --

MR. FITZGERALD: I don't think so --

MS. RANDELL: No --

MR. FITZGERALD: -- Al, we don't have any more -- we don't have anything else to turn in, do we?

MR. ASHTON: There was -- there was one I think yesterday that I inquired about and I think it had to do with fields for distribution as I recall. I don't remember it specifically. You were going to look at it over the lunch period and --

MR. FITZGERALD: Gary was going to do that. Is he here? Maybe we could -- yeah, he's -- he's in the building as they say --

CHAIRMAN KATZ: Okay --

MR. ASHTON: That's okay --

MR. FITZGERALD: -- he may have done that --

MR. ASHTON: -- I just don't want to have it forgotten.

CHAIRMAN KATZ: Okay, while we're looking into that, let's go through two procedural issues if we could. First we need to note for the record that myself and the Executive Director attended a presentation by ABB on explaining HD -- HVDC Light. And during that presentation they explained the technology and they explained some applications in other parts of the world. Since then we have learned that ABB has worked -- is going to -- is working actively with the companies. So that we have directed our staff and KEMA to sever any type of future conversations with ABB so that we don't raise any potential conflicts there. But I wanted to note for the record that that meeting did place -- did take place and I did get a briefing on how HVDC Light works.

Also we got today from Mr. Boucher a Motion to Compel Discovery, and specifically requiring the companies to provide certain calculated and measured EMF levels. And Mr. Marconi, do you want to address that.

MR. ROBERT L. MARCONI: Well, first of all, I'd like to ask the Company whether -- the Company's

counsel whether or not this information can be provided? And if not, give us an idea of why not?

MR. FITZGERALD: Sure. Is the -- is the question -- could I rephrase the question to whether we object to providing it?

MR. MARCONI: I understand you object to it. I'm also wondering about the ability to as well, so --

CHAIRMAN KATZ: Well --

MR. FITZGERALD: Well --

MR. MARCONI: -- by all means, you can give your objection.

MR. FITZGERALD: This gets -- this gets to the same question of is something technically possible, you know, or is it reasonable. And they're not always the same.

MR. MARCONI: Correct.

MR. FITZGERALD: And if I could just give you -- this will only take about two minutes, but I'd just like to give you some context for this. We received these interrogatories -- I think they were initially dated June 8th. They asked for information with respect to 45 properties abutting the right-of-way, they asked for 90 measurements, and 180 calculations in two towns. We also

received similar -- either informally for formally we received similar inquiries from other towns.

During the June hearings we had a conference of counsel. And we, we being the Applicants, made a case to them that we were just overwhelmed with work, trying to prepare all the information that was needed to respond to the public act and to provide you with what you needed. And we proposed at that time than rather than running all around the countryside doing all these measurements and other -- filling other requests, that we would approach the issue in a systematic way and we proposed to do what we have since done, which is to provide this information out to 150 feet for every foot of the right-of-way in 15-foot increments. And initially we proposed to do this only for the 15-gigawatt case. And -- and then in order to secure a consensus, not a universal agreement, but a consensus from the towns, that yes this was a reasonable way to approach the subject, we agreed that we would also do it at the 27.7 case in exchange for their agreement not to pursue these other miscellaneous requests, which were quite heterogeneous. And I must stay that during that meeting, Mr. Boucher was silent, he did not -- he was not one of the town lawyers who said yeah that sounds like a reasonable way to go.

In early July I received a supplemental communication from Mr. Boucher saying by the way we still want our measurements. And I responded to him we're not going to do them, we don't have the manpower or the man-hours, we are working flat-out to do what we had said we would do, and we believe that this is going to be a much more useful product for everybody, and we're also working flat-out to answer the AG's interrogatories.

And since then we have filed with the Council Exhibit 136, the revised Exhibit 96, the response to AG-14, the new mapping, all of which was underway during this time. And we are very appreciative of the reasonableness of the other towns who agreed to accept that effort in lieu of having us take hundreds of measurements and hundreds of point calculations in each of their towns. And we really do object to providing it here because we don't think it provides the Council with any significant useful information beyond what they're getting. And you've also asked -- you know, you've asked for some other information, you want us to go back and look at the -- in our next effort when we leave here is to start pouring through the historical -- to try and acquire and then pour through the historical loading records to answer requests that you made of us --

CHAIRMAN KATZ: Oh -- well, we'll get to that, because I think Mr. Ashton has an idea that will make that easier --

MR. FITZGERALD: Oh, okay --

CHAIRMAN KATZ: -- but we'll talk about that.

MR. FITZGERALD: And -- and you know, we're -- we feel we're pretty responsive to that. But we think that this effort, and particularly what we anticipate as a follow-on, is a diversion. And we would ask you not to make us squander our very limited resources on doing this.

And -- and Mr. -- just to respond to the one speck of legal argument in here, he says that this is required by the best management practices. The best management practices do indeed require baseline measurements of existing conditions. That's what we provided you in the application, in the EMF assessment in the application that was filed so many months ago, and --

CHAIRMAN KATZ: Thank you. I do not see Mr. Boucher here. Is one of his associates here to speak to this? (No audible response). Okay. I think in fairness, would you agree, we will take this up at our Council meeting when perhaps Mr. Boucher wishes to be present?

MR. MARCONI: I -- I would agree, Madam Chairman, that we should take this up on an occasion when there's sufficient notice to have it put on the agenda and not have to -- certainly we're not going to be granting this motion at this point -- and to see if Mr. Boucher has anything else to say on the behalf --

CHAIRMAN KATZ: Okay.

MR. MARCONI: I --

CHAIRMAN KATZ: Yes?

MR. LYNCH: I'm going to disagree.

CHAIRMAN KATZ: Okay.

MR. LYNCH: If Mr. Boucher wants to put in his motion, he should be here. Why are we going to put it off?

CHAIRMAN KATZ: Please weigh in.

MR. TAIT: I side with Mr. Lynch. This is an adversary system. He's been present here off and on. If he makes a motion, he ought to be here to defend it.

MR. ASHTON: Yep.

CHAIRMAN KATZ: Okay. Anyone else wish to weigh in on this? Mr. O'Neill.

MR. O'NEILL: I agree with your original suggestion, we should put it off until another meeting and give it careful consideration.

CHAIRMAN KATZ: Anyone else? I saw a hand down there. Mr. Ashton.

MR. ASHTON: Yeah, I have two feelings. I share Mr. Lynch's feelings that Mr. Boucher knows what's going on and ought to be here, especially having filed this motion when it was likely to come up.

And the second one is I must admit I'm troubled by the date that it's requested. It is a grab sample of data out of time, which as a professional in the field means absolutely nothing to me, where at least the Company has provided a consistent level of data across the spectrum of the geography here. So if you're -- if this is just going to be isolated for Middlefield, I don't know what in the world it would tell me, whatever the numbers are. It has no meaning to me at all as a professional. And I just, frankly, don't see the value of it.

CHAIRMAN KATZ: Thank you. Other opinions?

MR. EMERICK: In terms of substance I agree with what Phil just said.

MR. WILENSKY: Madam Chairman, can we take action on this today?

MR. ASHTON: Sure --

CHAIRMAN KATZ: We could.

MR. MARCONI: The discretion of the

Council.

CHAIRMAN KATZ: The discretion of the Council.

MR. WILENSKY: In other words, it does not have to be on the agenda, we can just --

MR. ASHTON: Just move it.

MR. HEFFERNAN: It sounds like you want to turn it down now or you want to turn it down later. (Laughter).

CHAIRMAN KATZ: Would the --

MR. TAIT: Is there some reason Mr. Boucher could not be here? I mean --

MR. LYNCH: There's a hand in the audience --

CHAIRMAN KATZ: I'm going to -- Miss Boord, I'm going to allow you to be recognized if you want to come up to a mic as the client.

COURT REPORTER: Please state your name.

MS. MARYANN BOORD: Maryann Boord, First Selectwoman of Durham. I'm certain that if Peter Boucher knew it was on the agenda today, he would have been present. It was not on the agenda and I would respectfully request that you wait to vote on this until he has an opportunity to address it.

MR. TAIT: With that request, I will --

MR. HEFFERNAN: Wait until later.

MR. TAIT: Let's put it on later.

MR. ASHTON: Okay.

MR. FITZGERALD: (Indiscernible) -- this is just a procedural thing, so -- since it's part of a docket, if you're going to take it up at a meeting and there's going to be argument, do you have to notice the docket? Does it have to -- does -- I'll leave that -- I'll leave the answer to Mr. Marconi --

CHAIRMAN KATZ: Yes --

MR. FITZGERALD: -- I just raised it for --

CHAIRMAN KATZ: I had the same thought.

MR. MARCONI: I would suggest that the docket be noticed. And if it's going to be discussed at a meeting, the Council may want to consider whether or not it wants to invite discussion by counsel --

CHAIRMAN KATZ: Yeah --

MR. MARCONI: -- or by attorneys at that point.

CHAIRMAN KATZ: I'm going to suggest out of respect to the Town of Durham that we delay this. But in the future if any attorneys drop motions on us, that day do not be surprised if we decide to take them up that day,

we have that discretion.

COURT REPORTER: One moment please.

(Pause).

CHAIRMAN KATZ: And we will -- we will take this up in the future and notify the affected parties.

Okay, other procedural issues -- oh, Mr. Ashton, you had an idea -- when I had asked naively about the historic -- you know, how do we historically determine the peak, Mr. Ashton suggested to me there might be a easier way of doing this.

MR. ASHTON: Having also exhumed records for 8,760 hours in a year and to try and get data that's meaningful from it, I know the magnitude of that request, if the data exists at all. Most trans -- all transmission lines have ratings. A 4-OTT (phonetic) copper line, for example, has a nominal steady full-load rating of -- it used to be I think 480 amperes, unless Mr. Zaklukiewicz has changed it in the last few years, and 556 MCM ACSR has a rating of 860 amps I believe. Very characteristically, the economic design calls for a loading of about half of that figure as being the point where capital costs and operating costs are about balanced. And so my suggestion would be to use a half of the full load rating, full-term -- long-term rating as a basis for going at this rather

than trying to dig through and find out what it is, because it's going to be really -- whatever the data shows, it could be more, it could be less, but it's -- that's a meaningful number anyway. And I think it -- it does provide what is generally being sought at a reasonable way of doing it. And that would be my suggestion.

CHAIRMAN KATZ: Mr. Zak, does that make sense to you?

A VOICE: Roger.

MS. RANDELL: Could we have a point of clarification first?

CHAIRMAN KATZ: Yes

MS. RANDELL: Sorry. By long-term rating, we would just inquire whether Mr. Ashton is referring to the continuous rating --

MR. ASHTON: Yeah --

MS. RANDELL: -- as opposed to the long-time --

MR. ASHTON: Yeah --

MS. RANDELL: -- emergency rating?

MR. ASHTON: Yeah, continuous rating.

MR. ZAKLUKIEWICZ: Those were -- those were continuous --

MS. RANDELL: Okay --

MR. ZAKLUKIEWICZ: -- numbers.

MS. RANDELL: Okay.

MS. RANDELL: In that case, I'll shut-up now.

MR. ZAKLUKIEWICZ: I -- I think that's logical, Mr. Ashton. The only thing, we're going to have to make a determination on is is in some cases where we have three lines on a right-of-way, the flow direction, and take it for the predominant flow direction --

MR. ASHTON: Sure --

MR. ZAKLUKIEWICZ: -- is the only issue that I see. And that was one of the problems I had with an hour-by-hour say for the June Street --

MR. ASHTON: Yeah --

MR. ZAKLUKIEWICZ: -- is the -- is the flow out of Devon towards June Street or is it going from the Middletown area through June Street and down to Devon for those given times. And we know that 99 percent of the time the flow is in one direction, and we'll just make that assumption if that's --

MR. ASHTON: Certainly there are a number of lines where the flows are anomalous, they don't track in any rational sense at all, but --

MR. ZAKLUKIEWICZ: But on the whole they do --

MR. ASHTON: -- on the whole --

MR. ZAKLUKIEWICZ: -- with the exception of the unusual generation that's on --

MR. ASHTON: Sure --

MR. ZAKLUKIEWICZ: -- and that's normally limited to hours or a minimal amount of times per year when certain generation is not available for whatever reason.

CHAIRMAN KATZ: Thank you. Mr. Frank.

MR. FRANK: I'm not prepared to comment on the suggestion. I, to be quite honest, don't know if it's a logical or reasonable assumption, and would like to have the opportunity to consult with our experts to get their opinion on it.

CHAIRMAN KATZ: That's fair.

MR. FRANK: I mean I do know when we looked at the numbers yesterday, you know, at the JCC there was an actual measurement on the existing lines at 10.5 milligauss. And when you compared that to the 15-gigawatt case and the 27-gigawatt case, the EMF readings were significantly lower. And so that was one of the reasons that we suggested we need to understand what the load was

on the line. So --

CHAIRMAN KATZ: Would it be fair --

MR. FRANK: -- I need to take it up with our experts to try to determine whether -- what Mr. Ashton suggests is logical or not or whether there's some other percentage or number that we'd be looking for.

CHAIRMAN KATZ: Would it be reasonable --

MR. FITZGERALD: (Indiscernible) --

AUDIO TECHNICIAN: Hang on a second --

MR. FITZGERALD: Sorry.

CHAIRMAN KATZ: Would it be reasonable to have you do that and cover this at our process meeting?

MR. FRANK: I'd be happy to do that.

CHAIRMAN KATZ: Is that reasonable?

MR. FITZGERALD: Well from my standpoint what counts is that Mr. Ashton thinks it's reasonable, so we'll do it, and then we'll see what happens. If people say we can't give it to you --

CHAIRMAN KATZ: Right -- well --

MR. FITZGERALD: -- we'll take that up at that time.

MR. ASHTON: Just recall --

MR. FRANK: I'm trying --

MR. ASHTON: -- that for each line to dig

through 8,760 hours of records, we're going to be here for three years if that's the kind of data digging we've got to do.

(gavel)

MR. FRANK: And I understand that and I'm trying to be reasonable about it --

CHAIRMAN KATZ: Right --

MR. FRANK: -- and without having to file extensive interrogatories on a fishing expedition --

CHAIRMAN KATZ: (Gavel) -- but --

MR. FRANK: -- and that's why I'm only -- I'm requesting that I have the opportunity to consult so that we can get to a reasonable position.

CHAIRMAN KATZ: Let's do this. Our understanding is now that the companies are going to go ahead and do this Ashton thing. At some point --

MR. ASHTON: The Ashton thing --

CHAIRMAN KATZ: -- we may come back -- yes -- we had the Wilensky factor on telecommunications and we'll have this --

MR. ASHTON: Call it the Phil factor, it's easier.

A VOICE: (Indiscernible) --

CHAIRMAN KATZ: Hmm?

A VOICE: (Indiscernible) --

CHAIRMAN KATZ: Yes. We may, Mr. Fitzgerald, if Mr. Frank comes back -- we'll have you do this, but we may come back and ask you to do something else --

MR. FITZGERALD: I --

CHAIRMAN KATZ: -- in addition.

MR. FITZGERALD: -- I understand that --

CHAIRMAN KATZ: -- if Mr. Frank can make -- and his experts can make a reasonable case for it. Is that fair to everybody?

MR. FITZGERALD: I --

MS. RANDELL: Yes --

CHAIRMAN KATZ: Your co-counsel is nodding --

MR. FITZGERALD: Yes. Holding -- holding --

CHAIRMAN KATZ: -- that's good enough for me.

MR. FITZGERALD: I think that's fine --

CHAIRMAN KATZ: Yes --

MR. FITZGERALD: -- yes.

CHAIRMAN KATZ: Okay.

MS. RANDELL: That's fine.

CHAIRMAN KATZ: Yes.

MS. RANDELL: We would just as soon have a clear understanding now of what we're doing for Mr. Ashton so we can get people working on it.

CHAIRMAN KATZ: Right. That sounds -- and it sounds like Mr. Zak understood him --

MS. RANDELL: Yep.

CHAIRMAN KATZ: -- and that was good enough for me. Okay. Mr. Frank, agreeable? As good as --

MR. FRANK: I --

CHAIRMAN KATZ: -- as agreeable as you get?

MR. FRANK: Yeah -- I mean, I -- obviously, it's the Council's request --

CHAIRMAN KATZ: Yes --

MR. FRANK: -- it's not my interrogatory. I may issue an interrogatory and I reserve my right to do that, but -- you know, I -- I just -- I don't want to leave the impression that I agree with the proposition without having consulted with my experts.

CHAIRMAN KATZ: And we understand that and we may request the companies to do some additional work on this issue.

MR. FRANK: Fair enough.

MS. RANDELL: Madam Chairman, one other

thing. Dr. Johnson is prepared to give a short bit of information further on Mr. Ashton's question on distribution lines. It's not a complete one. He was able to get a little more information --

CHAIRMAN KATZ: Okay --

MS. RANDELL: -- so if you'd like the little more now --

CHAIRMAN KATZ: Yes --

MS. RANDELL: -- we can do that.

CHAIRMAN KATZ: We'll do that.

MR. ASHTON: A tease.

CHAIRMAN KATZ: For the record.

DR. GARY JOHNSON: My name is Gary Johnson from Exponent.

In regards to Mr. Ashton's questions about distribution line and magnetic fields. In the brief amount of time since the question was asked, I looked a little bit further into it with the information I had available. And I think as I indicated at the time, overhead distribution lines, the measurements that I remember are in the four to eight milligauss range that you can come in contact with.

For the underground distribution, the few cases that I had readily available will tend to be as you

pass over the peak, about 8 to 13 milligauss. This is roughly at waist level or about 1-meter, about 40 inches above ground.

Now, I have some other information that I've requested. I don't know if it's going to contain additional information on these distribution line levels, but it may be in there. And over -- hopefully, I'll be able to get access to that and take a look at it over the next week or so and have a little bit more complete answer instead of just a few random spot measurements.

CHAIRMAN KATZ: Thank you.

MR. ASHTON: If it would help, I'd be -- if it would help, I'd be very happy to have a simple written explanation on it if that would make life easier from hauling a witness down here from Massachusetts.

MS. RANDELL: That's fine. Actually, we were going to ask you how would you prefer the additional information --

CHAIRMAN KATZ: Written would be fine --

MS. RANDELL: -- and we could do a written submission.

CHAIRMAN KATZ: We will that --

MR. ASHTON: K-i-s-s --

MR. O'NEILL: And doctor, if you could

elaborate on whether or not shielding was included in the underground option, it would be appreciated.

DR. JOHNSON: Pardon?

CHAIRMAN KATZ: On distribution?

MR. O'NEILL: On the underground -- underground distribution I think is what we were discussing.

DR. JOHNSON: Could you repeat the question?

MR. O'NEILL: Regarding your EMF calculations were -- was shielding considered in that underground option that you mentioned on distribution?

DR. JOHNSON: No, that was for standard -- standard type implementation of the underground type options.

MR. O'NEILL: Thank you.

CHAIRMAN KATZ: Okay. Are there any other procedural matters we need to do before we adjourn? Mr. Phelps.

MR. PHELPS: I just want to confirm our intentions for that process meeting on the 19th --

CHAIRMAN KATZ: Yes --

MR. PHELPS: -- we'll be sending a notice out for to determine the time. Right now we anticipate

10:00 a.m. Yes?

CHAIRMAN KATZ: 10:00 a.m. on the 19th in --

MR. PHELPS: Here --

CHAIRMAN KATZ: -- Franklin Square --

MR. PHELPS: -- Hearing Room 1.

CHAIRMAN KATZ: Hearing Room 1 for the attorneys, etcetera, for the parties and intervenors.

A VOICE: (Indiscernible) --

CHAIRMAN KATZ: Yeah. And the tentative schedule is again hearings September 8th and 9th here on the ROC report. And we also --

MR. MARCONI: (Indiscernible) -- did you want to mention -- (indiscernible) --

CHAIRMAN KATZ: No, let's not mention that -- we'll leave it at that.

MR. MARCONI: Okay.

CHAIRMAN KATZ: We're not taking it out any further. Okay. Any other procedural matters?

A VOICE: (Indiscernible) -- won't see you for two weeks --

CHAIRMAN KATZ: -- I think we will try not to do three days in a row again.

A VOICE: Madam Chairman, we won't see you for two weeks now?

CHAIRMAN KATZ: Yeah. Where I'm going in the Adirondacks, I have to walk into town for telephone and e-mail, it's going to be great.

MR. TAIT: And she's not walking.

CHAIRMAN KATZ: And I'm not walking.

A VOICE: (Indiscernible) -- your cell phone.

CHAIRMAN KATZ: Yes. Okay, anything else before we adjourn? And thank you everybody. This is not easy going through this and I appreciate everybody's patience. We are adjourned.

(Whereupon, the hearing adjourned at 4:00 p.m.)

HEARING RE: CL&P and UI
JULY 29, 2004

INDEX OF WITNESSES

HEARING RE: CL&P and UI
JULY 29, 2004

INDEX OF ISO NEW ENGLAND EXHIBITS

INDEX OF APPLICANTS' EXHIBITS

CERTIFICATE

I, Paul Landman, a Notary Public in and for the State of Connecticut, and President of Post Reporting Service, Inc., do hereby certify that, to the best of my knowledge, the foregoing record is a correct and verbatim transcription of the audio recording made of the proceeding hereinbefore set forth.

I further certify that neither the audio operator nor I are attorney or counsel for, nor directly related to or employed by any of the parties to the action and/or proceeding in which this action is taken; and further, that neither the audio operator nor I are a relative or employee of any attorney or counsel employed by the parties, thereto, or financially interested in any way in the outcome of this action or proceeding.

In witness whereof I have hereunto set my hand and do so attest to the above, this 6th day of August, 2004.

Paul Landman
President

Post Reporting Service
1-800-262-4102