ORIGINAL

STATE OF CONNECTICUT

SITING COUNCIL

CONNECTICUT LIGHT & POWER COMPANY AND UNITED ILLUMINATING COMPANY	DECEMBER 14, 2004 (10:00 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

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. . .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 December 14, 2004 at 10:00 a.m., at which time the parties were represented as hereinbefore set forth . . .

CHAIRMAN PAMELA B. KATZ: I'd like to call this continuation of the Docket 272 hearing to order.

The purpose of today's session of the hearing is the cross-examination of the Council's witness KEMA.

First, is there any procedural matters that need or housekeeping matters that need to be taken up before we proceed into swearing in the KEMA witnesses? Seeing none, at this time I'll ask Mr. Marconi if he could swear in Richard Wakefield and Johan Enslin.

MR. ROBERT L. MARCONI: Before the witnesses stand, what I'd like is for both witnesses to give their full name and spell their names for the purposes of the court reporter.

MR. RICHARD A. WAKEFIELD: Richard A Wakefield. Wakefield is spelled W-a-k-e-f-i-e --

AUDIO TECHNICIAN: Excuse me, one minute here --

CHAIRMAN KATZ: Just pull your mic a little closer please, Mr. Wakefield.

MR. WAKEFIELD: Are you ready now?

AUDIO TECHNICIAN: Yes.

MR. WAKEFIELD: Richard A. Wakefield. Shall I spell just my last name? W-a-k-e-f-i-e-l-d.

DR. JOHAN ENSLIN: Johan Enslin. Spelled J-o-h-a-n. The last name E-n-s-l-i-n.

MR. MARCONI: Thank you. Now gentlemen, if you could both please rise and please raise your right hand.

(Whereupon, Richard A. Wakefield and Dr. Johan Enslin were duly sworn in.)

MR. MARCONI: Please be seated.

CHAIRMAN KATZ: We have a number of exhibits, which we'll now have the witnesses verify in the hearing program on page 4. It will be Exhibits 7, 9, 13, 16, and 20. So Mr. Marconi, if you could do that please.

MR. MARCONI: Could I ask both witnesses first to indicate their positions with the company?

MR. WAKEFIELD: Yes. I am Vice President of Transmission and Regulatory Services for KEMA, Incorporated.

MR. MARCONI: And --

DR. ENSLIN: I'm a principal consultant in the area of electronics and harmonics for KEMA.

MR. MARCONI: Thank you. Now if you could both look at Council Exhibit 7, which I believe would be the curriculum vitae, could you both identify those and tell me if those exhibits are accurate -- true and accurate to the best of your knowledge and recollection?

MR. WAKEFIELD: Yes -- yes, they are.

DR. ENSLIN: Yes, they are.

MR. MARCONI: And do you have any changes or corrections that you wish to make?

MR. WAKEFIELD: No, I do not.

DR. ENSLIN: No.

MR. MARCONI: Okay. So those would be -- would you be, in fact, adopting that as your testimony for those exhibits?

MR. WAKEFIELD: Yes, we would.

DR. ENSLIN: Yes.

MR. MARCONI: Okay. Madam Chair, I would ask then that Council Exhibit 7, the curriculum vitaes, be

admitted as evidence.

CHAIRMAN KATZ: Any objection to making No. 7 a full exhibit? Hearing none, it's a full exhibit.

(Whereupon, Siting Council Exhibit No. 7 was received into evidence as a full exhibit.)

MR. MARCONI: Now, let me move on to Council Exhibit 8, which would be the Harmonic Impedance Study for Southwest Connecticut, Phase II Alternatives -- (pause) --

A VOICE: Uh -- (indiscernible) --

CHAIRMAN KATZ: Impedance --

MR. ANTHONY FITZGERALD: It's got a different number on what was just passed out.

MR. MARCONI: It's -- what I had asked -- what I had asked Council staff to do would be to number exhibits in the order in which they're being presented, because originally in the program I noticed that they had exhibits that are set to be introduced tomorrow --

CHAIRMAN KATZ: Well, let's just -- let's go by the hearing program number --

MR. MARCONI: The hearing program?

CHAIRMAN KATZ: Yes.

MR. MARCONI: Okay. Well, then we'll go with Council Exhibit 9, knowing that Council Exhibit 8 is

reserved for tomorrow, and that will be the harmonic study.

Could I ask the witnesses basically are you familiar with this exhibit?

DR. ENSLIN: Yes.

MR. WAKEFIELD: Yes, we are.

MR. MARCONI: And can you tell us -- tell the Council please who prepared this?

MR. WAKEFIELD: Yes. This was prepared by Dr. Enslin, by myself and Dr. Yi Hu.

MR. MARCONI: Okay.

CHAIRMAN KATZ: Can -- can we just say for all the exhibits that will be verified this morning they were prepared under your supervision, Mr. Wakefield?

MR. WAKEFIELD: Yes, they were.

MR. MARCONI: Okay. Now do you both, in fact, adopt this study as your testimony?

DR. ENSLIN: Yes.

MR. WAKEFIELD: Yes, we will.

MR. MARCONI: And are there any changes or corrections that you need to make in this exhibit?

MR. WAKEFIELD: Yes, there is -- there is one. And that is Tables 14, 15 and 16 we are proposing a slight modification to those tables. And this -- I

believe that staff for the Council has a copy of the revised pages, and we'll distribute copies, but otherwise I have a copy here. Those -- the changes to this table relate to resonance peaks observed at two buses, Southington 345-kV and Southington Ring No. 1 at 115-kV. And they were really described in a way that we didn't feel was completely accurate in our original report. This has been discussed in discovery also to date.

The note we would add to that particular -- to those particular tables reads the following way: Southington 345-kV and 115-kV substations have maximum impedance values below the third harmonic. From the detailed plotted results, it is clear that these are not resonance peaks as such. These maximum values indicated around or below the third harmonic are the result of the system characteristics and the filtering properties of the C-type filters. These maximum values are also damped to levels that they do not pose any problem in terms of over-voltages or resonances. Therefore, the results from these substations are excluded from the conclusions.

MR. MARCONI: Are those the only changes and corrections that need to be made?

MR. WAKEFIELD: Yes, they are.

MR. MARCONI: Okay. And so with those

changes and corrections then, do you adopt this as your -- in fact -- your testimony in fact?

MR. WAKEFIELD: We do.

DR. ENSLIN: Yes.

CHAIRMAN KATZ: Any objection to making No. 9 a full exhibit? Hearing none, No. 9 is a full exhibit.

(Whereupon, Siting Council Exhibit No. 9 was received into evidence as a full exhibit.)

MR. MARCONI: Let me move on to then what in the hearing program is marked as No. 13, which is KEMA responses to the Office of Consumer Council's fourth set of interrogatories. And again, gentlemen, are you familiar with those answers?

DR. ENSLIN: Yes.

MR. WAKEFIELD: Yes, we are.

MR. MARCONI: Okay. Are they true and correct to the best of your knowledge and belief?

DR. ENSLIN: Yes.

MR. WAKEFIELD: Yes, they are.

MR. MARCONI: Do you need to make any changes or corrections to those answers?

DR. ENSLIN: No.

MR. WAKEFIELD: No, we do not.

MR. MARCONI: And thus, do you adopt those

as your sworn testimony?

DR. ENSLIN: Yes.

MR. WAKEFIELD: Yes, we do.

MR. MARCONI: Okay.

CHAIRMAN KATZ: Any -- oh, are you all set?

MR. MARCONI: Yes. I would move those to be admitted, Madam Chair.

CHAIRMAN KATZ: Thank you. Any objection to making No. 13 a full exhibit? Hearing none, 13 is a full exhibit.

(Whereupon, Siting Council Exhibit No. 13 was received into evidence as a full exhibit.)

MR. MARCONI: Let me move on to what's been marked as -- in the hearing program as No. 14, which would be KEMA responses to the Town of Woodbridge interrogatories. Basically the same questions, gentlemen, are you familiar with these interrogatory answers?

DR. ENSLIN: Yes.

MR. WAKEFIELD: Yes, we are.

MR. MARCONI: And do you have any changes or corrections to make?

MR. WAKEFIELD: No.

DR. ENSLIN: No.

MR. MARCONI: And do you adopt them as your

sworn testimony?

DR. ENSLIN: Yes.

MR. WAKEFIELD: Yes.

MR. MARCONI: Okay. Again, Madam Chair, I move that those be admitted.

CHAIRMAN KATZ: Any objection to making No. 14 a full exhibit? Hearing none, it's a full exhibit.

(Whereupon, Siting Council Exhibit No. 14 was received into evidence as a full exhibit.)

MR. MARCONI: Then I would also move on to what has been marked as No. 16 in the hearing program, the KEMA response to CL&P/UI interrogatories. Again the same questions. Do you -- are you familiar with these answers?

MR. WAKEFIELD: Yes.

DR. ENSLIN: Yes.

MR. MARCONI: And do you have any changes or corrections to make?

DR. ENSLIN: No.

MR. WAKEFIELD: No.

MR. MARCONI: And do you adopt them as your testimony?

DR. ENSLIN: Yes.

MR. WAKEFIELD: Yes.

MR. MARCONI: Then Madam Chair, I ask that

those be admitted.

CHAIRMAN KATZ: Any objection to making 16 a full exhibit? Hearing none, it's a full exhibit.

(Whereupon, Siting Council Exhibit No. 16 was received into evidence as a full exhibit.)

MR. MARCONI: Let me also move on now to what has been marked as No. 18 in the hearing program, the KEMA response to CL&P interrogatory dated December 3, 2004. Are you familiar with those answers?

DR. ENSLIN: Yes.

MR. WAKEFIELD: Yes.

MR. MARCONI: And do you have any changes or corrections to make?

DR. ENSLIN: No.

MR. WAKEFIELD: No.

MR. MARCONI: And do you adopt those answers as your sworn testimony today?

DR. ENSLIN: Yes.

MR. WAKEFIELD: Yes.

MR. MARCONI: And again, Madam Chair, I'd move those be admitted into evidence.

CHAIRMAN KATZ: Any objection to making 18 a full exhibit? Hearing none, we'll make it a full exhibit.

(Whereupon, Siting Council Exhibit No. 18 was received into evidence as a full exhibit.)

MR. MARCONI: And then finally what has been marked as No. 20 in the hearing program, the KEMA response to the Town of Durham and Wallingford. Are you familiar with these answers?

MR. WAKEFIELD: Yes.

DR. ENSLIN: Yes.

MR. MARCONI: And do you have any changes or corrections to make?

MR. WAKEFIELD: No.

DR. ENSLIN: No.

MR. MARCONI: And do you adopt that as your testimony?

DR. ENSLIN: Yes.

MR. WAKEFIELD: Yes.

MR. MARCONI: Thank you. Again I'd ask that No. 20 be admitted into evidence, Madam Chair.

CHAIRMAN KATZ: Any objection to making No. 20 a full exhibit? Hearing none, it's a full exhibit.

(Whereupon, Siting Council Exhibit No. 20 was received into evidence as a full exhibit.)

CHAIRMAN KATZ: Let me note for the record on No. 17 we will verify the load flow analysis in the

January hearing.

MR. MARCONI: I do need to ask, Mr. Wakefield, is in fact KEMA a consultant for the State of Connecticut Siting Council?

MR. WAKEFIELD: Yes, it is.

MR. MARCONI: And has any member of the staff or any Council Member pressured KEMA into coming up with a particular result in any of its studies?

MR. WAKEFIELD: No --

DR. ENSLIN: No --

MR. WAKEFIELD: -- they have not.

MR. MARCONI: Okay.

CHAIRMAN KATZ: Thank you. Okay, at this point we're going to have brief direct by Council staff and then we will turn it over to the Applicant to begin cross-examination.

MR. S. DEREK PHELPS: Chairman, good morning. Gentlemen, good morning.

DR. ENSLIN: Good morning.

MR. PHELPS: I have a number of questions for you beginning with what is the name of your firm and where is it based?

MR. WAKEFIELD: Our firm is KEMA, K-E-M-E -- K-E-M-A, N-V. That's the larger company that owns KEMA,

Incorporated in the United States. So that company is based in Arnhem, the Netherlands. KEMA, Incorporated is based in the United States. And the headquarters of Transmission and Distribution Consulting, the group that we work for, is in Raleigh, North Carolina.

MR. PHELPS: How would you describe your firm's services?

MR. WAKEFIELD: Our firm provides services related to the design, testing, and analysis of power supply systems and equipment.

MR. PHELPS: Please give some examples of your most common types of clients?

MR. WAKEFIELD: We have a wide range of clients. The most common clients are electric utilities, manufacturers of electrical equipment, AC and DC traction organizations, in other words electric railroads, federal and state agencies involved in decisions related to electric power supply.

MR. PHELPS: How did you come to be retained by the Connecticut Siting Council?

MR. WAKEFIELD: We responded to a request for proposals issued by the Connecticut Siting Council early in 2004.

MR. PHELPS: What was the original scope of

services under which you were contracted to work?

MR. WAKEFIELD: We were asked to support the Connecticut Siting Council in reviewing studies made by parties in this case and by the Applicant, and to develop -- to assist them in discovery and in interpreting those results.

MR. PHELPS: When did you enter into that contract with the Council?

MR. WAKEFIELD: May 21st of 2004.

MR. PHELPS: Was that contract subsequently altered in some way? And if so, when?

MR. WAKEFIELD: The contract was altered in August -- I believe August 6th -- to add the additional study of harmonic impedance -- harmonic resonances and impedances on the Southwest Connecticut system.

MR. PHELPS: Would you please further describe the expanded scope of work that served to alter your contract with the Council?

MR. WAKEFIELD: We were asked to develop a harmonic analysis model -- a harmonic resonance model, perform harmonic analysis with that model as a first screen in assessing the feasibility of the proposed 345-kV improvements and various alternatives to those proposals.

MR. PHELPS: And finally, would you please

provide a brief outline as to the results of that study?

MR. WAKEFIELD: Yes. KEMA studied what has been called the New Base System called by the ROC group, R.O.C group, Study Case 5, using 24 miles of undergrounding of XLPE cables as opposed to 24 miles of HPFF cables that was in the original proposal by the Applicants, and to compare the harmonic resonance performance of that with the approved Phase 1 system.

And KEMA also investigated extending undergrounding with the XLPE cable along the Devon to Beseck corridor and looked at several lengths of additional undergrounding. Included among this were 10, 20, and 40 miles of undergrounding, and an additional set of cases that looked at 15 miles of undergrounding.

The studies also looked at two methods of mitigating the harmonic resonance performance and the resonance peaks associated -- and on the lower order of resonances near the second and third harmonics. Namely we looked at the STATCOMs as a mitigating method and we looked at C-type filters, a kind of passive filtering. Our results for the passive filtering were encouraging. Our results for the STATCOMs were that they -- they were -- they did help to mitigate, but they were not an effective mitigating tool.

With regard to the additional undergrounding along the corridor, based on the harmonic -- our harmonic impedance calculations alone and the associated results, we concluded that additional undergrounding of the corridor up to 20 miles appears to be technologically feasible.

MR. PHELPS: Thank you.

MR. FRED O. CUNLIFFE: Good morning.

MR. WAKEFIELD: Good morning, Mr. Cunliffe.

MR. CUNLIFFE: Did KEMA perform any transient network analysis?

MR. WAKEFIELD: No, we did not.

MR. CUNLIFFE: Were you asked to do one?

MR. WAKEFIELD: No, we were not.

MR. CUNLIFFE: What level of collaboration would be needed to perform a transient network analysis?

MR. WAKEFIELD: Extensive collaboration -- we believe extensive collaboration would be required with the Applicants and the owners of the -- the Applicant includes the owners of the Southwest Connecticut transmission system in order to make those studies reasonably accurate and defensible. It's very difficult to do such studies at arm's length.

MR. CUNLIFFE: In studying additional

undergrounding from Devon to Beseck, did KEMA consider three parallel sections of 1750-kcmil XLPE?

MR. WAKEFIELD: Yes, we did.

MR. CUNLIFFE: And did you also run a frequency scan for a fourth line?

MR. WAKEFIELD: Yes, we did.

MR. CUNLIFFE: And what was your reason to do that?

MR. WAKEFIELD: We -- we understood there were some questions regarding whether the rating of three 1750-kcmil cables would be adequate to meet the needs established by the Applicant. We still believe that they would be adequate. However, we didn't -- we wanted to make at least an evaluation as to what would be the effect on the harmonic impedance results if a fourth cable were added, which would add roughly 30 to 33 percent to the rating of the line on that corridor. And that -- that was the reason we added a limited number of cases at the -- with four parallel cables.

MR. CUNLIFFE: And what was KEMA's conclusion of that scan?

MR. WAKEFIELD: Our conclusion was that the addition of a fourth parallel cable would not significantly affect our conclusions and recommendations

in the initial report.

MR. CUNLIFFE: You also investigated STATCOMs as you previously testified. You also investigated C-type filters as well. Could these two types of machinery work together?

MR. WAKEFIELD: Yes. We -- we believe that -- again we felt that C-type filtering would be -- or possibly even other types of passive filtering -- we did look at C-type filtering -- that this -- these would be the most effective methods of dealing with the lower order of harmonic resonance peaks. STATCOMs seem to be less effective and added complexity to the system that the passive filtering would not. However, from an operational perspective, we believe that STATCOMs do provide additional value to the system. And possibly a combination of those and C-type filtering might be well worth investigating further. However, we did not perform such a study.

MR. CUNLIFFE: Thank you. Those are my questions, Chairman.

CHAIRMAN KATZ: Thank you. At this time we will have cross-examination by the Applicant. Mr. Fitzgerald.

MR. FITZGERALD: Thank you.

AUDIO TECHNICIAN: Mr. Fitzgerald, a microphone.

(Pause)

MR. FITZGERALD: Is this alright -- is this alright --

A VOICE: They're working on it --

MR. FITZGERALD: Okay? Good morning, gentlemen.

DR. ENSLIN: Good morning.

MR. WAKEFIELD: Good morning, Mr. Fitzgerald.

MR. FITZGERALD: Thank you for that helpful summary and I'm going to cover that same ground with you in just a little more detail. You've explained that the studies you did at the Council's request are of a type known as harmonic screening studies or they're also called frequency domain screening studies, right?

MR. WAKEFIELD: Yes.

MR. FITZGERALD: Okay. And before you did these studies, you had available the results of several frequency domain screening studies that had been performed by G.E., correct?

MR. WAKEFIELD: Yes.

MR. FITZGERALD: Now, studies of this type

use computer models of electrical systems to estimate certain characteristics of the system, true?

MR. WAKEFIELD: Yes.

MR. FITZGERALD: Okay. Now, you -- you didn't have available to you the computer model of the Southwest Connecticut electric system that G.E. had built because G.E. considered it proprietary and declined to make it available, right?

MR. WAKEFIELD: That's correct.

MR. FITZGERALD: So therefore, that -- in order to do a frequency domain screening study, you had to build a model of your own?

MR. WAKEFIELD: That's correct.

MR. FITZGERALD: And to do that you needed a great deal of information and data from the companies, CL&P and UI?

MR. WAKEFIELD: That's correct.

MR. FITZGERALD: And did they provide you with that information?

MR. WAKEFIELD: Yes, they did so. And they did so in a very timely fashion.

MR. FITZGERALD: Thank you. Now these -- the information that these harmonic screen or frequency domain screening studies provide indirectly relates to the

voltages that equipment at substations and switching stations may be required to withstand, is that right?

MR. WAKEFIELD: That's correct --

MR. FITZGERALD: Okay --

MR. WAKEFIELD: -- among -- I mean also the transmission lines themselves and also the customer equipment.

MR. FITZGERALD: Right, okay. Thank you. Now when electrical engineers speak of voltages on the electric system, do they distinguish between steady state voltages, transient over-voltages, and temporary over-voltages?

MR. WAKEFIELD: Yes, engineers do so.

MR. FITZGERALD: And could you give us a thumbnail explanation of the difference between those three different types of voltages -- or just tell us what those three different types of voltages are?

MR. WAKEFIELD: Sure. The third one was -- the first one was steady state voltages?

MR. FITZGERALD: Yeah, steady state, transient, temporary.

MR. WAKEFIELD: Okay. The steady state voltages -- did you refer only to voltages?

MR. FITZGERALD: Well -- only to voltages.

MR. WAKEFIELD: Yes. Steady state voltages are those that reside on the system under steady state normal operating conditions of the system.

Transient voltages are those that result from transient phenomena on the system, such as the sudden loss of a line, switching in of certain equipment, or the loss of equipment, or other changes in the equipment.

Temporary voltages are those that may result -- my understanding, may result from changes -- temporary changes on the system and they could -- they're not necessarily a response to a transient phenomena.

MR. FITZGERALD: And --

MR. WAKEFIELD: Dr. Enslin, would you agree with that --

DR. ENSLIN: Yes --

MR. WAKEFIELD: -- characterization?

DR. ENSLIN: -- those would typically be for a few cycles, consisting for a few cycles, maybe a second or two.

MR. FITZGERALD: I'm -- a temp -- a temporary --

DR. ENSLIN: A temporary voltage --

MR. FITZGERALD: -- over-voltage would be a few cycles or a second or two?

DR. ENSLIN: Yeah.

MR. FITZGERALD: And a cycle is a 60th of a second --

DR. ENSLIN: That's right --

MR. FITZGERALD: -- on a 60-hertz --

DR. ENSLIN: That's right --

MR. FITZGERALD: -- system like we have here, right?

DR. ENSLIN: That's right.

MR. FITZGERALD: Whereas -- what -- what are the time parameters for something that's transient but not long enough to be considered temporary?

DR. ENSLIN: Of course it's a gray area, you know, coming from a transient going into a temporary voltage and then eventually a steady state value. Transients would be very fast, but microseconds, less than a cycle definitely.

MR. FITZGERALD: Okay --

DR. ENSLIN: A temporary situation would be as I said a few cycles. And steady state would typically be minutes and hours --

MR. FITZGERALD: Fine --

DR. ENSLIN: -- a normal system operating condition.

MR. FITZGERALD: Now what these frequency domain studies actually model is not voltage but impedance, which is one of the compliments of voltage, is that right?

MR. WAKEFIELD: They do measure impedance --

MR. FITZGERALD: Yeah --

MR. WAKEFIELD: -- I wouldn't refer to it as a component of voltage.

MR. FITZGERALD: Okay. Well, volt -- excuse my terminology then -- but voltage equals current times impedance, right?

DR. ENSLIN: That's correct.

MR. WAKEFIELD: Yes.

MR. FITZGERALD: And what the frequency -- and the frequency domain analysis measures or estimates impedance?

MR. WAKEFIELD: That's correct.

MR. FITZGERALD: Okay. The electric transmission and distribution systems in North America of course operate at 60-hertz. And on the systems 60-hertz is called the fundamental frequency, right?

MR. WAKEFIELD: Yes.

MR. FITZGERALD: Okay. And the current

that is produced by electric generators is delivered to the generator bus at 60-hertz, right?

MR. WAKEFIELD: That's correct.

MR. FITZGERALD: But currents also flow on the system at other frequencies, which are multiples of the fundamental frequency, right?

MR. WAKEFIELD: That's correct.

MR. FITZGERALD: And these currents are called harmonic currents or harmonics for short?

MR. WAKEFIELD: Yes.

MR. FITZGERALD: Where -- where do harmonics come from?

CHAIRMAN KATZ: Briefly.

MR. FITZGERALD: They've been very concise.

MR. WAKEFIELD: Harmonics are -- originate with -- they originate with things that are phenomena on the system that are possibly transients or other types of temporary distortions, possibly equipment such as customer equipment or other power conversion equipment on the system that tends to have a different wave shape than a sinusoidal wave or possibly has components to the waveform that is at other than 60 cycles. And certainly any kind of step changes or distorted waveforms would have many different frequency components. And this is a

mathematical property of any particular wave shape you could anticipate in terms of voltage or current, that it could be broken down into many, many different harmonic frequencies.

MR. FITZGERALD: Um-hmm --

MR. PHILIP T. ASHTON: Would a -- would a large unbalanced, single-phase load cause harmonics?

MR. WAKEFIELD: Yes, I believe it would. Would you agree --

DR. ENSLIN: Say again. A single-phase --

MR. ASHTON: Would a large unbalanced single -- such as a single-phase load cause harmonics?

DR. ENSLIN: Maybe.

MR. ASHTON: So if you had a railroad for example -- a large railroad load, which might -- which is a single-phase load connected through a two-phase to three-phase transformer and there was an imbalance, that would show up as a harmonic?

DR. ENSLIN: Under certain conditions in the system, yes.

MR. FITZGERALD: Now to take the example that Mr. Ashton gave with the railroad, would you expect that harmonics produced by that source would be reflected in the steady state voltage analysis?

MR. WAKEFIELD: No, our analysis did not look at railroads as an input or that kind of a load in particular.

MR. FITZGERALD: Actually, I wasn't talking about this particular study --

MR. WAKEFIELD: Oh, I'm sorry --

MR. FITZGERALD: -- whether you looked at --

MR. WAKEFIELD: -- I misunderstood you --

MR. FITZGERALD: -- whether you looked at a railroad or not -- I mean if -- if a -- this relates to the question about the different types of voltages that are produced on the system and I was just asking whether harmonics from a railroad source would be relevant to steady state voltage harmonics?

MR. WAKEFIELD: No, I really -- I don't -- I don't think so. Not the type of frequency scan and harmonic impedance evaluation that we were performing, no.

MR. FITZGERALD: I'm not suggesting that you should have looked at a railroad in your scan, but -- first of all could I ask, Dr. Enslin, do you have any different answer to that question, as to whether harmonics from a railroad source would be --

DR. ENSLIN: A single-phase or a --

MR. FITZGERALD: A single-phase.

DR. ENSLIN: A single-phase railroad -- if the different -- single phases are connected at higher voltage level. And the primary -- well, we can go into detail, but it depends on the connections of the transformer -- in some cases the -- it will generate many third harmonic and ninth harmonic. Those harmonics may circulate inside a transformer. And some connections, depending on the connection of the transformers, those third harmonics can penetrate back into the higher voltage system.

MR. FITZGERALD: Okay. Okay in your report -- let's go back to what you did consider -- in your report you note that the two main sources of harmonic currents considered here are converter loads penetrating from the lower levels and the in-rush currents generating during the energization of power transformers. Could you tell us something about harmonic currents from the energization -- well, question withdrawn. Harmonic currents are generated from the -- are generated when a transformer is energized for the first time and put into service. Is that true?

MR. WAKEFIELD: Fair enough --

DR. ENSLIN: Yes.

MR. WAKEFIELD: Dr. Enslin will take that question.

MR. FITZGERALD: And also if it's taken out of service for maintenance and then it's re-energized, there would be harmonic currents associated with that startup?

DR. ENSLIN: Sure.

MR. FITZGERALD: And when you talk about in-rush currents, where -- where are those currents rushing -- (laughter) --

DR. ENSLIN: Well, if a transformer is set -- is energized, the flux of a transformer -- right, talk about the taking of -- but the flux of a transformer is not steady state because it's been set on -- you know, off the reconnection for a long time or whatever. So when you start in-rushing the current, the transformer may saturate because of the fact that the flux level and the point of wave where you connect the transformer to a system doesn't correspond and you may saturate -- or you will saturate the transformer when you switch it in. That will generate saturating magnetizing current, and that saturated magnetizing current then has dominantly harmonic components.

MR. FITZGERALD: Okay. Now, the

enerization of transformers resulting in this in-rush current, that can result in transient or temporary over-voltages?

DR. ENSLIN: Temporary over-voltages.

MR. FITZGERALD: Temporary, okay. And these transformer in-rush currents are also associated with the enerization of a transformer that occurs after fault clearing, right?

DR. ENSLIN: Yes, maybe.

MR. WAKEFIELD: Um-hmm.

MR. FITZGERALD: And when you have a fault, voltage can drop to zero where the fault is located?

DR. ENSLIN: Um-hmm.

MR. FITZGERALD: And the transformer is effectively de-energized while the fault is on the system?

DR. ENSLIN: (Answer not audible).

MR. FITZGERALD: And then if the fault is cleared by removing the faulted element from service, the voltage will return?

DR. ENSLIN: Yes.

MR. FITZGERALD: And that can happen to several transformers that are close together at the same time, right?

DR. ENSLIN: Sure.

MR. WAKEFIELD: It could.

MR. FITZGERALD: And when that happens, that will inject harmonic currents into the system?

MR. WAKEFIELD: Yes.

DR. ENSLIN: Yes.

MR. FITZGERALD: Under some circumstances such an event where a number of transformers are simultaneously re-energized after fault clearing, that could produce a lot of harmonic current on the system?

DR. ENSLIN: It's possible.

MR. WAKEFIELD: Yes.

MR. FITZGERALD: Okay. Now, the voltages that are -- let me focus on --

CHAIRMAN KATZ: Can I just interrupt, Mr. Fitzgerald. First, I'd like the witnesses to just speak up. And if you both agree, then both verbally please say yes. Nodding doesn't get picked up by the tape.

MR. WAKEFIELD: I guess smiling wouldn't get picked up either, would it. (Laughter).

MR. ASHTON: Mr. Fitzgerald, are you going to continue with this line because I have a question on transformer enerization where it's appropriate? I don't want to --

MR. FITZGERALD: Well -- any -- any

question that the Council has at anytime is appropriate --

MR. ASHTON: Well, I don't want to interrupt your train of thought --

MR. FITZGERALD: No, that's --

MR. ASHTON: -- or have --

MR. FITZGERALD: I have it written down here, so it doesn't matter. (Laughter).

MR. ASHTON: I have two questions that relate to this very thing. Mr. Fitzgerald asked a question concerning enerization of a transformer during fault conditions. Wouldn't it also be likely that a transformer associated with a generator step-up would be energized as that unit was called into service or removed from service in that the transformer may well be switched out or switched in as the unit comes on or comes off-line?

MR. WAKEFIELD: Yes.

DR. ENSLIN: Yes.

MR. ASHTON: So that's another source of harmonics not related to fault current per say?

MR. WAKEFIELD: That's correct.

DR. ENSLIN: Yes.

MR. ASHTON: Now, suppose a transmission line were taken out of service for maintenance not under fault conditions, when that line is opened or re-

energized, would there not be harmonics present on the system at the time of closing or opening of a breaker?

DR. ENSLIN: This is on a scheduled maintenance condition --

MR. ASHTON: Yeah. You know, I've got some insulator strings to replace --

DR. ENSLIN: Yeah --

MR. ASHTON: -- I want to change the SAG in the line, paint the towers, you name it.

DR. ENSLIN: Sure. Yes, it's possible.

MR. ASHTON: Okay, thank you. Those are my two questions, Mr. Fitzgerald, thank you.

MR. FITZGERALD: Okay. Now the -- in the harmonic screening analysis that you performed, you did not nor were you asked to consider any system contingencies?

DR. ENSLIN: No.

MR. WAKEFIELD: That's correct.

MR. FITZGERALD: So that you did not examine -- or question withdrawn. You did not in those studies seek to estimate the impedances that would be produced by enerization of transformers after faults?

MR. WAKEFIELD: That's correct.

DR. ENSLIN: That's correct.

MR. FITZGERALD: Basically, you looked at the normal operating conditions of the intact system?

MR. WAKEFIELD: That's right, under steady state normal conditions.

MR. FITZGERALD: Thank you.

CHAIRMAN KATZ: Mr. Wakefield, are these contingency studies something that the utility would need to do?

MR. WAKEFIELD: They might in association with looking at maintenance actions and also in looking at the recovery from certain key faults. They -- such contingency studies are not part of a routine screening analysis of harmonic impedances.

CHAIRMAN KATZ: But to fully evaluate the KEMA proposal for up to 20 miles of undergrounding, we have indicated by previous testimony that TNAs need to be done. Are these contingency studies something that also need to be done to fully evaluate whether up to 20 more miles of undergrounding is feasible?

MR. WAKEFIELD: I would say yes in conjunction with the transient network analysis.

CHAIRMAN KATZ: Thank you.

MR. ASHTON: Would you also want to evaluate the system under a blackout scenario, such that

we've had in my lifetime a half a dozen significant blackouts? And the issue of restoring the system then gets to be a bit hairy because you can get into a situation of over-voltages and so forth, transient conditions. Wouldn't that be a circumstance that would deserve some consideration in the kind of work we're talking here?

DR. ENSLIN: Well, I think -- of course you have to do blackout restart procedures and that has to be done for any system. What I think we've done here of course is nothing, you know, in that order. This was a first screening result --

MR. ASHTON: Yeah --

DR. ENSLIN: -- harmonic analysis result in order to determine how much undergrounding we can put under ground.

MR. ASHTON: But -- okay, fairly stated and fairly accepted. But wouldn't -- going beyond that, wouldn't you want to take a look at how you restore a system after blackout conditions assuming the system is flat and you've got to bring power in from the outside? Wouldn't that be a concern that you'd --

DR. ENSLIN: Oh, yes --

MR. ASHTON: -- want to give due credence

to?

DR. ENSLIN: (Indiscernible) --

MR. ASHTON: Thank you.

MR. WAKEFIELD: Absolutely. And --

DR. ENSLIN: Absolutely. And it has to be for any system --

MR. ASHTON: Yes --

DR. ENSLIN: -- overhead lines, whatever.

MR. ASHTON: I understand that.

MR. WAKEFIELD: And I believe cable systems are very tricky with regards to restoration. New York City provides a very good example of that, the Consolidated Edison system. Bringing that system back, as the restoration from the last blackout in August of 2001 would show -- was it 2001 --

A VOICE: (Indiscernible) --

MR. WAKEFIELD: 2002, okay. It was a massive undertaking and much slower than what was anticipated for overhead portions of the system, so --

MR. ASHTON: I had personal and direct experience with the '65 blackout, so someday in another hearing I'll testify to that.

MR. COLIN C. TAIT: How about the '44 one -- (laughter) --

MR. ASHTON: No, that one -- you were involved with that -- (laughter) --

CHAIRMAN KATZ: Back to you, Mr. Fitzgerald.

MR. FITZGERALD: Thank you. The lawyers are very sensitive to words and the Chairman referred to KEMA's proposal. Now, I -- I don't understand what you studied in your report to represent a proposal that KEMA has made. As you said, it's -- you've done a first screen of one measure of acceptability of certain configurations. You've not made any proposal of any kind, have you?

MR. WAKEFIELD: No, we have not. We have -- we have drawn conclusions based on the study that we did make and we have made recommendations for addition study. We have -- the conclusions we have drawn are based on the studies we have made and that's all.

MR. FITZGERALD: Alright. Now on this point of contingency analysis, a frequency domain screening analysis can be constructed that looks at contingencies and a transient network analysis, which is another kind of study that's been mentioned, also can be constructed that will look at contingencies, right? Two different -- two different types of studies, but each can be modeled -- or each can be constructed to model

contingencies?

MR. WAKEFIELD: Absolutely.

DR. ENSLIN: Yes.

MR. FITZGERALD: Okay. And let me -- although you did not do and you were not asked to do a transient network analysis, and you've been very clear about the fact that anything that was going to be built would require such an analysis, let me ask you some questions about transient network analyses in general so that we can all understand what they are. And you -- you are quite familiar with such studies and you -- it's something that you have done in other circumstances, right?

MR. WAKEFIELD: Yes, our company has done so. And those of us who prepared this report have been involved in such studies.

MR. FITZGERALD: Right.

COURT REPORTER: One moment please.

(Pause).

MR. FITZGERALD: Can I say T -- will I get in trouble if I say TNA for short to refer to --

A VOICE: That's fine --

MR. FITZGERALD: -- transient network analysis -- thank you --

A VOICE: (Indiscernible) --

MR. FITZGERALD: No, I didn't -- (laughter) -- a TNA models the electric system in more detail than a harmonic screening analysis, right?

DR. ENSLIN: Yes.

MR. WAKEFIELD: That's correct.

MR. FITZGERALD: And a TNA allows assimilation of discrete events that produce voltages and measures what the resulting voltages from those events would be?

DR. ENSLIN: Yes.

MR. WAKEFIELD: (Indiscernible) --

CHAIRMAN KATZ: Can we have a verbal response.

DR. ENSLIN: Yes.

MR. WAKEFIELD: The answer was yes. And I'll try not to shake my head -- (laughter) --

MR. FITZGERALD: Okay. Now, these -- these TNA studies are much more elaborate and time consuming than a frequency domain analysis, correct?

DR. ENSLIN: Yes.

MR. WAKEFIELD: Yes.

MR. FITZGERALD: So -- so as you've already told us, harmonic screens are often used as gate type

studies, as a -- sort of a first analysis to help engineers and planners evaluate whether a particular configuration is worth investigating further with a TNA?

MR. WAKEFIELD: Certainly. As a starting point you want to look at steady state conditions and see whether there are problems -- resonance problems on the system to begin with. Then you have to go to the next step, which is to look at various different transient situations and whether there are problems associated with those transients and also whether those problems can be mitigated in some effective way.

MR. FITZGERALD: Right. Thank you. Okay. We'll probably talk about TNAs a little bit more later, but let me come back now to the work that you actually did to your frequency domain scan.

After you constructed your model of the Southwest Connecticut system using the data that you got from the companies, you ran a harmonic scan for you called the Phase 2 base case, right?

DR. ENSLIN: Yes.

MR. FITZGERALD: So let's -- let's make sure that everybody knows what we're talking about when we mention the Phase 2 base case. This was a model of the Southwest Connecticut system as it exists today, plus some

additions. Right so far?

MR. WAKEFIELD: Yes.

DR. ENSLIN: Yes.

MR. FITZGERALD: And what you added to the system as it exists today was the Bethel to Norwalk project built as approved by the Siting Council but with only one of the two cables in operation under most circumstances?

DR. ENSLIN: We -- we actually studied both situations, with one cable in and with two cables in.

MR. FITZGERALD: And with two -- okay. And you also added for the base case the Middletown to Norwalk project with 25 miles of XLPE underground cable between Norwalk and East Devon?

MR. WAKEFIELD: Yes. As a substitute for what had -- for what was proposed in the original proposal by the Applicants as being HPFF cable.

MR. FITZGERALD: Right.

DR. ENSLIN: Yes.

MR. FITZGERALD: You know, we're always talking about miles of cable. And we tend and the Siting Council here to talk about linear miles, you know, what you see, but in fact you modeled 48 circuit miles of cable because you had two complete circuits for this 24-mile

stretch, right?

MR. WAKEFIELD: That's correct.

MR. FITZGERALD: Okay. Now, you found when you modeled the case, that Phase 2 base case, that your results agreed closely with those that G.E. had reported for the same system configuration?

MR. WAKEFIELD: Yes, relatively close.

DR. ENSLIN: Yes.

MR. FITZGERALD: Okay. Then you made a -- you made a change to the assumptions that you used in your model related to the load, right?

DR. ENSLIN: Well --

MR. WAKEFIELD: We did study different loading levels, yes.

MR. FITZGERALD: Well, okay. And you -- let me go back a step. When you -- either from running those studies or in some other way you determined that in the G.E. studies G.E. had not included any modeling of customer load. Is that right?

MR. WAKEFIELD: No, I don't believe so. I believe we were informed in response to a discovery by the Connecticut Siting Council, which we had prepared, that G.E. had -- I have a copy of it here somewhere -- the interrogatory response was that G.E. had included some

load for the purposes of damping, but the company -- even though we had requested information, specific information about the load, they were not forthcoming in telling us what the load was or what loads were used. And that's all we know about the load modeling that G.E. did. But we were informed that G.E. did include load for the purpose of damping.

MR. FITZGERALD: Gee, I thought that --

MR. WAKEFIELD: I think I have a copy of it here --

MR. FITZGERALD: Mr. Enslin, is that your -- is that your recollection as well?

DR. ENSLIN: Yes.

MR. WAKEFIELD: I have a copy if you -- I'm amazed I could find it this rapidly -- the witness was Alan Scarfone --

MR. FITZGERALD: Um-hmm.

MR. WAKEFIELD: Would you like me to read the answer that was provided by the Applicant --

MR. FITZGERALD: Sure -- sure, go ahead --

MR. WAKEFIELD: Yes --

MR. FITZGERALD: -- while I'm looking for something else.

MR. WAKEFIELD: We had requested load data

in megawatts and mega-VARS that G.E. incorporated into the EMTP model to provide damping. The response was that the studies performed by G.E. are not load flow studies, which we actually knew -- that's parenthetical, sorry about -- they are switching and frequency analyses based upon an electromagnetic transient program, EMTP, model. G.E. incorporated the load in the model to provide damping, but megawatt and mega-VAR loads are not specifically modeled as they are in the load flow model. In a similar fashion generators not modeled with a megawatt or mega-VAR output. The generators are either in-service or out-of-service as described in the referenced report.

MR. FITZGERALD: Okay. Now let me -- that could turn out to be helpful. Let me direct your attention to page 27 of your report and you say the network -- right at the top of the page, you say the network model in Aspen (phonetic) format provided by the Applicant did not contain load data -- I may be misunderstanding this --

MR. WAKEFIELD: Oh, yes, that -- that is a reference to the Aspen model that was provided to KEMA to help KEMA develop in relatively short order a model of the Southwest Connecticut -- or basically it's more than Southwest Connecticut, but the Connecticut transmission

system. These were not G.E. studies or a G.E. model -- at least I don't believe --

MR. FITZGERALD: Okay --

MR. WAKEFIELD: -- I don't know where the Aspen model initially -- what it initially resulted from. My -- my assumption had been that it was something the Applicant in conjunction with consultants had developed over time.

MR. FITZGERALD: Well when you --

MR. WAKEFIELD: But no loads were provided. It was a model of the electrical system. Then loads would be applied to that electrical system and also generation and you would get power flows and system performance that could be observed.

MR. FITZGERALD: Okay. So -- I have a recollection from reading your report and I can't put my thumb on it right now, but that you ran some results of the base -- you ran a base case and got results that closely agreed with G.E.'s and then you did something and got better results. This is before you put the C-filters in. And did you -- did you make some adjustment to the load that yielded better results is my --

MR. WAKEFIELD: Well actually --

MR. FITZGERALD: And -- excuse me -- and

we're talking about -- just for the Council's elucidation, we're talking about customer load here and not -- not --

A VOICE: System load --

MR. FITZGERALD: -- not system load.

MR. WAKEFIELD: That -- that's correct. We did -- I'm not sure if I understand completely what you're referring to. We -- initially we looked at full load or peak load conditions because our source of load information as stated in the report were -- or rather was a specific power flow case that was run by the system that showed the system under maximum stress. We also wanted to look at the effect of lower loads. And we looked at initially a hundred percent load case and a 50 percent load case. We subsequently then decided to look also for selected cases at a 70 percent load level because we thought that was the most credible load level at which you would have a minimum level of generation in service locally and all -- still have all capacitors switched in.

MR. FITZGERALD: Um-hmm.

CHAIRMAN KATZ: Mr. Fitzgerald, do you need two minutes off the record to frame your question?

MR. FITZGERALD: I don't think so.

CHAIRMAN KATZ: Okay. It looked like you were still searching for your reference.

MR. FITZGERALD: Well, yeah, I am, but I'm -- (laughter) -- but I appreciate the suggestion, thank you. I'm sorry, did you finish your answer, Mr. Wakefield?

MR. WAKEFIELD: Yes, I did.

MR. FITZGERALD: Okay. Now, load has a damping effect -- or does load have a damping effect on impedances?

DR. ENSLIN: Yes. Mainly at the lower harmonics.

MR. FITZGERALD: Okay. And are there different types of load that have different characteristics from the standpoint of impedances and harmonics?

MR. WAKEFIELD: Yes.

MR. FITZGERALD: And I have a list here of motor loads, resistive loads, electronic loads, and discharge lighting loads. Does that pretty much cover it?

DR. ENSLIN: (Indiscernible) --

MR. WAKEFIELD: Are we missing anything there?

DR. ENSLIN: No.

MR. FITZGERALD: Are the damping characteristics of these types of load different?

DR. ENSLIN: Well, the damping is mainly associated with the resistive part of the load.

MR. FITZGERALD: And -- and the resistive component of these different types of load is different from one to the other, right?

DR. ENSLIN: Sure.

MR. FITZGERALD: So if you are looking at or trying to assess what the damping effect of a load may be, not just the magnitude of the load but the composition of the load could be relevant?

MR. WAKEFIELD: Could be -- I'm sorry?

MR. FITZGERALD: It could be relevant?

MR. WAKEFIELD: It could be relevant?

MR. FITZGERALD: Yes.

MR. WAKEFIELD: Yes, it could.

MR. FITZGERALD: Okay. Now, the -- the data that you had to work with from the thermal load flows used in the NEPOOL load forecast did not distinguish between the different resistive characteristics of different types of load, did it?

MR. WAKEFIELD: The load data that we used included megawatt loads or real and also reactive loads.

MR. FITZGERALD: Yes, but aren't all of the four kinds of loads that I previously enumerated reactive

loads?

MR. WAKEFIELD: They are either real or reactive or a combination of the two -- they may have components of both, yes.

MR. FITZGERALD: Right -- yeah, right -- I'm sorry, yes. And so -- but that -- that data didn't tell you what portion of the load was resistive --

DR. ENSLIN: It did --

MR. FITZGERALD: -- and what portion was not, did it --

DR. ENSLIN: It did.

MR. FITZGERALD: Were you able -- did that -- did that tell you -- so you're saying that it wouldn't make any difference -- question withdrawn.

The thermal load flow data does not distinguish between purely resistive loads and motor loads, does it?

MR. WAKEFIELD: It does -- I'm sorry, could you repeat that question please.

MR. FITZGERALD: The thermal load flow data does not distinguish between purely resistive loads and electronic loads?

DR. ENSLIN: Electronic loads?

MR. FITZGERALD: Yeah -- or --

DR. ENSLIN: Electronic --

MR. FITZGERALD: -- motor -- I'm sorry, I'm sorry, I meant to say motor loads --

DR. ENSLIN: Motor loads --

MR. FITZGERALD: -- yeah --

DR. ENSLIN: Well, the motor loads are incorporated in the reactive and active portions of those loads --

MR. FITZGERALD: Yes --

MR. ASHTON: Can I ask for a short timeout in the sense that we've been throwing terms around here that I think are new to the Council. The term resistive is understood and that would be analogous to a load of a light bulb, is that not correct?

DR. ENSLIN: That's right. That's something that heats up.

MR. ASHTON: Okay. We've used the term real and reactive. Real is synonymous more or less with resistive load?

DR. ENSLIN: Yes.

MR. ASHTON: Okay. And I forget what the other term was, but there was another one that was buzzing around here --

A VOICE: (Indiscernible) -- motor --

MR. ASHTON: I'm sorry?

A VOICE: Modem or some --

MR. ASHTON: Motor -- motor load? A motor load is made up of a component of resistive load, and that's the power that's being delivered to the shaft. And reactive load, that's the energy that's dissipated in the magnetizing effect. Is that fair to say?

DR. ENSLIN: It's not dissipated --

MR. ASHTON: Well, it's involved with it, I'll put it that way. I don't mean to be --

DR. ENSLIN: Sent back and forth --

MR. ASHTON: -- I'm trying to put it in Council's terms --

DR. ENSLIN: Sure --

MR. ASHTON: -- Council parlance. Is that fair to say?

DR. ENSLIN: Yes.

MR. ASHTON: Okay. Why don't we go on, but I wanted to make sure there was no confusion between real, imaginary, and all the rest of it. (Laughter).

MR. FITZGERALD: If you have a megawatt of motor load --

A VOICE: Mother --

MR. ASHTON: Motor.

MR. FITZGERALD: -- and a megawatt of purely resistive load, they will have different damping characteristics?

DR. ENSLIN: Under steady state conditions, no.

MR. FITZGERALD: Okay. How about for the purpose of harmonics and transients and temporary voltage analyses?

DR. ENSLIN: Harmonics -- there will be harmonics, which of course you didn't model yet.

MR. FITZGERALD: Okay.

A VOICE: Bring that mic up a little bit more.

DR. ENSLIN: Sure.

MR. FITZGERALD: Now, can a proportion of these different types of load and the total customer load change over time?

DR. ENSLIN: Yes.

MR. FITZGERALD: And how would you expect Connecticut's load composition to change going into the future?

DR. ENSLIN: First of all, you have daily changes -- daily changes --

MR. FITZGERALD: I'm sorry, could you --

DR. ENSLIN: Daily changes.

MR. FITZGERALD: Daily changes, yes, okay.

DR. ENSLIN: And then you have growth, annual growth, summer and winter variations.

MR. ASHTON: Would you have seasonal changes too?

DR. ENSLIN: Yes.

MR. WAKEFIELD: And I think one thing that you also may be alluding to is --

CHAIRMAN KATZ: Well --

MR. WAKEFIELD: -- is a change in the composition of the load.

CHAIRMAN KATZ: Right.

MR. FITZGERALD: Yes. That actually was my question.

CHAIRMAN KATZ: Mr. Wakefield, don't anticipate -- (laughter) --

MR. FITZGERALD: Well, he wasn't -- he wasn't anticipating, he was interpreting. That was -- that was the question I meant to ask.

MR. WAKEFIELD: I believe you did ask what changes would you anticipate --

MR. FITZGERALD: Yeah -- yes --

MR. WAKEFIELD: -- in the load, yes.

MR. FITZGERALD: Yeah. And -- and so in terms of electronic load, purely resistive load, motor load, going into the future, if you do have an expectation, how would you expect to see the composition of the overall load change?

DR. ENSLIN: I think it would change more electronic-wise, if we want to say that. Meaning that the motor loads would be changed by drives, electrical drives. We'll see more active rectifiers, meaning equipment which is electronically processing the power.

MR. FITZGERALD: Um-hmm. Okay. In your report when you were discussing the maximum under the undergrounding configuration that would have included underground cable all the way to Beseck, you stated that no contingency analysis has been performed, but that it is -- but it is expected that with some lines out of service, the first resonance point will be reduced to lower values. And you found that therefore undergrounding of the entire Devon to Beseck corridor appeared to be a risky choice from a reliability perspective. How is it that even without doing a contingency analysis, you were able to expect that with some lines out of service, the first resonance point would go lower than it appeared in the all lines in analysis?

MR. WAKEFIELD: Could I ask first that you identify the place in our report you're referring to?

MR. FITZGERALD: Sure. Page 67.

MR. WAKEFIELD: Thank you.

MR. FITZGERALD: And --

MR. WAKEFIELD: Are you --

MR. FITZGERALD: -- under -- it's the paragraph under Figure 15.

MR. WAKEFIELD: Do you want to do it or --

MR. FITZGERALD: That's the -- that's the first reference.

(Witnesses conferring)

DR. ENSLIN: Do you want to do it or --

MR. WAKEFIELD: Why don't you go ahead and take it --

DR. ENSLIN: Okay --

CHAIRMAN KATZ: Are we off the record for a moment?

MR. FITZGERALD: Sure.

(Off the record)

CHAIRMAN KATZ: Uh --

MR. FITZGERALD: We need a quorum.

CHAIRMAN KATZ: We'll take a moment.

(Off the record)

CHAIRMAN KATZ: Mr. Wakefield, do you have an answer to the question? Do you want anything repeated?

MR. WAKEFIELD: The -- just the basic question please, Mr. Fitzgerald, if you're willing.

MR. FITZGERALD: Sure. And maybe I can simplify it, which is how is it that you expected that at least with respect to the case you were talking about at page 67, that although no contingency -- no contingencies had been run in the model, that if lines were out, the harmonic resonance would be lower than that which you modeled with all the lines in?

MR. WAKEFIELD: Simply, it's related to -- what we're speculating on is an increase -- a greater weakness of the system when key lines are lost. And the specifics I'm going to ask Dr. Enslin to comment on.

DR. ENSLIN: Yes. I think in general when a system with some of the lines out, you move -- in this particular system of course closer to the Phase 1 situation. And it -- we showed in our results actually that in Phase 1 you -- in basically a weaker system you have -- you have higher resonance peaks than with Phase 2. So we expect moving back the direction, that still have the capacitors -- some of the capacitors in line, a weaker system, that both the impedance value will go up at

different frequencies and the resonance may -- how much we don't know, but it may drop lower.

MR. FITZGERALD: Okay. Now, getting back again to the TNA studies, they can be focused specifically on over-voltages following faults with lines out, right? And --

CHAIRMAN KATZ: Wait a minute, I don't think you got an answer to that question.

MR. FITZGERALD: Oh, I'm sorry. Thank you. Do you both agree with that statement?

DR. ENSLIN: Yes.

MR. WAKEFIELD: Yes.

MR. FITZGERALD: And you would expect that such studies would provide information about temporary over-voltages to -- in system equipment would be exposed and harmonic screens would not?

DR. ENSLIN: Yes.

MR. FITZGERALD: And that's --

MR. WAKEFIELD: Yes, I agree.

MR. FITZGERALD: And that's particularly true of harmonic screens that were performed without contingency analysis?

DR. ENSLIN: Yes.

MR. FITZGERALD: Okay. Even transient

network analyses, these elaborate and detailed studies will not model all of the events that could produce temporary over-voltages on the system, will they?

MR. WAKEFIELD: No --

DR. ENSLIN: Yes --

MR. WAKEFIELD: -- they won't.

MR. FITZGERALD: Even with those types of studies, you're still talking about modeling a selection of a huge number of possible conditions that could occur?

DR. ENSLIN: Yes.

MR. WAKEFIELD: That's right.

MR. FITZGERALD: Okay. And is it -- is it the case that constructing and running a model for a transient network analysis requires the exercise of engineering judgment in several instances?

MR. WAKEFIELD: Absolutely.

DR. ENSLIN: Yes.

MR. FITZGERALD: And so -- and you -- and is it for this reason in part that you mentioned earlier that if you were to do a transient network analysis of this system, it would require close collaboration and it's not something that can be done at arm's length?

DR. ENSLIN: Yes.

MR. WAKEFIELD: Yes. For example, just the

modeling of a particular transformer and its non-linear characteristics would require direct interaction. And also the exercise of this engineering judgment is best done in a collaborative fashion as well.

MR. FITZGERALD: Alright --

CHAIRMAN KATZ: Can --

MR. FITZGERALD: -- now when --

CHAIRMAN KATZ: Can I interrupt while we're on that thought? How long does this collaborative effort usually take? Are we talking weeks, months?

MR. WAKEFIELD: I think we're talking months --

DR. ENSLIN: Yeah --

MR. WAKEFIELD: -- months --

DR. ENSLIN: -- a typical study of this nature may take months.

CHAIRMAN KATZ: Thank you.

MR. FITZGERALD: The --

MR. ASHTON: And to be -- and to be specific, six months would not be out of line, would it not?

MR. WAKEFIELD: No.

DR. ENSLIN: For an extensive system like this, no, it wouldn't be out of line.

MR. FITZGERALD: And when you get to the end of the line on such a study --

CHAIRMAN KATZ: No pun intended --

MR. FITZGERALD: -- well actually, let me -- let me -- (laughter) -- let me interrupt myself -- there are different levels of detail for TNAs, aren't there? I mean just as -- just as there are harmonic screening studies, you could have a fully detailed TNA or you could have -- you could do TNA screens looking at say a dozen worse case conditions that did not model, fully model the system? I mean --

MR. WAKEFIELD: That's true.

DR. ENSLIN: Yes.

MR. FITZGERALD: They'd have different values, they'd have different levels of utility, but it's not necessarily the case that any kind of -- there's only one kind of TNA and that's a full TNA of the whole system under all conditions?

DR. ENSLIN: But -- but that may take very long as we indicated.

MR. FITZGERALD: Yeah. But in any event, a necessarily when a TNA modeled is a specific system with a specific set of components --

DR. ENSLIN: Yes.

MR. WAKEFIELD: That's correct.

MR. FITZGERALD: And -- and so a TNA of today's system with a defined set of additions to it will not provide very much information about the voltage performance of the system after other additions might be made in the next five, ten, or fifteen years?

MR. WAKEFIELD: Well, it -- true if those additions very significantly change the nature of that system. But otherwise, the changes in the systems tend to be more evolutionary and it's more gradual that the -- in other words, the results might continue to be valuable for some period of time --

MR. FITZGERALD: Right --

MR. WAKEFIELD: -- but over a period of time as the system composition and design changes or evolves, then the transient network analysis should be repeated, especially if there are some signs of problems.

MR. FITZGERALD: Okay.

MR. BRIAN O'NEILL: As a follow-up to that statement, a TNA study of Phase 2 would have to be dependent on Phase 1 of the system, 217 would reflect 272, would it not?

DR. ENSLIN: Yes.

MR. WAKEFIELD: Yes, it would.

MR. O'NEILL: And as it is yet unbuilt, how thorough would that detail be on that TNA analysis of Phase 2?

DR. ENSLIN: It depends on the modeling of that specific Phase 1 section, how accurate that is.

MR. O'NEILL: And as it is yet unbuilt, would the reliance on that theoretical performance data from Phase 1, could we say with certainty that the TNA of Phase 2 would be necessarily reliable information or would it have a degree of variation?

DR. ENSLIN: There is a degree of uncertainty.

MR. ASHTON: Is that true where the parameters of Phase 1 are known and defined? In other words, the type of construction in Docket 217, that approval defined precisely where overhead lines exist, how long, what kind of configuration they would be in, and where undergrounds exist -- an underground line exist, and what type of underground line, given that information, doesn't that substantially reduce the uncertainty?

DR. ENSLIN: Yes.

MR. WAKEFIELD: Yes, it does.

MR. O'NEILL: Thank you.

CHAIRMAN KATZ: Back to you, Mr.

Fitzgerald.

MR. FITZGERALD: Thank you. There's -- I'd like to ask you a question about one of the graphs in your report, which is Figure 13. And I think if people don't have their reports with them, we could project it.

CHAIRMAN KATZ: Please project it. I don't expect every member of the audience to carry around their file. It's probably still under their pillow. (Laughter).

(Pause)

MR. FITZGERALD: Okay --

A VOICE: Bring it up a little bit --

MR. FITZGERALD: Now --

CHAIRMAN KATZ: Just for the record again, what figure is this?

MR. FITZGERALD: Figure 13.

CHAIRMAN KATZ: Page?

MR. FITZGERALD: It's on page --

A VOICE: 65 --

MR. FITZGERALD: -- 65.

CHAIRMAN KATZ: Thank you.

MR. FITZGERALD: This graph displays -- this figure displays in graph form some of the results that your frequency domain scans produced?

MR. WAKEFIELD: That's correct.

MR. FITZGERALD: And if I read this correctly, across the bottom of the page -- the axis across the bottom of the page is the harmonic number, the first point of -- or the harmonic resonance number, is that right?

MR. WAKEFIELD: That's correct.

MR. FITZGERALD: And going up the page, the vertical axis is the impedance that you measured in ohms. And the particular focus of interest here was where the -- or how high the impedance value would be at the third harmonic?

MR. WAKEFIELD: Actually, I would say we would be interested in how high the impedance value would be anywhere between the second and third harmonic and to even -- so -- so not just at the third harmonic alone --

MR. FITZGERALD: Okay --

MR. WAKEFIELD: -- because again the results of any study with a model are not precise, so --

MR. FITZGERALD: I understand. Okay. So the blue -- the blue line was the Phase 2 base case. The red line is that case with 15 additional miles of underground but no mitigation. And the yellow line -- I'm sort of getting ahead of myself by talking about the C-

filters here -- but the yellow line is the additional 15 miles of underground plus C-filters replacing capacitor banks at selected substations, right?

MR. WAKEFIELD: That is correct.

MR. FITZGERALD: And those C-filters were tuned to the third harmonic or assumed to be tuned to the third harmonic?

DR. ENSLIN: Yes.

MR. WAKEFIELD: Yes, they were.

MR. FITZGERALD: Now if we -- and if we look at the graph and look at the point where the three lines cross the third harmonic axis, isn't the -- isn't the yellow line, which shows the mitigation, isn't that at or a little bit above the other two?

DR. ENSLIN: It's about at the same value.

MR. WAKEFIELD: I'd say it's about at the same line, same level as the blue curve, which is the Phase 2 base case --

MR. FITZGERALD: Yeah --

MR. WAKEFIELD: -- and it is a little bit lower than the peak of the case with additional undergrounding with no mitigation.

MR. FITZGERALD: Okay. So --

CHAIRMAN KATZ: Is it within the accuracy -

- I mean this table is -- is it displayed within the accuracy of the model?

MR. WAKEFIELD: Yes.

DR. ENSLIN: Yes.

MR. FITZGERALD: Okay. So does that -- does that show that the performance is improved by the addition of C-filters?

MR. WAKEFIELD: Yes, it does.

MR. FITZGERALD: Why?

MR. WAKEFIELD: It shows, first of all, that the peak -- the first harmonic peak occurs at above 3.0. It also shows that the level of the C-type filter case is lower than the peak for the case with additional undergrounding but no mitigation. And I think between the second and third harmonics, which are a case of considerable concern because cases that approach the second harmonic are of the greatest concern, we know of significant damping associated with the filter action between the second and third harmonics, so the concern is what happens if these are to shift towards the second harmonic. Dr. Enslin, do you want to comment further on that, or --

DR. ENSLIN: Yes. I -- I think if you look at the graph with the extended undergrounding, we're not

worse off than with base case within the accuracy of the model.

CHAIRMAN KATZ: So harmonic impedance-wise --

DR. ENSLIN: For the extended undergrounding --

CHAIRMAN KATZ: Right --

DR. ENSLIN: -- showing the yellow line --

CHAIRMAN KATZ: Right --

DR. ENSLIN: -- the blue line, the so-called base case, the impedances cross at about the same value for the third harmonic.

CHAIRMAN KATZ: With 15 additional miles --

DR. ENSLIN: That's right. But that's with 30 -- well 20 actually -- 20 additional extra miles.

CHAIRMAN KATZ: Uh -- I believe this table --

DR. ENSLIN: I'm sorry, it's 15 miles, yeah, that's right.

CHAIRMAN KATZ: Yes, this table is 15 --

DR. ENSLIN: Fifteen miles extended undergrounding. So with 15 miles extended undergrounding, you get -- at the third harmonic you get around the same impedance value compared to just the base case without any

extended undergrounding. So what you buy here is a bit of margin to actually do that extra underground.

CHAIRMAN KATZ: Thank you.

MR. ASHTON: Is the difference here sufficient to be really meaningful given the fact that the impedance study is pretty broad brush --

DR. ENSLIN: Well --

MR. ASHTON: -- is this the kind of thing you would really want to go to a transient network analysis study for to confirm?

DR. ENSLIN: Yes, you would definitely want to do a TNA.

MR. WAKEFIELD: And I believe there's one other thing you would want to do, and that is that -- KEMA because of the time limitations and so on --

MR. ASHTON: Yeah --

MR. WAKEFIELD: -- was not able to optimize either the location of the C-type filters or the precise tuning of those filters. So that it's quite possible that some re-tuning of the filters and changes in their location could cause the level of the impedance at the third harmonic, if that becomes the biggest concern, to shift further to the right. Again, I would say that having it lower, significantly lower than either of the

curve between the second and third harmonic is of significant value as well.

MR. ASHTON: Would it be reasonable to say that this study as you have done it is indicative rather than definitive?

MR. WAKEFIELD: Yes.

MR. ASHTON: Thank you.

CHAIRMAN KATZ: And what steps does one take to go from indicative to definitive?

MR. WAKEFIELD: Two steps. One would be a more extensive harmonic impedance evaluation, looking at some of the issues that we just discussed, different -- greater attention to the design of the filters and location of the filters, possibly even looking at some contingencies that would be expected to occur over extended periods as opposed to contingencies that would be of a short nature. Otherwise, the other steps would be to proceed into the transient network analysis. And honestly given the importance of this line and its being built, and I'm talking Phase 2 here, I would suggest that those things probably should go in parallel with one another.

CHAIRMAN KATZ: So when you -- we talked about this six-month window that might be necessary to do the TNAs, this could be part of that six-month window if

they're on parallel tracks?

MR. WAKEFIELD: Yes, it could. But I think that that six-month window has already begun on the transient network analysis or at least we're going to find that out next week I understand.

CHAIRMAN KATZ: Yes, stay tuned. Thank you.

MR. FITZGERALD: Getting -- getting back to Figure 13, again these -- the results that are displayed in Figure 13 are results for normal operation of the intact system?

DR. ENSLIN: That's correct.

MR. WAKEFIELD: Yes.

MR. FITZGERALD: And it tells us nothing about the performance of the system under contingency conditions?

MR. WAKEFIELD: No, it doesn't.

DR. ENSLIN: No.

MR. FITZGERALD: For instance, it could be that in the event of a contingency, the curves would all move to the left, so you'd get that high peak of the yellow line on the third -- or between the second and third? You don't know?

DR. ENSLIN: We don't know.

MR. FITZGERALD: Okay. Do you -- do you know of any instance in which C-filters have been added to a system specifically to maximize the amount of underground cable that can be introduced into the system?

DR. ENSLIN: Not for that purpose, main purpose I would say.

MR. FITZGERALD: I mean that's -- that's generally not a design goal, is it?

DR. ENSLIN: Well, it can be. In this case it definitely is.

MR. FITZGERALD: Oh, yes. I'm talking about -- yes, in this case it definitely is. But have you been involved in other assignments in which the goal of the assignment was to maximize the underground portion of a land-based transmission system?

MR. WAKEFIELD: I have not.

DR. ENSLIN: Not in direct relations with this project.

MR. FITZGERALD: Can I have a moment please?

CHAIRMAN KATZ: Yes. Off the record.

(Off the record)

MR. FITZGERALD: No further questions.

CHAIRMAN KATZ: Thank you. Next is -- I'm

going to read the whole list since we don't know who is interested in crossing on this and who is not -- State Representative Robert Megna? Not present. Representative Al Adinolfi, do you have questions for these witnesses?

A VOICE: (Indiscernible) --

CHAIRMAN KATZ: Representative Adinolfi says no. The Town of Middlefield, Attorney Knapp?

A VOICE: No questions.

CHAIRMAN KATZ: Mr. Knapp says no questions. The Town of Wallingford and Durham, Mr. Boucher.

A VOICE: (Indiscernible) -- follow David Ball.

CHAIRMAN KATZ: Okay. Mr. Boucher indicates he's going to follow Attorney Ball, who I will call on next. Attorneys Ball and Kohler. (Pause). Do you have any audio/visual needs in your cross-examination? Okay. Could we have this turned off then.

COURT REPORTER: One moment please. (Pause).

MR. DAVID BALL: David Ball on behalf of the Town of Woodbridge. Julie Kohler is sitting next to me on behalf of Milford. I will be asking the bulk of the questions. Attorney Kohler will have some questions I

believe when I'm -- when I'm through. Thank you. Good morning, gentlemen.

MR. WAKEFIELD: Good morning.

DR. ENSLIN: Good morning.

MR. BALL: Let me ask you a general question. There -- there has been testimony in this docket about the need for the system to operate above the third harmonic. Is the third harmonic a threshold above which the system must operate?

DR. ENSLIN: Not specifically.

MR. BALL: So it's fair to say there are times when the system can operate below the third harmonic?

DR. ENSLIN: Under -- as we indicated, under contingencies it may.

MR. WAKEFIELD: The third harmonic has been specified by ISO New England and the R.O.C. group, the ROC group, as being a threshold that we should be above. And I believe that there's some margin built into that. And the margin of course is an allowance for the fact that things can happen on the system that would cause peaks to shift downward. So it's -- it's -- and I believe it's always been intended as being a measure or a benchmark and not -- I mean when we look at Phase 1 alone, we see that

there are cases where Phase 1 alone would be below the third harmonic, and that was approved. And probably it -- that doesn't mean there couldn't be some problems associated with Phase 1 alone, there well could be. But again, it just shows that there's nothing magic about 3.0, but it is reasonable to set benchmarks at times as a -- but they have to be reasonable ones.

MR. BALL: Alright. So for the purposes of your studies, you did establish the third harmonic as a goal for the system to operate above --

DR. ENSLIN: Yes --

MR. BALL: -- is that accurate?

MR. WAKEFIELD: Yes. As a basis for also evaluating the various cases that we looked at, because that had been established as an important benchmark. And I think these things again, even in this nature, need to be done in some kind of a collaborative fashion. If a party that is involved in the approval of a line has established that as a criterion, we can at least not ignore it, and we did not ignore it.

MR. BALL: Alright. Now, you testified that you had access to various harmonic studies that were performed by G.E., correct?

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

DR. ENSLIN: Yes.

MR. BALL: Alright. And in -- are you aware of conclusions that G.E. made as to the Applicants' proposal and whether or not the 24 underground miles alone would cause the system to operate below the third harmonic?

MR. WAKEFIELD: Were we aware of the studies they made in that regard?

MR. BALL: Um-hmm.

MR. WAKEFIELD: Yes, we were.

MR. BALL: Alright. Are you aware of any studies that were run by G.E. or the Applicants in which they examined the use of C-type filters to mitigate the harmonics problem?

DR. ENSLIN: No.

MR. WAKEFIELD: No, I am not aware of any such studies to date. Although, I do understand from a letter that was sent by the ROC group to the Siting Council last week that that may have changed since our report was filed.

MR. BALL: Alright, but there have not been any studies produced yet by the Applicants --

MR. WAKEFIELD: No, not that I'm aware of --

MR. BALL: -- in which they have looked at this mitigation measure, correct?

MR. WAKEFIELD: Correct.

DR. ENSLIN: No.

MR. BALL: Alright. Can you describe what C-type filters are?

MR. WAKEFIELD: I'm going to allow Dr. Enslin to do that, he's an expert on filtering.

DR. ENSLIN: A C-type filter is a very standard shunt capacitor, which is tuned together with a reactor to have a total harmonic filtering characteristic at a specific -- at a specific frequency. We selected mainly the third harmonic as being that tuned frequency.

MR. BALL: How big are they?

DR. ENSLIN: They are typically between 50 percent and a hundred percent larger in size than a standard capacitor shunt mechanical switch capacitor.

MR. WAKEFIELD: I --

MR. BALL: Now from -- I'm sorry --

MR. WAKEFIELD: I might add --

DR. ENSLIN: -- (indiscernible, overlap of talking) -- a footprint size, yes --

MR. WAKEFIELD: I might add one thing to that. I think I understand exactly what Dr. Enslin was

saying, but I'm not sure that it was clear to everyone that the C-type filters utilize the same capacitors that are in these capacitor banks being switched in and out. So those are part of the size of the units, in fact a fairly significant part of the size. And what he's saying is that between 50 and -- there's between a fifty to a hundred percent increase in the size allocated for a C-type filter as for just the switch capacitor bank.

CHAIRMAN KATZ: Can you indicate how big of a footprint you would need to add either inside or immediately adjacent to the substation to house the C-filter?

MR. WAKEFIELD: Dr. Enslin.

DR. ENSLIN: It does depend on the size of the filter, but --

MR. WAKEFIELD: Capacitor --

DR. ENSLIN: The size of the capacitor. But it -- as I said, from a -- from general-wise, it's between 50 and a hundred percent of the original size of the capacitor bank. So it depends on the base size of the voltage levels. But I guess at 115-kV, it would probably be between 50 feet by 50 feet, maybe a bit larger extra above the normal size associated with that filter -- with the capacitor bank, mechanical switch capacitor bank.

CHAIRMAN KATZ: And did you indicate that these additional C-filters would be added to the 115 substations at Southington, Berlin, Frost Bridge, and Glenbrook?

DR. ENSLIN: Our original study indicated that. We -- that was not done on a scientific method. It was not optimized at all. We just basically look at the largest capacity installations on the system and see what will happen if we retune those capacitors to the C-type design.

CHAIRMAN KATZ: For example -- let's take Frost Bridge Substation for example, that's one of the --

DR. ENSLIN: Larger --

CHAIRMAN KATZ: -- smaller substations -- if Frost Bridge didn't have enough room, could the system be optimized to put the C-filter in another substation?

DR. ENSLIN: Yes.

CHAIRMAN KATZ: Mr. Emerick, did you have a question?

MR. BRIAN EMERICK: Yeah, just a very general one. Why is it called a C-filter?

DR. ENSLIN: I don't know. (Laughter).

MR. EMERICK: Okay, that was a good question then.

DR. ENSLIN: It's basically a high bus band filter, so -- it came from the mid 1980's, first text in this regard and we defined it as a C-type.

CHAIRMAN KATZ: Back to you, Mr. Ball.

MR. BALL: Thank you. Just sticking with the issue of the footprint, the filters actually have more than one component, isn't that right, physically?

DR. ENSLIN: Yes.

MR. BALL: And is it possible to stack the components on top of each other in a way that could reduce the size of the footprint? Is that possible?

DR. ENSLIN: Yes. Some of the components have low voltage ratings than others. For instance, the reactor and the resistance normally have a lower voltage rating than the main capacitor bank, so that can be stacked in a way to optimize the footprint size.

MR. BALL: Alright. Now, understanding that based on the studies that you've done to date, that your opinion is that from a harmonics perspective, through the use of C-type filters alone an additional 20 underground miles beyond what has been proposed by the Applicants would be technically feasible, is that right?

MR. WAKEFIELD: Yes.

MR. BALL: Alright. I'd like to ask you

about capacitor banks. What are capacitor banks?

DR. ENSLIN: Capacitor banks are normally connected -- we're talking about shunt capacitor banks I guess -- capacitor banks are normally connected in shunt on the system to -- under steady state condition to regulate the voltage profile on your system.

MR. ASHTON: What does shunt mean?

MR. WAKEFIELD: That means from the higher voltage to ground.

MR. ASHTON: Okay. As opposed to series --

MR. WAKEFIELD: Which would mean in series with the transmission line itself.

DR. ENSLIN: Over eight line --

MR. BALL: Do capacitor banks contribute to the harmonics problem by increasing the amount of capacitance in the system?

DR. ENSLIN: Yes.

MR. BALL: Alright. Now once the 345-kV loop is constructed, is there the same need for capacitors as there is before the loop is constructed?

DR. ENSLIN: It would be differently allocated. It depends on the 115-kV system. Of course we haven't studied it, so we can't really give you a straight answer there. But yeah, there may be room to relook the

allocation of different capacitor banks, sure.

MR. WAKEFIELD: (Indiscernible) --

MR. BALL: Would it be fair -- I'm sorry, did you --

MR. WAKEFIELD: I was just going to say that clearly capacitors -- the switch capacitors that were there before are used largely for voltage control, so they tend to be switched in at heavier load times because otherwise the voltage will drop below acceptable limits. If you have the capacitance added by cables, then you don't have to add that same amount of capacitance with switch capacitors. But there -- there -- as Dr. Enslin is alluding to, it depends very much on the configuration of the undergrounding, where the capacitance is relative to the loads, and -- because again reactive power is not easily transmitted from one location to another.

MR. BALL: Would it be proper to model the anticipated resonance frequencies for a new 345-kV line between Norwalk and Middletown assuming that some of the capacitors are removed from service, would that be a proper assumption to make?

MR. WAKEFIELD: First you asked would it be possible to study it. And the answer would be yes --

MR. BALL: Would it be proper to?

MR. WAKEFIELD: Would it be proper to study it? Yes --

MR. BALL: Should we --

MR. WAKEFIELD: -- I would say so --

MR. BALL: -- as part of the planning process?

MR. WAKEFIELD: Yes, of course.

MR. BALL: Alright. In your studies did you assume the removal of any of the capacitor banks from service?

MR. WAKEFIELD: No, we did not.

MR. BALL: Alright.

CHAIRMAN KATZ: So just to follow up, is this something that needs to be done as part of making something definitive as opposed to indicative on --

MR. WAKEFIELD: Not in the nature of our assignment, which was to look at --

CHAIRMAN KATZ: No, I'm just saying -- not your assignment --

MR. WAKEFIELD: Okay --

CHAIRMAN KATZ: -- in order to thoroughly research this issue of how many more miles can be underground, is this study of taking capacitors out something that needs to be done?

DR. ENSLIN: When -- when you take capacitors out of service, of course the resonance frequency moves and it will probably move upwards. So if -- yeah, if it will help to actually increase the resonance frequency, it can be done.

CHAIRMAN KATZ: Okay.

MR. WAKEFIELD: Yes. Because again we did look at cases, as did G.E., with all capacitors in. The question was not asked were all capacitors still necessary. That would be a further study. That -- that I think might well be undertaken.

CHAIRMAN KATZ: And is the possibility the end result would be you could get even more undergrounding?

MR. WAKEFIELD: That -- it's possible that that could be one conclusion from it yes, because again capacitance has been one of the things driving these studies.

CHAIRMAN KATZ: Thank you.

MR. WAKEFIELD: What we have tended to do, as the Applicant has as well, is to look at the cases that are the most negative, which is the heaviest loading with the least amount of generation that weakens the system and the most -- the most capacitance switched in.

MR. BALL: Let me shift gears to STATCOMs. Can -- can you briefly describe what a STATCOM is?

MR. WAKEFIELD: Would you --

DR. ENSLIN: A STATCOM is a -- is an electronic -- a power electronic converter, which generate either a capacitive or inductive current 90 degrees out of phase with voltage. So it doesn't consist of real capacitors in general terms -- I'm talking about the main capacitors -- it doesn't consist of capacitors or reactors, but it emulates in a way a current waveform which looks similar.

MR. BALL: Alright. So it's fair to say that like a capacitor, a STATCOM provides voltage support. Is that accurate?

DR. ENSLIN: Yes. At the fundamental frequency.

MR. BALL: Alright. But unlike a capacitor, a STATCOM does not increase the capacitance in the system. Isn't that right?

DR. ENSLIN: Yes.

MR. BALL: So if a STATCOM is used, you can get the benefit of providing voltage support without negatively impacting the harmonics problem? Is that right?

DR. ENSLIN: Yes.

MR. BALL: Do STATCOMs also help to address transient problems by the way?

DR. ENSLIN: Because it doesn't have a real capacitor, the switching transients associated with capacitor switching, of course it doesn't have the same problem.

MR. BALL: Alright. Now --

CHAIRMAN KATZ: Which is less expensive, a C-filter or a STATCOM?

DR. ENSLIN: Well a C-type filter is much, much cheaper than a STATCOM --

CHAIRMAN KATZ: Thank you --

DR. ENSLIN: -- orders of magnitude probably.

MR. BALL: Alright. It's fair to say from your report that you've studied C-filters alone as a mitigation technique to help improve the harmonics problem, correct?

DR. ENSLIN: Yes --

MR. WAKEFIELD: Yes.

DR. ENSLIN: Yes.

MR. BALL: And your conclusion that an additional 20 underground miles would be technically

feasible assumes just the use of C-filters as opposed to STATCOMs. Is that correct?

DR. ENSLIN: Yes.

MR. WAKEFIELD: Yes.

MR. BALL: Alright. You also suggest in one of your conclusions that a combined mitigation solution might be possible using one or two STATCOMs together with C-type filters. Is that right?

DR. ENSLIN: Yes.

CHAIRMAN KATZ: Mr. Ball, are you on a certain page here?

MR. BALL: Yes. Page 69 of the report.

CHAIRMAN KATZ: Thank you.

MR. BALL: And I'm looking specifically at -- I guess it's Conclusion No. 8.

Now, the ROC group has examined a configuration where certain capacitor banks were removed from service and I believe four STATCOMs were added at various locations. Are you aware of that study?

DR. ENSLIN: Yes.

MR. WAKEFIELD: Yes, we are.

MR. BALL: Alright. I believe that was Case 7?

MR. WAKEFIELD: Yes.

DR. ENSLIN: Yeah, we've -- we've run similar cases.

MR. BALL: And the ROC group concluded in rejecting that case as a possible means of increasing undergrounding, that there was too much complexity in operating the system with the additional four STATCOMs. Are you aware of that?

DR. ENSLIN: Yes.

MR. WAKEFIELD: Yes.

MR. BALL: Do you believe that adding just one or two additional STATCOMs would create the same level of operational complexity as the ROC group identified in Case 7 with four STATCOMs?

DR. ENSLIN: It would be much more reduced. There's already one STATCOM on the system, Glenbrook -- or coming onto the system.

CHAIRMAN KATZ: Dr. Enslin, much more what?

DR. ENSLIN: It will -- sorry -- there's already one STATCOM coming onto the system in Glenbrook.

MR. WAKEFIELD: I believe he said it would be greatly reduced, the complexity --

CHAIRMAN KATZ: Greatly reduced. Thank you.

MR. BALL: Alright. It would -- it would

be easier to operate the system --

DR. ENSLIN: Sure --

MR. BALL: -- with one or two STATCOMs --

DR. ENSLIN: Rather than four --

MR. BALL: Alright. And when you suggested one or two STATCOMs, you are including the Glenbrook STATCOM --

DR. ENSLIN: Yes --

MR. BALL: -- as one of the two -- alright. Where would you place the second one?

DR. ENSLIN: It would be very difficult to define without a detailed study.

MR. BALL: Alright. Your -- without doing a detailed study, how is it that you are able to come to the conclusion that in addition to C-type filters an additional STATCOM might be helpful or provide excellent harmonic results? How do you come to that conclusion?

DR. ENSLIN: Well in this report we only investigated the harmonic performance of a system. And if you as a criteria have only the harmonic performance -- actually the C-type filters alone can do the same job, alright, without the STATCOMs, because we didn't study any voltage stability or transient stability phenomena in the whole system.

MR. BALL: Do C-type filters provide voltage support?

DR. ENSLIN: Fundamental reactive power support, yes.

MR. BALL: Okay. Is there some added benefit then to having an additional STATCOM in terms of a mitigation procedure?

DR. ENSLIN: On the harmonics performance, I don't think so.

MR. BALL: So it would purely be an issue of voltage support in dealing with the transient issues?

DR. ENSLIN: Yes.

MR. BALL: Alright. And again, that's something -- do you feel that would be worthwhile for a more detailed study to be done, including the concept of one additional STATCOM in addition to what already exists with C-type filters?

DR. ENSLIN: That's at least my feeling, yes.

MR. BALL: What does it mean to optimize a filter? Can you explain what that means?

DR. ENSLIN: There are certain criterias set in a specification based on losses, based on frequency variations on the system -- I'm talking about steady state

frequency variations. Also in terms in this case, of course the overall system harmonic performance. So what I mean by optimizing a filter is changing the quality factor, the quality of the filter basically, as well as the exact tuning of that filter.

MR. BALL: In your study did you assume the optimization of the filters?

DR. ENSLIN: No, we didn't optimize the filter.

MR. BALL: And I believe you might have touched on this during Mr. Fitzgerald's questioning, but just so that I'm clear, is there something about modeling in the optimization of the filters that could lead to improved harmonics results in your studies?

MR. WAKEFIELD: Yes.

DR. ENSLIN: yes.

MR. BALL: Alright. Why is that?

DR. ENSLIN: It may be that in some cases you can tune the filter at the lower frequency for instance if the main concern would be to filter low order in-rush currents from transformers for instance. That can be one of the criteria to be used in the optimization process.

MR. BALL: So as part of the optimization

process, one can anticipate contingencies and optimize the filters to deal with those anticipated contingencies?

DR. ENSLIN: At least --

MR. WAKEFIELD: Yes --

DR. ENSLIN: -- the filtering part of it, yes.

MR. FITZGERALD: I'm sorry, could you -- I didn't -- could you just repeat that please.

DR. ENSLIN: What I said is just the filtering part of a C-type filter you can optimize to filter of course the negative impacts of in-rush currents.

MR. WAKEFIELD: And one might, for example, look at not doing these processes in series fashion as we have where we have harmonic screening studies followed by transient network analysis, but the two going on more or less in parallel and in collaboration with one another, whether they were done by KEMA or some other engineering firm, whereby the results of the transient network analyses, especially earlier ones that identified specific transient problems in physical locations on the system that had to get greater attention than others shall we say, that the C-type filters could then be designed to help mitigate those situations in those locations on the system where transient problems appeared to be great.

Would you -- would you agree with that, Dr. Enslin?

DR. ENSLIN: Yes.

MR. BALL: Okay. And my question is given -- assuming you had the time and were asked to do so by the Siting Council, does KEMA have the ability to do this more detailed level of harmonics analysis?

MR. WAKEFIELD: Yes, we do.

DR. ENSLIN: Yes.

MR. BALL: I will shift gears again. Initially you modeled in for the additional undergrounding between East Devon and Beseck three XLPE cables, is that right?

MR. WAKEFIELD: That's correct.

MR. BALL: Alright. And you then did a subsequent study, I believe you testified on direct examination, modeling in four XLPE cables for the additional stretch of undergrounding. Is that right?

MR. WAKEFIELD: That's correct.

DR. ENSLIN: Yes.

MR. BALL: Do you believe that four cables of XLPE would be necessary for the stretch between Devon and Beseck?

MR. WAKEFIELD: No, we don't. We believe that three 1750-kcmil cables would be adequate.

MR. BALL: Alright. And just so the record is clear, your studies show that even with four XLPE cables, assuming you have filters as a mitigation technique, the system can operate above the third harmonic?

MR. WAKEFIELD: Yes.

MR. BALL: And from a harmonics perspective, one can feasibly construct an additional 20 underground miles even with four XLPE cables?

DR. ENSLIN: Correct --

MR. WAKEFIELD: From a harmonics perspective alone, yes.

DR. ENSLIN: Yes.

MR. BALL: Alright. There have been a number of questions Mr. Fitzgerald asked about transient network analyses. Is it fair to say that a key aspect of planning for a project of this size is mitigation?

MR. WAKEFIELD: Yes.

DR. ENSLIN: Yes.

MR. BALL: So in addition to performing transient network analyses that identify problems, voltage problems, transient problems, it's fair to say that it's equally important to perform studies considering mitigation techniques, is that right?

DR. ENSLIN: Yes.

MR. WAKEFIELD: Yes.

MR. BALL: Alright. To date have the Applicants shared any of the results of their transient network studies with you?

MR. WAKEFIELD: No.

DR. ENSLIN: No.

MR. BALL: If requested by the Siting Council, could KEMA conduct studies to address the results of the transient network analyses, which I guess we're going to be getting next week, including mitigation measures after the studies are provided to you?

MR. WAKEFIELD: Yes --

MR. BALL: Do you have the ability to perform studies that would include mitigation of the problems identified in transient network analyses?

MR. WAKEFIELD: Yes, we do.

DR. ENSLIN: Yes.

MR. WAKEFIELD: I think the problem might be one of timing and schedule --

MR. BALL: Assuming you had --

MR. WAKEFIELD: -- and access -- and access to the Applicant and the system data that would be required, yes.

CHAIRMAN KATZ: Assuming you had the time and the money?

MR. WAKEFIELD: That's it, Chairman Katz. (Laughter).

MR. ASHTON: That's an if problem.

MR. BALL: How much time would you need once the transient network analyses are provided to you in order to perform your own studies analyzing mitigation measures?

MR. FITZGERALD: Well, I suppose I don't object if he thinks he can answer it --

AUDIO TECHNICIAN: A microphone --

MR. FITZGERALD: -- but doesn't it depend on what --

AUDIO TECHNICIAN: -- Mr. Fitzgerald --

MR. FITZGERALD: I don't see how they can answer that question.

DR. ENSLIN: It would be very difficult to determine the timing, you know --

MR. BALL: Alright --

DR. ENSLIN: -- because it depends really on the cooperation between in this case the Applicant and the consulting company.

MR. ASHTON: And it also depends too on the

nature of what the TNA studies show --

DR. ENSLIN: Sure --

MR. ASHTON: -- so that -- whether more TNA runs have to be made to test mitigation measures or what have you. So it's -- it's imponderable at this stage of the game, isn't it?

DR. ENSLIN: Sure.

MR. BALL: Fair enough. So it's fair to say that once those studies are provided to you, you'll be in a better position to let us know how much time you would need in order to perform studies looking at mitigation measures, is that right?

MR. WAKEFIELD: Yes.

DR. ENSLIN: Yes.

MR. BALL: Alright. Alright, I don't have any further questions. Miss Kohler will have a few.

CHAIRMAN KATZ: Well, we're going to take a lunch break now -- is it very few --

MS. JULIE DONALDSON KOHLER: I have --

CHAIRMAN KATZ: -- or would you like to go after lunch?

MS. KOHLER: I actually just have a few cleanup questions. It will probably be --

CHAIRMAN KATZ: Well, let's keep going

then.

MS. KOHLER: Okay. Julie Donaldson --

MR. PHELPS: Counselors, could you separate those two microphones please. Thank you.

MS. KOHLER: Julie Donaldson Kohler for the City of Milford. I only have a few cleanup questions left.

In your October 18th report you concluded that 10, 15, and 20 miles of additional length of underground transmission lines were feasible from a harmonic standpoint. Where did each of these lengths originate from?

MR. WAKEFIELD: All of the lengths originated from what will be the East Devon Substation. And from that point moved northward until the desired length was achieved.

And by -- and since you raised the question, you might say well why -- where did this 15-mile one come from, because we looked at 10, 20 and 40, and the 15 -- just to answer a question which hasn't directly been asked but you gave me a lead into it, is the -- is that we understand that at about 15 miles there is a piece of property owned by the Applicant that might be suitable as a termination station and might be past certain obstacles

that were -- that you'd like to avoid shall we say. And that was why 15 miles was selected as just one more case to examine.

MS. KOHLER: I have even fewer questions now I think. So -- so to take off on your last statement, would you agree that from a harmonics standpoint that that 15-mile stretch that would start at Devon, go through Orange and through Woodbridge and terminate at that CL&P parcel would be feasible?

MR. WAKEFIELD: Based again on the harmonic results alone, yes.

MS. KOHLER: Correct. And is it safe to assume also that as the Devon Substation is located in Milford and the length of the transmission line route from the substation to the next town is under 10 miles, that under any of these scenarios under these harmonics perspective, it would also be feasible to underground through Milford?

MR. WAKEFIELD: Yes.

MS. KOHLER: That's all I have.

MR. TAIT: I -- I have a question. Are we talking about 20 miles in gross and the Council can put it where it wants to, divide it up in different pieces? Does it have to start at East Devon or it could start in the

north? Why does it have to start at East Devon?

MR. WAKEFIELD: Go ahead, Dr. Enslin.

DR. ENSLIN: You don't -- you don't have to start at East Devon of course. We just tried to extend it --

MR. TAIT: I want -- my answer -- can we put it anywhere we want it?

DR. ENSLIN: We can, but of course the harmonic impedance calculation will vary.

MR. WAKEFIELD: But Mr. Tait, we did do -- in response to discovery by the Towns of Durham and Wallingford, we did do a few additional studies, we were limited in terms of time because the questions only came a week ago, where we did look at splitting up a 20-mile stretch where 15 miles would be from Devon north and five miles would be east -- east of Beseck. And then we looked at a 10 split. Although when you go 10 miles east of Beseck, I think you're outside the -- you're past the length of the line, it goes past Oxbow Junction I believe. But -- but at any rate, neither -- from a harmonic perspective alone, neither of those cases led to any different conclusions.

MR. TAIT: That's what I thought your answers were. So while we have been talking about from

East Devon north, that's not necessary a condition precedent?

MR. WAKEFIELD: That's right.

CHAIRMAN KATZ: All set? We will recess until 1:00 o'clock.

(Whereupon, a luncheon recess was taken.)

CHAIRMAN KATZ: Before we resume cross-examination, I'd like to say a few words about January. In January we've put on the website the proposed dates and we're going to of course start off with cross-examination of the ROC report and we'll have KEMA back and we can cross-examine on the load forecast analysis.

We also have what we're calling cleanup days and I invite suggestions by all interested parties on those days. In this docket we've opened many doors on many subjects. January is a good time to close some doors and complete the record on certain subjects so that the Council can make an intelligent decision. And I'd like cleanup days to see what doors are available to be closed because we have enough in the record. So I'd like your thoughts on that and I'd like you to send your thoughts to Derek Phelps on cleanup days.

I only have one request, if you could make those thoughts in a constructive and friendly manner. I

do my Siting Council reading faithfully every night after a long day with clients and if you could avoid sentences like the Council is running roughshod over the due process rights of the towns, I'd be happier and less sneakers would be thrown. But we do invite your comments on how to best handle cleanup days.

Okay, let's continue with cross-examination, and Mr. Boucher.

MR. PETER BOUCHER: Thank you, Madam Chairman. Good afternoon, gentlemen.

MR. WAKEFIELD: Good afternoon.

DR. ENSLIN: Good afternoon, Mr. Boucher.

MR. BOUCHER: I'm Peter Boucher and my clients are the Towns of Wallingford and Durham.

Initially, I'd like to direct you to page 6 of your initial report, at that point you indicate that you investigated extending the underground with XLPE cable along the Devon to Beseck corridor. And my -- my initial question is why did KEMA limit its investigation of undergrounding to end at the Beseck Station as opposed to continuing beyond Beseck?

MR. WAKEFIELD: There was no particular reason to select -- with the exception of the fact that the feeling was this was the most likely corridor to --

because of its proximity to New Haven and West Haven and so on to -- but there was no intent to exclude other areas, it was just that we couldn't study all the different possibilities and permutations.

And secondly, we felt it was the closest electrically to the Norwalk/Stamford area and New Haven and where the loads were. So those -- those were the primary reasons.

CHAIRMAN KATZ: If you could have gotten to Beseck, 40 miles, you would have kept going, correct, undergrounding? If you found --

MR. WAKEFIELD: Oh, yes. Yes. And that -- that and the fact that it appeared that more than 20 miles of undergrounding would probably not be acceptable or at least would be very risky. But there was no intent to exclude other possibilities. And as we stated this morning, some -- some little -- I'm sorry -- limited additional studies have been made that show that actually splitting up that amount of undergrounding is not only -- it appears to be possible -- it hasn't been thoroughly studied, but it -- it would not necessarily degrade the situation in any way.

MR. BOUCHER: Right. Thank you. In following up on the closing question from Council Member

Tait just before the lunch recess, numbered paragraph 6 on page 69 of your report is where you indicate that a 20-mile underground extension is a workable solution, and I believe your response to a question from Council Member Tait was that that 20 miles didn't have to be located in any specific location in order for that -- at least from a harmonic resonance perspective for that conclusion to bear -- to bear out. Is that correct?

MR. WAKEFIELD: Well, we're not saying it could be done anywhere --

MR. BOUCHER: Okay --

MR. WAKEFIELD: -- because we haven't studied having it done anywhere. But based on the limited studies we've performed of what was requested by the Towns of Durham and Wallingford and also the Town of Woodbridge, it does appear that along that corridor and possibly looking Devon to Beseck and then past east to Beseck that some mixing and matching might be possible without any serious problems.

The thing that -- the reason I'm being hesitant is that we -- when we ran the additional checks in order to be able to answer the interrogatories in time for the hearing today, we were not able to extend our frequency analysis to look north and east of the new area

we were looking at to look at some additional buses and substations up there that could possibly lead us to change the conclusion. But honestly, I'm going to tell you I really doubt that it would.

MR. BOUCHER: Okay. In the -- in the responses that you filed yesterday to the supplemental Durham and Wallingford discovery request --

MR. WAKEFIELD: Yes --

MR. BOUCHER: -- in most if not all of the responses you seem to indicate that there's an actual improvement in the situation marginally when you take a specific segment length, 10 or 15 or 20 or even 40 miles and you segment it. And in each case there appears to be a consistent --

MR. WAKEFIELD: A slight improvement. And I think -- you know, your intuition might even tell you that if you -- let's say you decided to take the 20 miles and put five miles of it over in the northwest corner of Connecticut, you're not even going to see it electrically down in Southwest Connecticut. So the further away you get -- the more electrically separated you get in general, the less impact it's likely to have on Southwest Connecticut.

MR. BOUCHER: Okay. But that pattern then

is consistent as I've observed, namely if you take a segment of 20 miles and you break it into 15 and 5, the -- the lower order harmonic resonance is going to actually move up slightly?

MR. WAKEFIELD: In the cases we looked at and we were asked to discuss, the answer would be yes. And -- but it's a very slight improvement. On the other hand, it is an improvement.

MR. BOUCHER: Thank you. On page 69 of your report, your recommendation No. 1, I'd like to understand what you're trying to highlight here when you say that Phase 2 should be designed in detail and commissioned as soon as possible preferably together with Phase 1. Are you saying that they should be commissioned simultaneously? Go into service at the same point in time for some particular reason?

MR. WAKEFIELD: I don't think it's necessary that they be -- that they go into service identically at the same time. Each project provides significant improvement to Southwestern Connecticut.

I think Dr. Enslin might want to say a word about the damping that -- and the strengthening of the system that our studies indicated would take place when Phase 2 was added to Phase 1, and also I think one of the

studies we ran with Phase 1 where both Phase 1 cables were in place and one of them was removed for service led to some concern at a higher harmonic. Do you want to say a word about that, Dr. Enslin?

DR. ENSLIN: Yeah, sure. What we found is that if you take Phase 1 and you just use one cable for Phase 1, that the system is really -- you know, may have some problems, both low resonance harmonic, but also higher frequency resonances. We have some graphs showing -- showing those results in the report.

And secondly, I think it's clear in our results that Phase 2 is bringing a very good system response harmonic-wise to the whole area because of the strength of the system brought into Phase 2. So the sooner the better, basically, is the answer for both phases.

MR. BOUCHER: Your -- your modeling that you discuss, which is Study Case 5 --

DR. ENSLIN: Yes --

MR. BOUCHER: -- that's with 24 miles of XLPE --

DR. ENSLIN: Yes --

MR. BOUCHER: -- in Phase 2 and with only one of the two HPFF cables --

DR. ENSLIN: Yes --

MR. BOUCHER: -- in Phase 1 -- what, installed or energized, or operating, or --

DR. ENSLIN: Well, they are -- of course they are installed in the system but electrically isolated, meaning both the capacitance and the power flow through that second cable would be disconnected. It's an open circuit breaker basically.

MR. BOUCHER: And --

MR. WAKEFIELD: Electrically removed from the system --

DR. ENSLIN: Still in place --

MR. WAKEFIELD: -- but possible to be switched in if conditions call for that.

MR. BOUCHER: And -- and that condition is different from that contemplated in the Phase 1 as certificated from the Council, if you know that?

DR. ENSLIN: Yes.

MR. BOUCHER: Alright. Now is there a need for one of those two HPFF lines to be off the system in order for Phase 2 to work as -- based on your modeling and in order to deal with the harmonic resonance issue?

DR. ENSLIN: Well if you -- if you use Phase 1 with HPFF cable, you have larger charging

capacitance. And by adding now Phase 2 even with XLPE, it can drive the resonance point below three. And I think that is one of the major reasons why the Study Case 5 was done with just one cable.

MR. BOUCHER: Okay. So in order to make Phase 1 work, it has to be modified in that regard at least under Base Case 5 where you've modeled the H -- the -- the XLPE for the first 24 miles?

MR. FITZGERALD: I'm going to object to that question simply because it uses the term of art modified. The testimony is not that the Phase 1 needs to be modified. It is that the operation of Phase 1 was modeled in a particular way. So the question misstates the prior testimony. And these witnesses may not be alert to the particular meaning that modification has in Siting Council proceedings.

CHAIRMAN KATZ: Mr. Boucher, can you just rephrase the question.

MR. BOUCHER: I'll rephrase the question. In your opinion, gentlemen, does -- does Phase 1 need to be operated without the second HPFF line in order for Phase 2 to operate in the manner in which you've modeled it?

MR. WAKEFIELD: It needs to be modeled

without one of the HPFF lines in service in order to get the results that we got. We did not make a specific evaluation -- we -- we accepted Study Case 5 as the new base case. We -- admittedly we could have tried to look at whether that step was necessary or not, but we did not make that explicit evaluation.

MR. BOUCHER: And your conclusion on page 68, Conclusion No. 2, which says that Phase 1 alone shows high risks in terms of the harmonic performance for the seventh harmonic when only one HPFF cable is in operation --

MR. WAKEFIELD: Yes --

MR. BOUCHER: -- what's the scenario that you're describing there?

MR. WAKEFIELD: That's the scenario where you don't have any Phase 2 improvements made to the system at either HPFF or XLPE, so there's no Phase 2 improvements at all --

MR. BOUCHER: Right --

MR. WAKEFIELD: -- or reconfiguration. You only have Phase 1 and you remove one of the HPFF cables from service, and then you run a frequency scan on it, and what we found was a very high harmonic resonance at the seventh harmonic. We are not concluding that could not be

mitigated. We are only observing that the seventh harmonic can sometimes be a problem and it's high enough that it should receive some attention, and maybe it already has.

MR. BOUCHER: So you're referring to the scenario in which Phase 1 is not interconnected with a constructed and operating Phase 2 --

MR. WAKEFIELD: That's correct --

MR. BOUCHER: -- in that -- alright --

DR. ENSLIN: That's correct.

MR. WAKEFIELD: That's why we say in there Phase 1 alone with no Phase 2 improvements.

MR. BOUCHER: Right. And if both -- if you know, with both HPFF cables in operation, do you -- do you have any resonance issues with Phase 1 still?

MR. WAKEFIELD: There's --

MR. FITZGERALD: Objection. Does he mean with Phase 1 with both cables in and no Phase 2? Is that the question?

CHAIRMAN KATZ: Would you rephrase your --

MR. BOUCHER: I'll accept that clarification.

MR. WAKEFIELD: Yes, with Phase 1 in service both cables and no Phase 2, we do not see that

high resonance at the seventh harmonic.

MR. BOUCHER: Okay, thank you. Did you look at whether any other modeling scenarios for Phase 1, other than taking one of the two HPFF circuits off line, whether there were any other modeling changes that you would make or could make that would improve the -- or add to the extent of undergrounding in Phase 2?

MR. WAKEFIELD: No, I can't think of any. Can you, Dr. Enslin?

DR. ENSLIN: No.

MR. BOUCHER: What about adding C-filters or any of the other mitigation schemes that you explored with regard to Phase 2, is it possible that any of those approaches if addressed to Phase 1 could allow for additional undergrounding in Phase 2?

MR. WAKEFIELD: We did not make such studies. We did not do a complete harmonic screening analysis of the Phase 1 alternative. We just made the relatively few studies that we point out here. And then in particular, we didn't look at mitigation associated with Phase 1 alone because we really -- the heart of our study was going to Phase 1 and Phase 2 operating together.

MR. BOUCHER: Do you think it might be productive to take a look at whether there are any

mitigation schemes that could be introduced to Phase 1 that would permit additional undergrounding in Phase 2?

MR. FITZGERALD: Well, I -- at this point I think I need to object.

CHAIRMAN KATZ: I agree.

COURT REPORTER: One moment please.

(Pause).

CHAIRMAN KATZ: Mr. Boucher, Phase 1 is an approved docket with approved D&M plans and I guess we don't want to go there.

MR. BOUCHER: Alright. Well for the record, I'd like to claim the question. I think since it hasn't been built, it's a worthy question for the Council to know the answer to.

CHAIRMAN KATZ: Well, you can -- your objection has been noted.

MR. BOUCHER: Okay. That's all I have then.

CHAIRMAN KATZ: Thank you, Mr. Boucher. The Town of Orange? Not present. The City of Norwalk? Not present. The Town of Westport?

A VOICE: (Indiscernible).

CHAIRMAN KATZ: The Town of Westport says no questions. State Representative Mary Fritz? Not

present. The City of Meriden? Not present. Assistant Attorney General Wertheimer?

A VOICE: No questions.

CHAIRMAN KATZ: Mr. Wertheimer says no questions. State Representative Raymond Kalinowski? Not present. The City of Bridgeport? Not present. Communities for Responsible Energy? Not present. The Office of Consumer Counsel, Attorney Johnson?

MR. BRUCE JOHNSON: Yes, I do have cross -- (indiscernible) --

(Pause)

AUDIO TECHNICIAN: Attorney Johnson, would you just turn that microphone please.

CHAIRMAN KATZ: (Indiscernible) -- like an opportunity after we go through all the others to have further cross of KEMA today?

MR. FITZGERALD: Not -- not so far?

CHAIRMAN KATZ: Okay.

(Pause)

MR. JOHNSON: Good afternoon, gentlemen. I'm Bruce Johnson, representing the Office of Consumer Counsel.

The -- to the extent my questions delve into load flow issues, which are really the responsibility

of another witness, I -- you know, please let me know and I'll try to avoid that subject.

The -- I have reference to some of your answers to the OCC interrogatories. Could you look at the question OCC numbered as 34 -- 35-B -- (pause) -- are you with me?

MR. WAKEFIELD: Yes --

DR. ENSLIN: Yes.

MR. WAKEFIELD: Yes, we are.

MR. JOHNSON: And KEMA has concluded that transient studies would be needed in order to make a complete analysis of the design possibilities for this line, right?

DR. ENSLIN: Yes.

MR. WAKEFIELD: Yes, we have.

MR. JOHNSON: And in 35-B your answer, you state that you have not established either minimal levels of transient performance or preferable levels of transient performance. Why is that?

MR. WAKEFIELD: Well, we -- well, first, we were not asked to do so. And second, I would say that it's rather difficult to come up with measures of transient performance that will cover all possible eventualities and to be adequate to cover -- it's more a

matter of developing standards that would cover the kind of response of the system to a transient event. That might be done. We -- we have not done that. And we -- we do it here to the existing standards that have been adopted by NEPOOL and ISO New England and by the Applicants themselves. Dr. Enslin, do you want to refer -- to expand on what I've said at all?

DR. ENSLIN: No, that's fine.

MR. WAKEFIELD: Alright.

MR. JOHNSON: But you would agree that in order -- if transient studies were conducted by KEMA or otherwise, that -- that you'd need some standard to interpret the results and see whether you've identified problems or have identified no problems, right?

MR. WAKEFIELD: Yes --

DR. ENSLIN: Yes.

MR. WAKEFIELD: -- absolutely.

MR. JOHNSON: Turn to the answer to OCC-39, Subpart C and E, if you would. And let me know when you have the document in front of you.

MR. WAKEFIELD: Yes, we have it in front of us.

MR. JOHNSON: KEMA says there that a Phase 2 system with 34 to 44 miles of undergrounding -- which

I've, you know, worded a different way with the additional 10 to 20 miles that KEMA has spoken about -- they state that such a Phase 2 system would be better for Southwest Connecticut than would Phase 1 alone, right?

DR. ENSLIN: Yes.

MR. WAKEFIELD: Yes, that's correct.

MR. JOHNSON: My question in follow-up on that is would such a system, that is one that featured between 34 and 44 miles of undergrounding for Phase 2, would such a system make the Southwest Connecticut electrical system stronger than would a Phase 2 project with 24 miles of undergrounding as the Applicants have proposed?

MR. WAKEFIELD: Do you want to respond to that, Dr. Enslin?

DR. ENSLIN: Can you repeat the question please --

MR. JOHNSON: Yes --

DR. ENSLIN: -- just exactly what do you mean by the different --

MR. JOHNSON: The question asked about the -- whether the KEMA recommended approach, that is to say 10 to 20 miles of additional undergrounding, whether it would strengthen the system or not. And the answer given

-- and if I'm paraphrasing inaccurately, please let me know -- is that, yes, it would improve it relative to Phase 1 only. I'm asking you whether a Phase 2 system with the additional 10 to 20 miles of undergrounding that KEMA has recommended for further study, whether such a system would make the Southwest Connecticut electrical system stronger than would a Phase 2 project with 24 miles of undergrounding? In other words, without the 10 to 20 miles under discussion added?

DR. ENSLIN: So -- but still the section would be of a red line when -- the extra section I guess -- -

MR. JOHNSON: Would be?

DR. ENSLIN: The section between Beseck and East Devon would be then a red line.

MR. JOHNSON: That's my assumption --

DR. ENSLIN: Okay --

MR. JOHNSON: -- I'm simply asking you to compare the configuration you recommended for further study to the configuration at the outset of this docket, which was the primary recommendation that the Applicants made?

DR. ENSLIN: The only thing I think we can say, because of course we have different issues about

system strength, is that we found that the extended undergrounding provides more damping on the system. That we did recognize, yes.

MR. ASHTON: Did --

MR. WAKEFIELD: We did not investigate short-circuit strength, which is often associated with systems -- what's called system strength. I would expect the two to be very similar in terms of system strength alone. Dr. Enslin has pointed out that the additional damping is a benefit of additional undergrounding. It comes at the expense of a slight shifting downward in the first and lower order harmonic resonance points.

MR. ASHTON: And would it also not then potentially -- potentially increase problems in restoration of a system because of the much increased charging current?

DR. ENSLIN: Yes.

MR. WAKEFIELD: Yes, it could.

MR. ASHTON: So there's pros and cons --

DR. ENSLIN: Yes --

MR. WAKEFIELD: Absolutely.

MR. JOHNSON: Could you briefly indicate what further studies you think would -- if any, would be needed to answer that question more definitively about the

relative system strength of the 10 to 20 miles extra versus the 24 miles?

MR. WAKEFIELD: I would -- I would say short-circuit studies would be among those --

DR. ENSLIN: Yeah --

MR. WAKEFIELD: Would you agree?

DR. ENSLIN: Yeah. But -- and of course the results of the transient studies as well.

MR. JOHNSON: Any others?

DR. ENSLIN: A comparison in terms of short-circuit calculations between the two systems.

MR. JOHNSON: So speaking broadly -- and let me ask and you know the -- would the additional 10 to 20 miles of undergrounding that KEMA has recommended for further study, relative again to the 24 miles which is the main proposal the Applicants originally made, would that additional 10 to 20 miles overall weaken the electrical system, leave it the same, strengthen it, or don't you quite know the answer to that at this point given the state of the data that we have?

MR. WAKEFIELD: We have not studied it. Therefore, we are a little uncertain as to what the answer would be. My intuition tells me that the system strength would not be significantly changed between the two.

MR. JOHNSON: Thank you.

MR. ASHTON: Wait a minute, I've got a question. I want to be sure --

MR. JOHNSON: By all means.

MR. ASHTON: I want to be sure I understand the use of the term weaken. Would you define that, Mr. Johnson, please?

CHAIRMAN KATZ: Well -- (laughter) --

MR. JOHNSON: I -- I'm not an engineer. The -- the -- I -- OCC generated this question based on the -- as the question itself says the original application which at certain pages describe the Southwest Connecticut electrical system as inadequate to meet national regional reliability performance standards, the --

MR. ASHTON: You're not sure?

MR. JOHNSON: Then I would -- well, I -- no, then I would say that to strengthen the system you would move it toward meeting the national and regional --

MR. ASHTON: Okay --

MR. JOHNSON: -- reliability performance standards.

CHAIRMAN KATZ: So let's ask the witness the question that way.

MR. ASHTON: Yeah. I want to be sure this answer comes out clearly and responsively because weaken can have a host of meanings that may or may not affect the answer.

MR. JOHNSON: Understood. I appreciate the clarification. Would --

CHAIRMAN KATZ: So based on this clarification, if the witness could -- if you need it repeated, Mr. Johnson will be glad to --

MR. ASHTON: I -- in preface to that, I think probably an acceptable synonym for that would be improve. Is that fair, Mr. Johnson?

MR. JOHNSON: Yes.

MR. ASHTON: Would it improve the system or not? And I think where you need to be careful as to where it might and might not.

MR. WAKEFIELD: I think -- we don't have a single measure by which to answer that question. What we have observed is that doing -- adding the 10 -- adding the 10 to 20 miles of additional undergrounding would slightly move the lower order resonance points to a lower -- a slightly lower level.

We have also observed that increased damping results from the additional capacitive charging on

that corridor and that having more damp resonances and impedances at the lower frequencies is a good thing. So there's a balance there. And we've not made a single evaluation by a single standard as to which is the most beneficial or which would be the greater improvement if you want to say improvement.

MR. JOHNSON: So on this question as Council Member Ashton helped me rephrase it about moving the electrical system in Southwest Connecticut toward meeting the national and regional standards, is it fair to say in summary that your conclusion is that some of your data indicates that it would, that is to say the 10 to 20 miles of further undergrounding, and in others it indicates it would not, but that you would prefer that further studies were done to really answer that question more firmly?

MR. WAKEFIELD: Well, I think we have recommended already that additional studies would be required. And those studies I believe will help to answer the question of which of those two changes that we've noted, one of which is a positive change, and one of which is a negative change, which of those two would be the most important in terms of overall system performance and would allow us to answer the final question, which is are you

better off with the 10 to 20 miles or are you worse off in some respect. And of course all that needs to be balanced against the public interests of undergrounding.

MR. JOHNSON: Thank you. Could you turn please to the answers provided previously to OCC-45. Let me know when you have the text in front of you.

DR. ENSLIN: Yes --

MR. WAKEFIELD: We have the text in front of us now.

MR. JOHNSON: I have reference here now to OCC-45-A and 45-B. KEMA states that it did not -- it could not answer the question because it didn't know what was meant by making the most efficient use of generation resources, right?

DR. ENSLIN: Yes.

MR. WAKEFIELD: That's correct.

MR. JOHNSON: What I want to do to try to clarify and make it possible for you to give an answer is to offer you a definition of such efficient use and then see if you could answer it for me. Assume please that efficient use of generation resources means that ISO New England, the operator of the wholesale market, could -- is able to dispatch the lowest cost generation units at all times, that -- in other words that ISO New England is able

to dispatch all generation in the wholesale market according to the normal bid stacking rules that it establishes for the market across New England. If -- if -- assuming that that is what is meant by efficient use of generation resources in Southwest Connecticut, could KEMA answer 45-A? In other words, do you think it's possible to make the most efficient use of generation resources as specified just now under any or all of the three configurations described there?

MR. WAKEFIELD: It will not be possible for us to answer that. We have not -- our -- our charge from the Siting Council was limited to technical feasibility alone. We were specifically asked to -- not to evaluate the economics, but to focus on the technical feasibility. Obviously -- and to make a decision related to economic dispatch of generation, whether it's by stack loading or some other means, one must take into account numerous cost elements, specifically fuel related costs, O&M costs, incremental and marginal costs. And this requires a -- it's an important study to be made, but it's not one that we have made.

MR. JOHNSON: Assume, if you could -- let me -- let me work a little harder to try to get an answer from you, if I may. Assume that you don't need any

economic data to pursue this, you merely need to find out whether ISO is dispatching, according to its own preexisting rules, where wholesale market participants, generators bid into the market wherever they wish to bid in, and then ISO arranges those bids in an order in order to produce the results -- and I will represent and ask you to accept subject to check that ISO has -- and other participants, I think including the Applicants perhaps, have stated that it is not presently possible in Southwest Connecticut to make this economic dispatch --(gavel) -- that -- that, for instance, is in the application and it's also -- you know, you refer to the inadequate local generation in your own report -- so assuming -- you know, is it -- is it feasible under either -- under any of these configurations to make the dispatch according to ISO's normal rules? Do you -- (gavel) --

CHAIRMAN KATZ: Mr. Johnson, I'm going to cut this short because I think the witnesses have pretty much stated that these types of questions concerning ISO and economics were not within their scope of work.

MR. JOHNSON: Okay, thank you. Let me refer, if I may, to -- and you'll have to let me know whether I'm straying into load flow analysis -- the question that the Applicants -- Question 3-A, which KEMA

answered on -- filed answers to on November 12th.

(Pause)

MR. WAKEFIELD: Yes, we're there.

MR. JOHNSON: You say there that motor loads were not represented in your analysis, but rather that constant loads were assumed, right?

DR. ENSLIN: Yes.

MR. WAKEFIELD: Well, we say that motor loads were not modeled separately.

MR. JOHNSON: Okay. If motor loads are modeled separately, would the results and the conclusion of your harmonic analysis be different?

MR. WAKEFIELD: Not having made such a study, we can't comment on whether they would or wouldn't be. One would suspect that if you modeled loads in a different way, you would at least have some change in the results, whether it would be a significant change or not, I cannot say.

MR. JOHNSON: Motor -- but motor loads react differently with the electrical system than constant loads do, right?

DR. ENSLIN: Only under contingency conditions. Under steady state conditions --

MR. JOHNSON: So the answer is sometimes?

DR. ENSLIN: Yes --

MR. WAKEFIELD: Well, we didn't study contingency conditions.

MR. ASHTON: Well, I think -- (gavel) -- he gave you an answer to the question. I think he said that at this stage he doesn't know because they didn't run the studies. Now you're putting words into his mouth that I don't think he's prepared to digest.

A VOICE: I like that metaphor.

CHAIRMAN KATZ: Why don't we go to another question.

MR. ASHTON: Yeah.

MR. JOHNSON: Do you -- do you -- does KEMA believe that the presence of motor loads could have a material impact on the analysis compared to the assumption that the loads are constant and the motor loads are not separately modeled?

MR. WAKEFIELD: Well, we stated that we did look at both megawatt loads and mega-VAR loads. And the model that we use, power factory, does represent both real and reactive portions of loads. So in a sense the effects -- some of the effects of the motor loads are incorporated in the loads that we assumed.

Now in terms of detailed modeled motor

dynamics and specific locations of large motor loads on the system, we, once again, did look at numerous buses at sometimes fairly low levels for real and reactive loads, but we did not explicitly model motor dynamics and motor loads separately. And there are numerous models that can get fairly detailed. So in that respect we did not explicitly model motor loads, and we're unable to say what the results of modeling them would be.

MR. JOHNSON: Since Southwest Connecticut is more of an urbanized environment than other parts of Connecticut, would you expect motor loads to be more prominent in Southwest Connecticut than those other areas as a feature of normal electrical operations?

MR. WAKEFIELD: Because of the density of the -- the urban nature and the density of Southwestern Connecticut, one would expect motor loads, especially those associated with building, air-conditioning, chillers, and units of that sort to be greater. With respect to its industrialized nature where you might have very large motor loads in specific locations that could have effects, I would expect it to be lesser so.

MR. JOHNSON: Thank you. Could you turn to the answer you provided to OCC Question 55.

MR. WAKEFIELD: Just one moment please.

(Pause)

MR. WAKEFIELD: Okay, we are there now.

MR. JOHNSON: KEMA there makes reference to the applications of C-type filters in other countries and briefly indicates that there's, to its knowledge, up to five years of operating history with those filters --

DR. ENSLIN: Yes --

MR. JOHNSON: -- in those other places. As far as I can understand in reading your answer to the question, there's no indication of whether those years of history in the other countries have been problem filled or problem free or something in between. Could you give an assessment of what that experience has been, the up to five years experience you refer to in terms of problems with the filters?

DR. ENSLIN: As far as we know, we haven't done a detailed study looking at reliability and so on and availability of these filters. We didn't get across any major reliability problems on this design. The five -- it's probably more than five years, but I think five years from the low end. There are also a number of these installations in the U.S. as far as we know, at least in Alabama Power we believe there are some. There might be some others as well. So we haven't done a detailed study

to determine where they are. We listed there the ones which we as KEMA have been personally involved, so those are real experiences we have with these type of filters.

MR. JOHNSON: And your -- and your understanding of that experience around the nation or around the world is that the years of operation have been pretty much problem free or is that not a fair summary?

DR. ENSLIN: That's -- that's -- we are always -- problems in commissioning and so on -- but operation-wise it's pretty maintenance free, very similar to regular capacitor banks.

MR. JOHNSON: Is KEMA aware of any particular operating complexities or operating difficulties that ISO or other operators would need to understand and take account of in connection with C-type filter applications?

DR. ENSLIN: No. We anticipate that they will be -- and New England ISO -- very similar than standard mechanical switch capacitor banks in terms of operating conditions. We -- we don't -- the protection are somewhat more complicated than a standard bank, but there are good solutions worldwide for these protection issues.

MR. JOHNSON: Do the applications that you

contemplate for the filters if -- you know, if the Siting Council follows in the path you've identified, do those applications require operator intervention or special action by the operators from time to time?

DR. ENSLIN: Not different from standard to mechanically switch capacitors.

MR. JOHNSON: Go if you -- go, if you would, to the answer provided to OCC-59. (Pause). Are you with me?

DR. ENSLIN: Yes --

MR. WAKEFIELD: Yes, we are.

DR. ENSLIN: Yes.

MR. JOHNSON: KEMA says it has no knowledge of power converters within the model used for the study you did. Could the presence of DC to AC converters or similar such devices in electronic proximity to Southwest Connecticut affect the results and conclusions of your analysis?

DR. ENSLIN: Not in the harmonic results. We did include the Glenbrook STATCOM and the filters of the HVDC light connection through the --

MR. WAKEFIELD: Cross Sound --

DR. ENSLIN: -- Cross Sound Cable DC link. We did include those, but just the harmonic portions of

it.

MR. JOHNSON: The -- so you did take account of the Cross Sound Cable --

DR. ENSLIN: Yeah --

MR. JOHNSON: -- installation?

DR. ENSLIN: -- the capacitor banks, yes --

MR. WAKEFIELD: But not as a harmonic source, okay.

DR. ENSLIN: The harmonic source of both the STATCOM in Glenbrook and the HVDC light link would only generate -- if so, they will only generate high frequency harmonics, which is not, you know, in the frequency range which we studied. So they won't affect the lower harmonics as a source of harmonics.

MR. JOHNSON: Thank you. Chairman Katz, I've gone through all the questions I have. Given the carve-out of the topics related to load flow, I would, you know, perhaps want to come back when the other witnesses are available, but that's all I have for now.

CHAIRMAN KATZ: Well, we will reserve your right to revisit on the load flow analysis.

MR. JOHNSON: Thank you.

MR. FITZGERALD: Can I make an inquiry just before Mr. Johnson leaves? He appears to have two sets of

responses from KEMA? Do you --

MR. JOHNSON: Uh --

MR. FITZGERALD: We have an initial -- we have a partial response dated November 29th to your questions --

MR. JOHNSON: I --

MR. FITZGERALD: -- but I don't think we got a second one.

MR. JOHNSON: Commissioner -- or Chairman Katz, what we found on the usual distribution that the Siting Council does of such things, that part of the OCC questions were answered in an initial batch and then about one or two days later all of the OCC questions were asked with the original batch of answers folded in in the order that OCC had asked them, so that it was -- the second document was a complete set of materials. And that's what I'm keying off of. So yes, in terms of what we received from the normal service list distribution procedures, the Commission -- the Council has --

CHAIRMAN KATZ: Mr. Fitzgerald, you did not get this?

MR. FITZGERALD: I would never say that -- (laughter) -- all I would say is that I don't have it from memory and I've not read it -- but there's so much stuff

that comes, I --

CHAIRMAN KATZ: Okay --

MR. FITZGERALD: -- it could have come and I overlooked it, but I -- none of us -- I just checked and none of us have it. It may be that others don't either.

CHAIRMAN KATZ: Okay, we will take note of that --

MR. FITZGERALD: Thank you --

CHAIRMAN KATZ: -- and perhaps during the break we can explore the distribution --

MR. JOHNSON: Chairman Katz, I just looked at the hearing program, which of course was all brought into the record, under Item 13 it's referenced to OCC interrogatories and KEMA's answers, and it refers to the partial answers of one day and the complete set in the next day. So that it's clear -- and also of course given the fact that the Council has distributed them, at least from OCC's computers that they were -- they're in the record.

MR. FITZGERALD: We're not -- we're not raising any --

CHAIRMAN KATZ: No --

MR. FITZGERALD: I just would like --

CHAIRMAN KATZ: -- we'll be glad to discuss

it at the break. Okay, that concludes your questions, Mr. Johnson?

MR. JOHNSON: It does.

CHAIRMAN KATZ: Okay. During -- we passed out a memo from Siting Analyst Mike Perrone to Derek Phelps. The Council itself does not want to make Mr. Perrone a witness. What we want to do is in January ask the Applicant questions about those issues. And we think that's probably the best way to handle it. Miss Randell, do you think -- were you nodding in agreement?

MS. LINDA RANDELL: I'll even say so in agreement. Yes, when this memo was handed out, I conferred with Ms. Bartosewicz and that's what we were going to suggest --

CHAIRMAN KATZ: Okay --

MS. RANDELL: -- we're happy to deal with it in January.

CHAIRMAN KATZ: Right. I think -- my attorney here -- he's telling me that that's -- he thinks that's the cleanest way for us to do it. So what we'll do is use that as a point of information for you. And if you could provide the necessary witness so we could follow up on the those substations and how they might be amendable to C-type filters, we'd appreciate it.

MS. RANDELL: Certainly.

CHAIRMAN KATZ: Okay, boss? (Laughter).

MR. MARCONI: Yes.

CHAIRMAN KATZ: Okay, let's continue on the list. And we are -- State Representative Themis Klarides? Not here. Woodlands Coalition, questions?

A VOICE: No.

CHAIRMAN KATZ: No questions from Woodland. ISO New England, Attorney Macleod. Mr. Macleod.

MR. ANTHONY MACLEOD: Thank you, Madam Chair.

CHAIRMAN KATZ: And again, we will reserve your right in January to ask about the load flow analysis.

MR. MACLEOD: Thank you. Tony Macleod on behalf of ISO New England. Good afternoon.

DR. ENSLIN: Good afternoon.

MR. WAKEFIELD: Good afternoon, Mr. Macleod.

MR. MACLEOD: I guess just to start off with a couple of obvious questions. I think that this represents -- this report represents your final report at least so far, correct?

DR. ENSLIN: Yes.

MR. WAKEFIELD: Yes, that's correct

MR. MACLEOD: And --

(Laughter)

CHAIRMAN KATZ: The word finality and this docket just don't seem to go together.

MR. MACLEOD: And it also represents the completion of your current assignment, correct?

DR. ENSLIN: Yes.

MR. WAKEFIELD: Yes.

MR. MACLEOD: And that assignment again was to determine the maximum technologically feasible amount of underground cable that can be installed in this project from a harmonics viewpoint?

MR. WAKEFIELD: That's correct.

DR. ENSLIN: Yes.

MR. MACLEOD: Okay --

CHAIRMAN KATZ: Can I just ask a clarifying question on that? Mr. Wakefield, it's your understanding that the Council has also engaged you to review the ROC report when it's submitted, correct?

MR. WAKEFIELD: That is -- that is absolutely correct. That was the one hesitation I had in terms of our assignment, because our assignment goes beyond the specific harmonic impedance study to providing other technical assistance to the Siting Council. And

that has been the case since the beginning of our assignment.

MR. MACLEOD: Understood. But with respect to this report, the main purpose of this report at any rate is to determine the maximum technologically feasible amount of underground cable that can be installed on the project, correct --

MR. WAKEFIELD: Yes. As I said earlier --

MR. MACLEOD: -- regardless of any other assistance you may give to the Council --

DR. ENSLIN: Yes --

MR. WAKEFIELD: True --

MR. MACLEOD: -- in terms of reviewing the ROC report or other submissions by the Applicants?

DR. ENSLIN: Yes.

MR. WAKEFIELD: That's correct.

MR. MACLEOD: Okay. And if I understand correctly, your recommendations are basically that -- or your conclusion is that perhaps 10 to 20 miles of additional underground can be installed. And I think you've stated that in terms of being from East Devon to Beseck, but you've also said that perhaps that could be dropped anywhere in the system. At any rate, your conclusion is expressed in a range, is that correct?

MR. WAKEFIELD: Yes, that's correct.

MR. MACLEOD: And your other conclusion is basically that 40 miles would be too risky. You said that as well?

MR. WAKEFIELD: Yes, we have.

MR. MACLEOD: My impression in looking at the report is that you perhaps purposely indicated a range of miles rather than saying, for example, that 17.6 miles could be installed or 22.1 miles could be installed. Am I correct that you -- you have purposely kind of given a round range of possible undergrounding that can be installed, further undergrounding?

MR. WAKEFIELD: Yes, that was intentional. I do not believe there is a bright line as to what -- as to when technological feasibility is exceeded or not. In some cases for certain measures there of course is a bright line. In this case many considerations come into play and there are limits to what are feasible mitigations as you know and -- that was the reason that we specified here a range.

MR. TAIT: Mr. --

MR. MACLEOD: And if I heard correctly this morning, I think you responded to Mr. Fitzgerald's last question as saying you haven't been given exactly this

kind of assignment before, which was to indicate the maximum amount of underground cable that could be installed in a given project.

MR. WAKEFIELD: We --

MR. MACLEOD: You may have conducted harmonic screenings before --

MR. WAKEFIELD: We --

MR. MACLEOD: -- but you haven't actually been asked to determine the maximum amount?

MR. WAKEFIELD: We --

DR. ENSLIN: That's true.

MR. WAKEFIELD: That is correct. I -- as an aside, I rather doubt there are too many entities that have been given the assignment of finding -- (laughter) -- the amount of maximizing the amount of underground --

MR. MACLEOD: Right. I'm not trying to suggest that you have less experience than anybody else in the field --

MR. TAIT: Mr. Wakefield -- excuse me -- do I gather then that your 10 to 20 -- 20 is not a maximum? Is not a finite line? We can go higher than 20?

MR. WAKEFIELD: We --

MR. TAIT: Don't you have some maximum thing?

MR. WAKEFIELD: We --

MR. TAIT: Forty is too much, right?

MR. WAKEFIELD: We --

MR. TAIT: How about 35?

MR. WAKEFIELD: We --

MR. TAIT: How about 30, 27? I'm quite serious --

MR. WAKEFIELD: Yes --

MR. TAIT: -- I took 10 to --

MR. WAKEFIELD: -- I understand that.

MR. TAIT: I took 10 to 20 to mean that 20 was max.

MR. WAKEFIELD: That is in fact what we said. That is -- that is based on the analysis that we did that looked, Mr. Tait, at resonance points that were approaching 3.0 --

MR. TAIT: Can we rely on the 20 as being max?

MR. WAKEFIELD: Yes.

MR. TAIT: And it might be less than 20?

MR. WAKEFIELD: It might.

MR. TAIT: But you're pretty sure that 10 is okay?

MR. WAKEFIELD: Yes.

MR. ASHTON: Well --

MR. TAIT: You'll stand behind 10 and won't go higher than 20?

MR. WAKEFIELD: That's true. We're not backing away from our conclusions --

MR. TAIT: No, I --

MR. WAKEFIELD: -- which --

MR. TAIT: Mr. Macleod raised a question that this was a range, that I understand 17.3 is too much -- I mean --

MR. WAKEFIELD: That's okay --

MR. TAIT: -- you can't do that --

MR. ASHTON: Let me be sure I understand it. Earlier today you testified that your work was indicative, not definitive --

MR. WAKEFIELD: That's correct.

MR. ASHTON: -- in coming up with the 20, that is insofar as you have made studies --

MR. WAKEFIELD: Yes --

MR. ASHTON: -- and that work or that conclusion is subject to verification or possible change based upon additional network analysis, further refinements, what have you. So, I -- in answer to Mr. Tait's question, the answer is it's indicative at this

time given the studies we have done, but not conclusive? Is that a fairly -- a fair statement?

MR. WAKEFIELD: That is. And we -- in our -- I believe the words in the report very -- and in the executive summary clearly state from a harmonic resonance perspective alone we make these conclusions. And obviously our conclusions are based on the study that we made.

MR. ASHTON: That's fine.

MR. MACLEOD: Is -- I'm sorry, Mr. Ashton --

MR. ASHTON: (Indiscernible, overlap of talking) -- Mr. Macleod. I'm all through.

MR. MACLEOD: Okay. Is -- is another way to put that maybe then that the results of your harmonic screens would limit the amount of undergrounding to an additional 20 miles, but that that conclusion is subject to further limitation based on the results of TNA studies and contingency studies?

MR. WAKEFIELD: I wouldn't put it quite that way. That conclusion has already been qualified and it doesn't --

MR. MACLEOD: Which -- when you say that conclusion --

MR. WAKEFIELD: The conclusion that you refer to that's in our report --

MR. MACLEOD: Okay --

MR. WAKEFIELD: -- that based on harmonic resonance studies alone --

MR. MACLEOD: Um-hmm --

MR. WAKEFIELD: -- we conclude 10 to 20 would be feasible. But we also acknowledge in our study and in our recommendations that transient network analyses need to be performed. And if conditions result from those additional studies that cannot be mitigated, then they would cause the earlier conclusions to be -- to need to be revisited.

MR. MACLEOD: I understand that, but I guess I was trying to put it in a different way. I think you responded to either Professor Tait or to Mr. Ashton that you stood behind your conclusion that from a harmonics viewpoint, 20 miles was the maximum?

MR. WAKEFIELD: Yes.

MR. MACLEOD: Are you suggesting that the results of the TNA study might increase the amount of undergrounding that is possible or would the harmonics conclusion that you reached still apply in terms of limiting it to 20 miles?

MR. WAKEFIELD: I believe that -- no, I don't believe the transient network analysis will lead to the conclusion that a greater amount could be undergrounded --

MR. MACLEOD: Okay --

MR. WAKEFIELD: -- however, everything is possible.

A VOICE: There you go.

MR. MACLEOD: Well -- (laughter) -- I'm not going to go there -- yeah, subject to check, very good -- (laughter) --

A VOICE: Somebody will.

MR. MACLEOD: And I take that just in terms of your qualification with respect to TNA analyses and contingency studies, that there is nothing you've said today in response to questions from anybody or in your report regarding possible undergrounding from a harmonics viewpoint that is not subject to the results of a TNA study and contingency studies? Too many double negatives?

MR. WAKEFIELD: Yeah, I --

MR. MACLEOD: I can put it another way. Is there anything you've -- is there any -- anything you've said in your testimony today or in your report that would not be subject to your qualification regarding the need

for further TNA analysis and the contingency studies?

MR. WAKEFIELD: Yes. I would say that our -- our results clearly show the difference between the Phase 1 system and the Phase 2 system from a harmonic perspective. And even with transient network analyses, we are -- we are confident that having a lower harmonic impedance at the lower order of harmonics will be better than having a higher impedance. We're also --

MR. MACLEOD: Well, I meant --

MR. WAKEFIELD: -- we're also confident --

MR. MACLEOD: Maybe I can shortcut that. I meant with respect to your 20-mile conclusion --

MR. WAKEFIELD: Oh, with respect to the 20-mile --

MR. MACLEOD: Yeah --

MR. WAKEFIELD: -- alone?

MR. MACLEOD: Right.

MR. WAKEFIELD: The only thing I guess I would say with respect to that would be the mitigation results that are in our report, we're confident that the action -- the appropriate application of C-type filtering could be beneficial regardless of what the transient network analyses show because of their ability (1) to reduce harmonic impedances in areas where there are

critical problems; and second, because they allow the switching in and out of capacitor banks without shifting the harmonic impedance points or peaks of the system, which is the difference between the C-type filter as a way of switching capacitance in and off the system and traditional switch capacitors.

MR. MACLEOD: Can we go to your report for a few moments. I believe on page 27 you said that a load in the range of 70 to a hundred percent of the full load with all capacitors in service was expected to be the worse case from a harmonic impedance perspective. That's at the -- under 3.6.5 in the first paragraph.

DR. ENSLIN: Yes.

MR. WAKEFIELD: Yes.

MR. MACLEOD: Let's suppose that -- now you have the capacitors in service at that point, correct?

MR. WAKEFIELD: Yes --

DR. ENSLIN: Up to 70 --

MR. MACLEOD: Let's suppose that you were operating at 40 percent load --

MR. WAKEFIELD: Um-hmm.

MR. MACLEOD: -- would you still have all the capacitors in service?

MR. WAKEFIELD: I --

DR. ENSLIN: I guess not.

MR. WAKEFIELD: I doubt very much that you would.

MR. MACLEOD: And if you had replaced those capacitors with C-filters, would you have the filters in service --

DR. ENSLIN: Probably not --

MR. MACLEOD: -- at 40 percent load?

MR. WAKEFIELD: Do you want to answer that?

COURT REPORTER: One moment please.

DR. ENSLIN: Sorry.

(Pause)

CHAIRMAN KATZ: (Indiscernible) -- C-type filters are passive filters, no one is actively putting them in or out of service, correct?

DR. ENSLIN: Well, the ISO at similar considerations for a regular mechanical switch capacitor can decide to put the capacitor in or out. There's another criteria which can be used here, and that is damping. So if the ISO or whoever decided it may be a good idea to keep the capacitors in even at lower load levels and it still can maintain the voltage and thermal ratings on the system, then it may be a good idea keeping those capacitors in service for a longer time just from a

damping point of view, not from a resonance or anything like that, just from a damping point of view. So they are not -- they can be an extra criteria, a positive criteria which you can use to actually determine if a capacitor should be in or out.

MR. MACLEOD: Well --

CHAIRMAN KATZ: But once the C-type filter is put on line, then it's --

DR. ENSLIN: It's in or out. It's in or out.

CHAIRMAN KATZ: It's in or out --

DR. ENSLIN: That's right --

CHAIRMAN KATZ: -- by whatever the circuit is --

DR. ENSLIN: That's right.

CHAIRMAN KATZ: Okay.

MR. FITZGERALD: Well --

DR. ENSLIN: There's no control. It's just in or out.

CHAIRMAN KATZ: Yeah. Mr. Fitzgerald, did you have a question?

MR. FITZGERALD: I didn't hear -- you kind of trailed off in your statement, so I didn't hear the end of it.

CHAIRMAN KATZ: I asked if once the C-type filters are put on line in a system, then they're operating based on what they see on the circuit. And he said yes. Correct?

DR. ENSLIN: Yes.

MR. MACLEOD: If -- let's take this in a couple of steps. Is it possible to have some but not all filters operating?

DR. ENSLIN: Yes.

MR. WAKEFIELD: Yes.

MR. MACLEOD: And if you're at lower load, say again 40 percent, would it be likely or is it possible that you would only be operating 30 to 40 percent of the filters?

DR. ENSLIN: Probably --

MR. MACLEOD: I mean I'm not asking what the exact --

DR. ENSLIN: The exact number --

MR. MACLEOD: -- relationship is, but I mean --

DR. ENSLIN: At that -- at that sort of low voltage level, probably most of it will be off.

MR. MACLEOD: Okay.

MR. WAKEFIELD: Yes.

DR. ENSLIN: Just from a voltage profile point of view.

MR. MACLEOD: And if they were off, would you still have the filtering and the damping?

DR. ENSLIN: No.

MR. WAKEFIELD: No. But you would have something good. You would have less capacitance on your system. And when you get less capacitance on your system, your resonance points move to the right, they move up.

MR. MACLEOD: Well as between -- if you were at the 40 percent load level --

MR. WAKEFIELD: Yes --

MR. MACLEOD: -- and you did not have the benefit of the damping and the filters, would that change your assumptions or your results that you obtained in your study based on 70 to 100 percent of the load being the worse case scenario --

MR. WAKEFIELD: I doubt --

MR. MACLEOD: -- with all caps on?

MR. WAKEFIELD: I don't think it would change that conclusion. Forty percent load, my understanding is that's pretty close to the light load cases that are studied for ISO New England. At least the CL&P loads that we examined indicated that the 2009 summer

light load case was roughly 40 percent of the 2009 summer peak case. So if that's your light load case, from a power flow perspective, I very much doubt that you're going to have very many capacitors on in your system. And that being the case, I believe that your resonance peaks will have moved significantly to the right. And therefore, this will not, I don't believe, affect the conclusions we've drawn at all.

MR. MACLEOD: With respect to load, I had one other question in your conclusions, and I just wanted to clarify this, and I think it's a fairly simple answer. Your first conclusion on page 68 indicates that system resonance peaks are better in the KEMA results than in the Applicants' Phase 2 base case due to the fact that active and reactive power loading was added at all the different substations --

DR. ENSLIN: Well at all the different loads --

MR. MACLEOD: -- did -- did you put -- I beg your pardon?

MR. WAKEFIELD: I'm sorry, could we clarify exactly where on page 68, because I know you told me --

MR. MACLEOD: Conclusion --

MR. WAKEFIELD: -- but I --

MR. MACLEOD: -- yeah, down at the bottom, it's Conclusion No. 1.

MR. WAKEFIELD: Yes, okay. Do you have it?

MR. MACLEOD: And I was reading the last couple of lines.

DR. ENSLIN: 69 --

MR. WAKEFIELD: No, 68. Make sure you get to the right place here.

DR. ENSLIN: Okay -- there, got it.

CHAIRMAN KATZ: Power loading I believe is where you're asking the question, was added at the different substations?

MR. MACLEOD: Yes. Now my question was simply whether or not you put more load in than G.E. did in its studies?

MR. WAKEFIELD: That we do not know because we were -- we had -- all we have to go on in that respect is what I read this morning, which was the response from the Applicant when we asked what the active and reactive loads were that G.E. had assumed in its studies. And we were told only that they did introduce load for damping. And the -- so we -- we don't -- we don't know whether what we added was greater or lesser than the loads assumed by G.E. in their modeling.

MR. MACLEOD: Getting back to the notion of -- or the desired goal of technological feasibility, I take it we're all on the same page that what we're in search of here is reliability and a reliable system. And I think you alluded this morning to factors such as engineering judgment. I know that you testified this morning -- I think I heard you refer to a huge range of conditions that can occur on the system. And I know that you've indicated that this particular kind of assignment is not one that you have undertaken before. Is the -- in terms of reliability for a non-technical person like myself, I envision a cliff, and I don't know whether at some point you become unreliable, whether it's that bright a line. But is it fair to say that given the various conditions that can occur on the system, the fact that we perhaps haven't gone to this extent before of trying to determine the exact maximum amount of underground you can put in a system of this sort, that engineering judgment would come into play in establishing a kind of margin of safety between where you go and where the edge of the reliability cliff is? Would that be a proper thing to do --

MR. WAKEFIELD: Would it be proper --

MR. MACLEOD: -- to leave yourself --

MR. WAKEFIELD: Would it be proper to conclude that engineering judgment must be exercised in deciding what is technologically feasible and what is not technologically feasible --

MR. MACLEOD: Well, that's --

MR. WAKEFIELD: -- is that what you're asking me?

MR. MACLEOD: No, that's -- that's -- I'm assuming the answer to that is yes --

MR. WAKEFIELD: I like that question -- (laughter) --

MR. MACLEOD: -- that sounds rather logical, but --

MR. FITZGERALD: We'll all adopt it.

MR. MACLEOD: I'm assuming that based on the fact that there are a lot of different conditions at play here, that you can make different assumptions about what the system is today, what it will be five years from now, ten years from now, during the life of this expected improvement, that things may change, and that we don't even know today with certainty what we're facing. You, for example, have not done a contingency study. I don't know that anybody has seen how this will operate once we have, you know, a full contingency study done --

CHAIRMAN KATZ: Mr. Macleod, you're really bordering on the edge of testimony by these long questions, so if we could make them shorter, that would be great.

MR. MACLEOD: I will try -- I will try. Is it --

MR. ASHTON: We can always swear him in --

MR. MACLEOD: I'd rather not be sworn in, thank you. Is it appropriate in designing a system to allow a margin of safety to take into account the sorts of uncertainties and variations in operating conditions that can occur on the system when you're trying to determine how much underground cable can be put in?

MR. WAKEFIELD: Yes, it is appropriate to do so. I think we have an example of that before us. The Applicant brought a proposal to the table a year ago that included a level of undergrounding with HPFF, which ISO New England then found unacceptable after further studies. ISO New England and the ROC group established a 3.0 standard or benchmark for which to judge acceptability. I have always assumed and I think others have, but I'll speak only for myself, that that 3.0 was based on having some margin there. And possibly various studies that took place subsequently by the Applicant may have convinced

them that in fact such was wise. When we looked at Phase 1 alone, even though our studies were limited, we found that it would not pass that standard. That does not in itself mean that Phase 1 is not reliable. It does mean that additional studies sometimes lead to refinement and to a need to change what are these margins that you're talking about. That's -- I mean reliability standards setting and power system planning are always based on looking at a number of additional things that give us a margin of safety --

MR. MACLEOD: So --

MR. WAKEFIELD: -- that's why we look at worse cases, not because we think the worse cases are really going to happen, but because the worse cases take into account the fact that other things happen which we didn't anticipate and now all of a sudden we wish we'd planned differently. It's a -- it's a very challenging process to plan a power system. And we -- we understand that. And we have participated in that process numerous times and -- and I think I've said enough.

MR. MACLEOD: So technological feasibility, in other words, may not mean that you go absolutely as far as you can before you go over the reliability cliff?

MR. WAKEFIELD: That's right.

MR. MACLEOD: I tried to make that a short answer -- or a short question, Madam Chair --

CHAIRMAN KATZ: We appreciate that.

MR. MACLEOD: -- thank you. Taking a quick look at the interrogatory responses that you provided to ISO, Interrogatory No. 1 asks for information about the size of C-type filter installation. And you've given some testimony on that today. Your interrogatory response indicates that you contacted filter manufacturers I believe. Are the C-type filters that you're referring to there designed for steady state duty?

MR. WAKEFIELD: First there's part of your question which doesn't reflect our answer --

MR. MACLEOD: Okay --

MR. WAKEFIELD: Would you like --

DR. ENSLIN: You indicated that we contacted filter manufacturers? Our experience from previous --

MR. MACLEOD: Oh, I'm sorry --

DR. ENSLIN: -- from previous designs --

MR. MACLEOD: -- it says the final -- the final size depends on the selected manufacturer --

DR. ENSLIN: Yeah --

MR. MACLEOD: I'm sorry, I misstated that -

-

DR. ENSLIN: -- that is correct.

MR. WAKEFIELD: Um-hmm.

MR. MACLEOD: Is the -- is the -- let me withdraw that. I think you had testified that you were familiar with some recent installations in the United States. Were those C-filters designed for steady state duty?

DR. ENSLIN: The ones which I've got knowledge about are in Europe actually.

MR. MACLEOD: Oh, okay. I thought you'd said something about Alabama a little earlier?

DR. ENSLIN: That's just a paper I got, so I -- I don't know the details.

MR. MACLEOD: Okay.

MR. WAKEFIELD: But -- but that is in service?

DR. ENSLIN: Yes, that's in service.

MR. WAKEFIELD: So it obviously must be dealing with steady state situations?

DR. ENSLIN: That's right.

MR. WAKEFIELD: And what was the size of -- no, I'm sorry, I'm not asking questions -- (laughter) --

MR. MACLEOD: You can go ahead if you want

--

MR. WAKEFIELD: Well --

MR. MACLEOD: -- I'll listen to the answer and I'll see whether I have any --

DR. ENSLIN: If I can recall correctly, I think it was a 220-kV installation and it was at two different substations, a hundred mega-VARS each, I think.

MR. MACLEOD: Is this the Alabama one or --

DR. ENSLIN: I think so, yeah --

MR. MACLEOD: Okay --

DR. ENSLIN: -- it's the Alabama one.

MR. MACLEOD: Well, is it -- is it true that you would need a larger C-type filter in order to deal with the extreme temporary duty from simultaneous in-rush from many transformers?

DR. ENSLIN: If you design the filter to actually filter those in-rush currents, yes.

MR. MACLEOD: Okay, so --

DR. ENSLIN: But you can decide not to do that by shifting the resonance.

MR. MACLEOD: And when you say --

CHAIRMAN KATZ: Shifting the what, I'm sorry?

DR. ENSLIN: By shifting the design or

changing the design --

MR. WAKEFIELD: Tune -- tune --

DR. ENSLIN: Tune the design of the filter.

CHAIRMAN KATZ: Thank you.

MR. MACLEOD: And when you estimate that the C-type filter installations here would be 50 to 100 percent larger than the footprint of capacitor banks, are you talking about the steady state C-type filters or --

DR. ENSLIN: Yes --

MR. MACLEOD: Okay --

DR. ENSLIN: -- yeah, steady state.

MR. MACLEOD: And so, conceivably, then you would need even larger space for C-type filters which were large enough to handle temporary over-voltages?

DR. ENSLIN: Temperature over-voltages or --

MR. MACLEOD: I'm sorry --

MR. WAKEFIELD: Temporary --

MR. MACLEOD: -- the in-rush from --

DR. ENSLIN: Other currents?

MR. MACLEOD: Yeah, right.

DR. ENSLIN: Yeah. But I don't think it's going to be that large differently.

MR. MACLEOD: In terms of the spacing of C-

type filters, now there's a reactor component --

DR. ENSLIN: Yes --

MR. MACLEOD: -- with a C-type filter, correct -- would you need -- you would need, would you not, to allow sufficient space between the reactor and other components to, basically, prevent the --

DR. ENSLIN: Voltage --

MR. MACLEOD: -- the magnetic current from the reactor from affecting the other components?

DR. ENSLIN: It depends on what technology reactor you use. If you use a air core reactor, that is the case, yes.

MR. MACLEOD: Alright. So wouldn't that suggest that you can't -- you're not going to be able to stack all of these? There's some reference I think in the interrogatory responses to stacking --

DR. ENSLIN: Some --

MR. MACLEOD: -- in order to minimize space --

DR. ENSLIN: Some of the components like the resistors are stacked normally. I've seen some reactors I think stacked as well. Normally, the reactors are large, so they're mounted -- if there's enough space, they're mounted on the floor -- you know, on the ground

level.

MR. MACLEOD: And if you had larger C-type filters in order to deal with the in-rush, the transformer in-rush, would you still be able to stack them or would you need to space them?

DR. ENSLIN: That -- that's difficult to determine on this -- on here --

MR. O'NEILL: Pardon me, I'd like to inject a question if I may. Thank you. Has the Canadian power industry used C-filters?

DR. ENSLIN: As far as I know -- again this is just not from personal experience, but I believe also -- hydro has DC links, some of the filtering capacitors are also C-type design.

MR. O'NEILL: Of the size and capacity --

DR. ENSLIN: Yeah, yeah. Probably larger I guess.

MR. O'NEILL: Probably or --

DR. ENSLIN: I'd have to -- I'm not sure right now.

MR. O'NEILL: You're not certain. Thank you.

MR. MACLEOD: In terms of tuning the filters, is it true that the properties change with

temperature and age?

DR. ENSLIN: Yes.

MR. MACLEOD: Such that you need to go back and return the filters?

DR. ENSLIN: It depends on the design. If you have a very sharply tuned filter, it may -- it may be necessary. If it's designed such to have a bit larger variation in both component parameters and frequency, it's probably not necessary.

MR. MACLEOD: Well, let's say that you have a climate where you have hot summers and cold winters and you have that kind of temperature change, is that going to affect over a period of time the need to tune the filters?

DR. ENSLIN: Yeah, if you have large temperature variations, you -- you may have to design that in the original design. But in the -- I'm not as sure if you really have to go back quite often to retune them --

MR. MACLEOD: If you do --

DR. ENSLIN: -- I don't think that is --

MR. MACLEOD: If you do have to retune them, how -- how long -- would you -- would you need to take them out of service to do that?

DR. ENSLIN: Well if you do it on the capacitor side, it's probably quite quickly, just take a

few in and out to get back to the resonance frequency.

MR. MACLEOD: But they do have to go out of service --

DR. ENSLIN: Yeah --

MR. MACLEOD: -- for a period of time?

DR. ENSLIN: -- if you have to retune.

MR. MACLEOD: And how many filters -- do you have any idea how many filters we would be talking about in terms of optimizing the system here?

DR. ENSLIN: We studied in our report I think -- we studied in total five different filters of different sizes. Two are at about 150 mega-VARS and the others are -- no, sorry -- three is about 150 and one is 260 and the other one is 130. So it's basically just a replacement of the original capacitors at the substation, but this is not optimized as I said before.

MR. MACLEOD: Well has KEMA performed any studies to estimate what it would cost to modify the substation capacitor banks at Frost Bridge, Southington, Glenbrook, and Berlin Substations to C-type filters?

DR. ENSLIN: No --

MR. WAKEFIELD: No --

DR. ENSLIN: -- we haven't done a detail design.

MR. MACLEOD: And I guess the final question is you have acknowledged -- you do acknowledge that if the results of the transient network analyses and the contingency studies are not satisfactory, then you would conclude that the extension is not workable?

MR. WAKEFIELD: If --

MR. MACLEOD: I'm looking at your interrogatory response 26 to ISO if you want to refer to that.

MR. WAKEFIELD: Alright.

CHAIRMAN KATZ: Before you answer that question, could you clarify what you understood satisfactory to mean in the question?

MR. WAKEFIELD: No, but it would be helpful to know what satisfactory means in that context.

CHAIRMAN KATZ: Could you expand on your question then.

MR. WAKEFIELD: 26 --

MR. MACLEOD: I would say that it would be something which would result in acceptable thermal voltage stability and short-circuit duty limits, that it would be within harmonic screening limits, and that there would be means of accommodating temporary over-voltages. But I am not an engineer, so consequently I would have to say that

it would be whatever the engineers would find satisfactory --

CHAIRMAN KATZ: No -- that's -- I think that's a much better question than asking just satisfactory.

MR. MACLEOD: Okay.

MR. WAKEFIELD: What I was going to add in responding to your question was -- I'm sorry, is there another question before --

CHAIRMAN KATZ: No.

MR. WAKEFIELD: Was that if these analyses yield results that are not satisfactory -- and their satisfactory can be used to mean a number of different possible technical conditions that could result from these studies, including over-voltages, but there's another couple -- another few words that are important in our response, and that is if they're not satisfactory and if no acceptable mitigation is possible --

MR. MACLEOD: Yes, understood --

MR. WAKEFIELD: -- then we would conclude that an underground extension would not be workable.

MR. MACLEOD: And by acceptable mitigation, do you include in terms of what is acceptable something that is not so complex as to impose undue operational

difficulty? In other words, it's not undesirably complex?

MR. WAKEFIELD: In determining what's unacceptable --

MR. MACLEOD: Yeah --

MR. WAKEFIELD: -- do I include operational considerations?

MR. MACLEOD: Yes.

MR. WAKEFIELD: I do.

MR. MACLEOD: Yeah. Thank you. No further questions.

CHAIRMAN KATZ: Thank you, Mr. Macleod. We're going to take our afternoon break in a moment but I just want to see on who we have left that wishes to cross-examine KEMA today. Can I have a show of hands for parties which plan to cross-examine KEMA. (Pause). Okay, we're going to take a break and then we're going to come back and --

A VOICE: (Indiscernible) --

CHAIRMAN KATZ: Yeah, I know. We're going to come back and do Council questions.

MR. FITZGERALD: I do -- I do have some very brief just to close -- actually raise by something you asked -- (laughter) --

MR. MACLEOD: That lets me off the hook.

CHAIRMAN KATZ: Okay, we'll take a 10-minute break. We'll come back to Mr. Fitzgerald and then we'll do Council questions.

(Whereupon, a short recess was taken.)

CHAIRMAN KATZ: Okay, we will resume. The first item, we have a housekeeping matter. We have one KEMA exhibit that we forgot to list in the hearing program and to have verified. And Mr. Marconi, if you'll take it from here.

MR. MARCONI: Yes. I would -- again I would ask both witness to examine what we're going to add to the hearing program as Exhibit 21, Council Exhibit 21, which would be KEMA's responses to ISO New England's interrogatories, dated November 22, 2004. I would ask if both you gentlemen can respond whether you're familiar with KEMA's responses?

MR. WAKEFIELD: Yes, we are.

DR. ENSLIN: Yes, we are.

MR. MARCONI: And do you have any changes or corrections that you would like to make to those responses?

MR. WAKEFIELD: No.

DR. ENSLIN: No.

MR. MARCONI: And do you adopt those

responses as KEMA's testimony today?

MR. WAKEFIELD: Yes, we do.

DR. ENSLIN: Yes.

MR. MARCONI: And Madam Chair, then I would ask that these responses be added as an exhibit and admitted.

CHAIRMAN KATZ: Any objection to making No. 21 a full exhibit? Hearing none, it's a full exhibit.

(Whereupon, Siting Council Exhibit No. 21 was received into evidence as a full exhibit.)

CHAIRMAN KATZ: Mr. Fitzgerald, we are tracking down the full set of KEMA responses to the OCC interrogatories.

MR. FITZGERALD: Thank you, I appreciate it.

CHAIRMAN KATZ: Because in checking my stack, I also did not have it.

MR. TAIT: The only Fitzgerald statements -- (laughter) --

CHAIRMAN KATZ: Okay. Mr. Fitzgerald, we're going to go to you and then we're going to start down with Mr. Cunliffe and go to that end of the table.

MR. FITZGERALD: Thank you, Madam Chairman. Gentlemen, I want to ask you a couple of questions taking

off from a statement or a question that Chairman Katz made, and I believe what she said was --

CHAIRMAN KATZ: I'm already regretting this -- (laughter) --

MR. FITZGERALD: Once --

MR. ASHTON: (Indiscernible) --

MR. FITZGERALD: Once filters are in service, they are either on or off according to what they see. Now -- that's s-e-e I think --

CHAIRMAN KATZ: That's my one semester of double E questions -- (laughter) --

MR. FITZGERALD: Now, C-type -- C-type filters include a capacitor as one of their components, right?

MR. WAKEFIELD: Yes.

DR. ENSLIN: Yes.

MR. FITZGERALD: Okay. And actually, isn't it the case that the filters are on or off according to whether the capacitors are on or off?

DR. ENSLIN: It's -- it's one design, so it's a capacitor, a reactor. And it's -- it's all in one --

MR. FITZGERALD: Yes --

DR. ENSLIN: -- and if you turn on the

capacitor, all of that is in service.

MR. FITZGERALD: Right. So if you turn on the capacitor, it's all in service. If you turn off the capacitor, there's --

DR. ENSLIN: It's all off.

MR. FITZGERALD: It's all off, there's no filtering going on?

DR. ENSLIN: No.

MR. FITZGERALD: Okay. And whether or not the capacitor and therefore the filter is on, will depend on the need for reactive power support for voltage in the local area?

DR. ENSLIN: Mainly, yes.

MR. FITZGERALD: Now, Mr. Wakefield made the point that if the caps are switched out in addition to the filters going off, something else happens, which is capacitance is taken off of the system, so there's less capacitance for the system to deal with, right?

MR. WAKEFIELD: That's right.

MR. FITZGERALD: Okay. So on the one hand there's no -- the filter isn't operating and on the other hand there's less capacitance on the system?

(No audible response)

MR. FITZGERALD: Now once the Bethel to

Norwalk project is built and the Middletown to Norwalk project is built, assuming that Middletown to Norwalk has at least 48 circuit miles of underground cable, the capacitance on the Southwest Connecticut system that will contributed by capacitors, including the capacitors in the filters, will be less than the capacitance contributed by the underground cable systems, alright?

(No audible response)

MR. FITZGERALD: And the capacitance associated with the cables will be there all the time, it never gets switched on or off?

MS. RANDELL: You need them to respond --

MR. FITZGERALD: Oh, I'm sorry --

MS. RANDELL: -- you've asked two questions --

MR. FITZGERALD: I'm being -- I'm being reminded that I haven't required audible responses.

CHAIRMAN KATZ: Yes, please.

MR. FITZGERALD: Two -- alright, so there's two -- two questions I guess -- of course one of them was the long one, what -- what --

MS. RANDELL: Just have him confirm, he said yes --

MR. FITZGERALD: Okay. Could you just

confirm, you said -- you answered affirmatively to the last two questions?

DR. ENSLIN: I just want to get them again please.

MR. FITZGERALD: Okay. Once -- once the Bethel to Norwalk project and the Middletown to Norwalk project are built, assuming that Middletown to Norwalk has at least 48 circuit miles of underground cable, the capacitance on the Southwest Connecticut system that will be contributed by capacitors, including those in the C-filters, will be less than the capacitance contributed by the underground cable systems?

DR. ENSLIN: Yes.

MR. FITZGERALD: And the capacitance associated with the cables will be there all of the time, it is not switched in and out?

DR. ENSLIN: Except if one of the cables are switched off of course.

MR. FITZGERALD: Except if one of the cables is switched off, such as we -- well, I'll just leave it with that. So at low load, say 40 percent of peak, you would not expect the capacitors to be on, right?

MR. WAKEFIELD: No. That's not to say that there couldn't be some that would be on, but you would not

expect the capacitors, the switch capacitors that are there for voltage support to be on in a 40 percent load.

MR. FITZGERALD: Okay. Mr. Enslin, is that --

DR. ENSLIN: Yes.

MR. FITZGERALD: -- your answer as well -- okay. Therefore, you would not expect the C-filters to be operating at that load level?

DR. ENSLIN: That's possible.

MR. FITZGERALD: You would expect that under those conditions the system would be operating with the capacitance of the cables?

DR. ENSLIN: Yes.

MR. FITZGERALD: And that capacitance would therefore be un-mitigated by the C-filters?

DR. ENSLIN: That's possible.

MR. FITZGERALD: And that is not a set of conditions that you modeled?

DR. ENSLIN: No.

MR. FITZGERALD: And that was because you expected that the worse case conditions that you set out to model would be high load conditions --

DR. ENSLIN: Um-hmm --

MR. FITZGERALD: -- with capacitors --

DR. ENSLIN: Um-hmm --

MR. WAKEFIELD: Well, we did -- I'm sorry -- just to -- just -- because it -- it's not directly what you've suggested, but it's very close to it. We did look at a number of cases at 50 percent load --

MR. FITZGERALD: Okay --

MR. WAKEFIELD: -- and those cases had all the capacitance of the underground cable, XLPE and HPFF. And on top of that, all capacitors switched on. So they were worse than the case where you'd have your capacitors switched on. And 50 percent load is a pretty low load, it's very close to the light load case that's run for study purposes, so --

MR. FITZGERALD: Which is -- which is --

DR. ENSLIN: Forty --

MR. FITZGERALD: -- 40 percent --

MR. WAKEFIELD: Forty percent.

MR. FITZGERALD: Okay. Just a moment please. (Pause). But in that case that you just described with the 50 percent load, were the C-filters on?

DR. ENSLIN: Yes, I think they were.

MR. FITZGERALD: Because if the capacitors were on, the C-filters were on?

MR. WAKEFIELD: Yes, that's right --

DR. ENSLIN: Yeah, if the capacitors are on --

MR. WAKEFIELD: -- that's right --

DR. ENSLIN: -- then the C-filters are on as well.

MR. FITZGERALD: Okay. Thank you.

MR. TAIT: Is that all, Mr. Fitzgerald?

MR. FITZGERALD: Yes.

MR. TAIT: Fred.

MR. CUNLIFFE: Thank you, Vice Chair. The C-type filter -- this is on page 34 of your report, the third paragraph down -- the C-type filter provides fundamental power reactive -- fundamental reactive power, but provides harmonic filtering characteristics at lower frequencies and damping characteristics at higher frequencies. Could you define damping?

DR. ENSLIN: Yes. At higher frequencies the shunt resistor is actually damping the higher frequencies which may be associated with the voltage at that bus bar.

MR. WAKEFIELD: Let me just add that -- I believe, and you can correct me if I'm not stating it correctly -- that damping in this context means attenuating the impedance of or reducing the impedance of.

Is that --

DR. ENSLIN: That's correct --

MR. WAKEFIELD: -- would you agree?

DR. ENSLIN: Yeah.

MR. CUNLIFFE: Thank you. And if I could go to page 67, Figure 15. While you've identified lower order harmonics, there are also higher order harmonics. What is their implication to the system? And is there --

DR. ENSLIN: Yes, there are some higher order harmonics. We haven't focused on those. But if you could look at that specific results you see for especially I think the 40 miles underground, it has a higher resonance at about the -- what is it -- the eighth -- nearing the ninth harmonic. And as you decrease the undergrounding, the resonance goes up. And that's based on the system characteristic.

MR. CUNLIFFE: Does that need to be attenuated in any way?

DR. ENSLIN: Well just looking at that picture, it's relatively -- even though it looks as a high peak, if you really look at the axis, it's only at about 200, 250 amps, so it's not actually that bad to be honest. It's about three to four times -- even -- I don't even think three times the characteristic impedance of a

system. So it's -- the eleventh may be a bit of a problem. And it should -- you know, it's at least been looked at. But I don't see it as a major issue.

MR. CUNLIFFE: Thank you. Those are my questions.

MR. TAIT: Brian.

MR. EMERICK: Yeah, I have a couple of questions. Your study is based upon the use of XLPE cable. Do you have direct experience in using 345 XLPE cable?

DR. ENSLIN: You mean personally --

MR. EMERICK: Yes --

DR. ENSLIN: -- within KEMA? KEMA is a consulting company and we don't operate systems. But yes --

MR. EMERICK: You've designed --

DR. ENSLIN: -- we've specified and designed cables, XLPE cables up to that voltage level, yes.

MR. EMERICK: I guess eliminating the risky scenario that you evaluated and focusing on the 20-mile addition, if you were to go that route, it adds 88 circuit miles of XLPE. Do you know if XLPE has a fault rating?

DR. ENSLIN: A fault rating you mean?

MR. EMERICK: Yeah.

DR. ENSLIN: Yeah, it's like --

MR. WAKEFIELD: I'm sure it does.

DR. ENSLIN: It does have a fault rating.

MR. EMERICK: Do you know what it is?

MR. WAKEFIELD: That would depend on the particular cable and its design, and those vary with manufacturers. We don't have a specific fault rating for a specific cable before us, but --

DR. ENSLIN: We can get it.

MR. WAKEFIELD: One manufacturer of course is ABB and they -- we -- Dr. Hu has looked at some of their data. And I'm sure that fault ratings and tolerances will be addressed in the detailed information on their -- in the manufacturer's products.

CHAIRMAN KATZ: Let me sort of ask a follow-up question. Let's assume for a minute that the ROC report has 24 miles of XLPE in it and they give us a fault rating of what those 24 miles of XLPE is. Could we extrapolate that fault rating into the XLPE that you're talking about north of East Devon? I mean there wouldn't be any difference, correct? Wouldn't you probably want to use the same cable manufacturer for both?

DR. ENSLIN: Yes, you would probably want

to use the same.

CHAIRMAN KATZ: Okay. And if the fault rate isn't in the ROC group report, we'd appreciate it if it gets in there.

MR. TAIT: Is the fault rate from Dr. Gregory in this docket?

MR. FITZGERALD: Yeah, there's a --

MR. EMERICK: We have a --

MR. FITZGERALD: -- there is an exhibit. I can't -- I can't tell you offhand what it is, but there's an exhibit in which he --

MR. TAIT: Didn't he testify himself --

MR. FITZGERALD: He testified and he --

AUDIO TECHNICIAN: Mr. Tait --

MR. TAIT: I'm sorry. Didn't Dr. Gregory testify as well as some CL&P witnesses --

MR. FITZGERALD: Dr. Gregory submitted an exhibit in this docket which updated his fault rate estimates from Docket 217.

MR. TAIT: Right. And is KEMA aware of that exhibit or that -- that exhibit in this docket?

MR. WAKEFIELD: I am aware of the earlier information that Dr. Gregory provided, I believe it was back in June. I have not seen the update.

MR. EMERICK: I guess I would ask if you could familiarize yourself with the updated fault rating that we have. And given the fact that you just indicated you have experience with 345 XLPE, as to whether you agree with that rating that we currently have in the record.

MR. TAIT: Miss Randell.

CHAIRMAN KATZ: Yes, Miss Randell.

MS. RANDELL: Thank you. I'm advised by my technical people to ask whether we could have a clarification, because when -- I think what you're talking about is fault rate and not fault rating --

MR. ASHTON: Failure rate --

MS. RANDELL: -- and I just thought --

MR. WAKEFIELD: Okay --

CHAIRMAN KATZ: Okay --

MS. RANDELL: -- we'd clarify that --

DR. ENSLIN: Failure rating or --

A VOICE: No --

A VOICE: No --

MR. TAIT: Failure rate --

MR. EMERICK: Failure rate --

MR. TAIT: Failure --

CHAIRMAN KATZ: Failure rating?

A VOICE: Failure rate --

MS. RANDELL: Failure rates? Okay.

MR. TAIT: Yes, failure rate.

MS. RANDELL: Thank you --

CHAIRMAN KATZ: Failure rate.

MR. WAKEFIELD: Okay --

CHAIRMAN KATZ: Is that -- is that helpful?

MR. WAKEFIELD: Because initially I thought we were talking about fault rate --

DR. ENSLIN: For short-circuit --

MR. TAIT: No, no --

MR. WAKEFIELD: And then all of a sudden I'm thinking --

MR. ASHTON: Not --

MR. WAKEFIELD: -- oh, failure rate --

CHAIRMAN KATZ: The reason we ask is we spent a lot of time in Phase 1 when we were discussing HPFF versus XLPE, supposedly that HPFF had less fault failure, a less failure rating. But now we're talking about XLPE in this docket, so it's now time to revisit the failure rate. Mr. Emerick.

MR. EMERICK: Yeah. I go back to my question, if you could review the record Mr. Gregory offered, an update of the failure rate for different cables, and one of them was XLPE, and given that you have

experience in XLPE, if you could review that exhibit and indicate whether you agree with that information that we currently have in the record?

DR. ENSLIN: We will do that.

MR. WAKEFIELD: We will do so.

MR. TAIT: And our staff can get you those documents.

MR. WAKEFIELD: Thank you.

MR. EMERICK: With that, thank you.

CHAIRMAN KATZ: Mr. Heffernan?

MR. GERALD J. HEFFERNAN: No questions.

CHAIRMAN KATZ: Mr. Tait?

MR. TAIT: No further questions.

MR. ASHTON: I have two --

MR. FITZGERALD: Excuse me. I can give you a reference.

CHAIRMAN KATZ: Okay.

MR. FITZGERALD: Exhibit 113 and 113A in this docket.

CHAIRMAN KATZ: On Docket 272.

MS. RANDELL: Right.

CHAIRMAN KATZ: Okay.

MR. ASHTON: I've read your qualifications, they're quite impressive, but I'm wondering if any of the

three of you have had utility system operating experience, not engineering, but you've had to live with your mistakes so to speak?

MR. WAKEFIELD: Well, I think -- speaking for myself, I've had to live with a lot of mistakes -- (laughter) -- but --

MR. ASHTON: I won't press the question --

MR. WAKEFIELD: -- and most of them my own I might add -- but no, I have not had direct operational experience. And I don't know -- I'll let Dr. Enslin speak for himself.

DR. ENSLIN: Well, no. I also only have design experience.

MR. ASHTON: Okay, it's all design. Is your colleague the same way?

MR. WAKEFIELD: It's the same answer.

MR. ASHTON: Okay. I would be appreciative of your comment as to whether you would recommend a system given two choices, one is a system which can operate day in and day out without having to be tinkered with for operational reasons, the other one whose characteristics are such that as we discussed here today and other times you have to take an element out of service in order to keep the system voltages under control, which is a more

reliable system all things being equal?

MR. WAKEFIELD: If everything else is equal --

MR. ASHTON: Yeah.

MR. WAKEFIELD: -- then the one that you have to adjust or switch in and out would be the less reliable case --

MR. ASHTON: Thank you --

MR. WAKEFIELD: -- because you -- for one thing, human beings are subject to making mistakes every once in awhile, and if they -- whether they do it or they program a computer to do it, there's always the possibility it won't be switched in or out when it should be or that the wrong settings were made. So it's always better if you can -- if you can have a system designed so that adjustments of that sort don't have to be made.

MR. ASHTON: Thank you. No further questions.

CHAIRMAN KATZ: Mr. O'Neill.

MR. O'NEILL: Yes. Based upon Exhibit 17, your load flow analysis of Phase 2 undergrounding alternatives, in the body of the conclusion on page 18, you mentioned that based upon results of your load flow studies there is no indication that placing up to 20 miles

of 345-kV from Devon to Beseck underground would lead to a situation that could not be mitigated either by system reinforcement at voltages of 115-kV and below --

MR. TAIT: Brian, I think -- I'm not sure if they agree with --

MR. WAKEFIELD: We have not found the reference that you're referring to, Mr. Murphy, I'm sorry --

CHAIRMAN KATZ: Mr. O'Neill --

MR. O'NEILL: O'Neill.

MR. WAKEFIELD: I'm sorry, Mr. O'Neill.

A VOICE: The wrong document --

MR. O'NEILL: The load flow analysis --

CHAIRMAN KATZ: The -- I'm sorry. Mr. O'Neill wasn't here when we indicated that we are going to do the load flow analysis report in January.

MR. ASHTON: Okay.

MR. O'NEILL: Okay, I'll try to put off this question until January --

MR. ASHTON: Write it down.

CHAIRMAN KATZ: Do you want to plant the seed now and -- so they'll be ready?

MR. O'NEILL: Yes. You indicated that with the additional 20 miles of undergrounding there would be a

direct result in failure on the 115-kV lines and that these effects could be mitigated. The question I was going to put forward was how extensive would that impact be on the 115-kV lines?

MR. WAKEFIELD: I believe we state in there that there would be additional -- there would be additional 115-kV lines that would over load -- would experience thermal overloads on contingencies.

We also pointed out that there are -- even before -- in the base cases that were provided to the towns by the Applicant that there were some six thermal overloads on the 115-kV system and below on contingency.

We also stated that we -- I believe we stated we assumed that these could be dealt with and mitigated, and acknowledged that such mitigation might include such things as reconductoring or even building additional lines. At any rate, we also stated that we did not investigate the specific mitigations for each of those overloads. But did I answer your question?

MR. O'NEILL: Yes. And the rest of the question I'll hold until January.

CHAIRMAN KATZ: Okay.

MR. O'NEILL: Thank you.

CHAIRMAN KATZ: Mr. Murphy?

MR. JAMES J. MURPHY, JR.: No questions, Madam Chairman.

CHAIRMAN KATZ: Mr. Wilensky.

MR. EDWARD S. WILENSKY: Just one -- just one brief question -- and maybe it's a stupid question, I don't know -- if there is one type of cable that's being used we'll say from Devon to Norwalk, XLPE, can you use another type of cable if underground was decided upon for the 20 miles that you're talking about? Can you mix and match, in other words, is what I'm asking?

MR. WAKEFIELD: You can clearly --

MR. WILENSKY: Does it make any sense --

MR. WAKEFIELD: -- but -- but -- does it make sense? Basically, no.

MR. WILENSKY: Okay.

MR. WAKEFIELD: In other words, it's -- what I'm trying to say -- I don't mean to be flip about it -- it's always better on a system to standardize the cables, the voltages and so on that you use if it's possible to do so. And in general, it would be better to use the same size XLPE cable in two different parts of your system if you could do so, just because of things like maintenance and so on. So that's why when I say it doesn't make sense not to do so, I say no it doesn't make

sense not to do so. It makes every bit of sense to do so. There could be in some cases technical reasons why -- or even physical reasons why you would go to a larger cable in one setting than another or vice versa.

COURT REPORTER: One moment please.

(Pause).

MR. WILENSKY: Thank you.

CHAIRMAN KATZ: Mr. Lynch.

MR. DANIEL P. LYNCH, JR.: No questions.

CHAIRMAN KATZ: Thank you. Is there anyone else who I did not call upon who has questions for KEMA?

(No audible response).

Okay, I just want to talk briefly about -- I've been giving a lot of thought to January and I want to expand upon my thought for cleanup day. One possible cleanup day that I'd like you to think about is making it EMF day. We -- we did get several people who commented that they believe the record needs to be completed more on EMF, (1) health effects, (2) buffer zones, etcetera. So think about the possibility of making the first cleanup day EMF day. We need to have Dr. Bailey back if that was the case, etcetera. The Towns would need to have who they think is appropriate. So, I'd like you to direct comments to Derek Phelps on that possibility for the first cleanup

day.

Also, is Linda Wilson or her attorney in the room? That's also a cleanup item. She's indicated I guess --

MR. TAIT: Madam --

CHAIRMAN KATZ: Yes?

MR. MARCONI: It's Ralph Wilson and Allison Wilson for the late Wendell Wilson's estate.

CHAIRMAN KATZ: Oh, okay.

MR. TAIT: When we do EMFs, I'd be interested in DC and undergrounding EMFs. I feel under-educated on the effects of --

CHAIRMAN KATZ: Underground --

MR. TAIT: -- undergrounding on EMFs and DC cable undergrounding.

CHAIRMAN KATZ: Yeah.

MR. FITZGERALD: (Indiscernible) -- on DC tomorrow, but --

CHAIRMAN KATZ: Okay --

MR. TAIT: Okay. If you could cover --

MR. FITZGERALD: But -- but EMF covers an awful lot of ground for us, so --

MR. TAIT: All I'm --

MR. FITZGERALD: -- so we will need to have

some specific indication --

MR. TAIT: Okay --

CHAIRMAN KATZ: Well --

MR. FITZGERALD: -- of what we'll be talking about --

CHAIRMAN KATZ: -- let me refer you to --

MR. FITZGERALD: -- so we can get the right people here --

CHAIRMAN KATZ: -- Attorney Stone and -- I think of November 4th where he lists some possible -- November 8th where he lists some possible things, and he breaks it up into health effects of EMFs, (2) the establishment and impacts of appropriate buffer zones, (3) EMF mitigation, and the EMF impacts of underground lines.

MR. FITZGERALD: Well, I --

CHAIRMAN KATZ: So there's some subsets there.

MR. FITZGERALD: With all -- with all respect, I think we're more interested in what you feel is going to be --

CHAIRMAN KATZ: Well, I guess my --

MR. FITZGERALD: -- or should be on the docket --

CHAIRMAN KATZ: My statement is that's a

reasonable way I think of breaking it up into EMF subsets.

MR. FITZGERALD: But -- well if all of those are going to be opened, then we need -- then we need to have all of our witnesses. I mean, hell, if we're -- if we're -- if we're going to go back into the general issue of health effects, that's Dr. Cole, Aaronson, all those people --

CHAIRMAN KATZ: What I'd like to do -- this is how I envisioned it, we'd pick a topic for like the morning, we'd bring in whoever is needed to be a witness on that, and that would be the last shot on that subject, for example health effects; or an afternoon topic could be something different, we'd bring in the witnesses, and give everybody a last shot on that. That's what I'd like you to start thinking about, you and all the other parties on how we might break this up into reasonable bites of the apple. And I don't expect an answer now. I -- I'm planting this idea -- well, Miss Randell, I guess you have an idea.

MS. RANDELL: Well -- no, I guess I have a question. I think we understand the concept. Our concern when we read letters like Mr. Stone's is that it covers everything that's already been addressed in maybe six hearing days --

CHAIRMAN KATZ: Yeah --

MS. RANDELL: -- and I could be short on that. And we're concerned that we actually have to bring back every witness who was ever here who would be subject to question on any subject that was ever covered. And I didn't think that's what you intended --

CHAIRMAN KATZ: No, no --

MS. RANDELL: -- by cleanup.

CHAIRMAN KATZ: No. I'd like especially the town -- well, this letter is from the Towns of Cheshire, Durham, Milford, Orange, Wallingford and Woodbridge -- I'd like some more specificity -- specificity is that a word --

MS. RANDELL: Close.

CHAIRMAN KATZ: -- on what witnesses they'd like to bring back.

MS. RANDELL: That would be helpful. Thank you.

CHAIRMAN KATZ: Does that help?

MS. RANDELL: Yeah, that -- that's helpful.

CHAIRMAN KATZ: Right. And then I will query my Council members with that same question, what witnesses would they like to bring back for the completeness of the record.

MR. TAIT: Well, I'd like to say what I'm interested in and you can figure out what witness would do it --

CHAIRMAN KATZ: Alright --

MR. TAIT: -- but I'm also interested in buffer zones for undergrounding. Although it's not in the legislation, the intent to me is clearly there, if there is EMF problems and there's buffer zones for overhead, there's clearly EMF problems for underground and there's got to be buffer zones for underground. So -- that will either be briefed or if you have any information that will help me with that.

CHAIRMAN KATZ: So these -- these are the thoughts that would be helpful on what witnesses do we need to bring back for cleanup day.

MS. RANDELL: And could --

CHAIRMAN KATZ: And then if you can give us any idea is this a short cross-examination or should we block out half a day, that would also be helpful.

MS. RANDELL: That would be helpful. And I'm told by my people that we could -- if we could ask for only new questions and new -- you know, requesting new information and not going back --

CHAIRMAN KATZ: Yes --

MS. RANDELL: -- to what we said on June 6th, that would be appreciated.

CHAIRMAN KATZ: Yeah, if any type of -- looking back can only be in the very briefest of summary manner, that would be appreciated.

Anyway, so I'm going to ask you, as my mother would say, talk among yourselves also on how to -- procedurally on how to best accomplish this from both the point of view of the parties and intervenors and the applicant to accomplish our goal of having very effective cleanup days. Is there any other procedural issues? Yes?

MS. RANDELL: I hate to do all these housekeeping because it's usually Mr. Johnson's job, but it does occur to me that we have this issue of anybody else's witnesses. We have a pretty good understanding of what you're looking for --

CHAIRMAN KATZ: Right --

MS. RANDELL: -- from our witnesses -- or will once you get to all those items. But if anybody else is planning to put on, you know, what they --

CHAIRMAN KATZ: A direct case?

MS. RANDELL: -- would argue is a direct case --

CHAIRMAN KATZ: Yes. The towns, after you

--

MS. RANDELL: -- we'd like to hear it --

CHAIRMAN KATZ: Yes. The towns have indicated they want to see the ROC report before they preclude putting on a direct case. I think that's a fair request. But as soon as this ROC report is out, I'm going to ask the towns to communicate with Derek Phelps on whether you plan to put on a direct case because that would be helpful for scheduling purposes.

MS. RANDELL: Thank you.

CHAIRMAN KATZ: Any other procedural issues, this is a good time? Also, Mr. Marconi wants me to ask if everyone received a copy of the Estate of Linda Wilson letter concerning the Royal Oak jog?

MR. MARCONI: If -- if I can say one thing, Madam Chairman? It looks like I've got two documents here. It looks like it's -- one is from Ralph E. Wilson, Trustee of the South Main Street Trust, it was faxed to my office on 12/13. And actually, it looks like there is both a Linda Wilson still alive and a trust from some of her former property. So it looks like there's an intervenor form from a Linda Wilson in care of Sebastian Giuliano her attorney. And then there is a Ralph E. Wilson, Trustee, and it's also in care of Sebastian

Giuliano their attorney.

CHAIRMAN KATZ: Okay.

MR. MARCONI: So I'm wondering if everybody received a copy of this on the service list.

CHAIRMAN KATZ: Okay. We will make sure everybody gets a copy. This is something, Mr. Boucher, we're going to need to take up. Also, the City of Middletown if you could talk to your colleague there. We're going to need to take up this issue on one of the cleanup days because they raised some issues about the Royal Oak jog that I think we need to explore.

Other procedural issues that you want us to be thinking about or you want other people to be thinking about? (No audible response).

Okay. Tomorrow morning 10:00 a.m. is CEOs and mayors. These will be treated as limited appearances. And then at 11:00 o'clock we'll get into ABB and DC cable.

Anything else before we adjourn today? Going once -- we're adjourned.

(Whereupon, the hearing adjourned at 3:20 p.m.)

HEARING RE: CL&P and UI
DECEMBER 14, 2004

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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.

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In witness whereof I have hereunto set my hand and do so attest to the above, this 22nd day of December, 2004.

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