October 2, 1984

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correspondence on other subjects. We mentioned that at a previous conference of parties, I believe, as long ago as last February. Perhaps it was the July conference.

In any event we continue to receive some correspondence, particularly between the Staff and the Applicant on subjects that do not relate to the emergency diesel generators. The parties have got to be selective. Somebody has got to be in charge of deciding which Board receives which correspondence. We don't want it all.

In terms of discovery, of which there is little left in this case, our usual rule is the Board does not have to receive copies of discovery, particularly informal discovery materials.

Receiving information copies of correspondence, however, does not serve to give the Board formal notice of anything. We get a lot of correspondence. It gets lost in the shuffle sometimes. If parties have anything that they want to bring to the particular attention of the Board as support for any action which they desire the Board to take, or in support of their obligation to notify the Board of something, even though the bottom line conclusion of the notifying party is that no action need be taken, then a more formal legal pleading is required to be filed before us.

Changing subjects, the Board is considering setting a finding schedule on the subject of crankshafts to

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becomes necessary as we approach the two-hour time limit, but operate on that assumption.

Can you give us an estimate, which I recognize may be less firm, for the remaining portion of the crankshaft subject?

MR. STROUPE: Judge Brenner, I would hope that I could complete crankshafts in general in a day to a day and a half.

JUDGE BRENNER: A day and a half is too long.

MR. STROUPE: Well, I was close, wasn't I?

JUDGE BRENNER: I will just give you that comment now, and we don't have to pursue it further at this point.

MR. STROUPE: I would hope that I could complete crankshafts in a day.

JUDGE BRENNER: We expect to finish the issue this week.

MR. STROUPE: So do I.

JUDGE BRENNER: We won't finish in this week if you take a day and a half.

MR. STROUPE: I will do my best, Judge Brenner, to try to complete it in a day.

JUDGE BRENNER: All right. Instead of talking about it, we will let you get to it right now.

MR. STROUPE: Thank you, Judge Brenner.

JUDGE BRENNER: Proceed, please.

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was employed at Lloyd's right at the end of 1949 through 1950.

I received that training at the Kodak organization at Harrow just outside of London, one of the suburbs of London.

Q Again was that in 1949 or '50?

A I think it was in the early '50s. I cannot recall now.

Q Have you had any non-destructive examination training since that point in time?

A No, only the fact that I had been using these things. We had some of our own non-destructive testing equipment when I was with Sugarline in London.

Q Are you a qualified examiner in mag particle, ultrasonic or eddy current examination?

A I have no U. S. qualifications in those subjects, but as a -- what we would refer to as a licensed professional engineer in Great Britain, I would be allowed to perform those tests if I wanted to. If I felt I would be happier with somebody else doing it, a man who is doing it all the time, then naturally I would call one of those people in, but I am well able to judge the results of such testing.

Q Dr. Anderson, I direct this question to you.

Have you had any training or experience in

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non-destructive examination?

A (Witness Anderson) Not per se, no. My interests have allowed me to do a little bit of research in the area.

I also am putting together a course with the professionals in the Bay area to give an extension course at San Jose State, but I have not taken a formal course in it, no.

Q The experience that you indicated involved what sort of non-destructive examination method?

A Principally X-ray, field emission imaging, and ultrasonics.

Q I take it I would be safe in assuming from your answer that you are not a qualified non-destructive examination inspector in either mag particle or liquid penetrant eddy current or ultrasonic?

A No. That would be a technician that would have such qualifications I don't.

Q Dr. Anderson, what sort of training and/or experience do you have in stress analysis?

A For example, fracture mechanics and areas like that? We teach it at the university. I have not taught the course but I have read the book that we use in it.

I have, in some of my consulting, been required to evaluate -- consulting other than this particular instance -- to evaluate the work of others and in

ceramic materials.

Q What would the diameter of one of those fibers be?

A These materials are essentially the materials we used in the space shuttle. And the total diameters are 10 microns to 11 microns. And they're rotated in a field so that we can treat all sides of them.

Q Could you tell me, Dr. Anderson, what a micron is in inches, what the equivalency is?

A Yes. Well, in inches, a micron is normally a millionth of a meter, so there are a thousand to the millimeter.

Q Thank you.

Getting back to the replacement crankshafts -- an issue in this proceeding -- I believe you indicated to me that to be able to give me the effective depth of the increase in strength attributable to shot-peening you would have to know the time, the intensity, and some other factors. Don't you, in fact, have access to those figures?

A I'm not sure. Were we referring to trying to estimate it or were we trying to measure it? One technique for actually physically measuring it would be by x-ray diffraction using Bragg's law, where we would be able to get some idea of the distortion to the crystal system.

Q Well, I'm referring to what you were talking

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about. What method were you referring to in terms of being able to judge the effective depth?

A I'm not sure that I— If I was asked to estimate the effective depth of the cold working, those were the parameters that I would require. But I haven't calculated what the effective depth is because I don't know whether it's uniform in all places, and I haven't seen the final physical specimen.

Q Have you had access, Dr. Anderson, to the LILCO exhibits filed in this proceeding that relate to the shot-peening? Specifically, the various exhibits from Metal Improvement that relate to the quality assurance records.

A Yes, I believe I have.

Q Don't those records contain information as to the intensity at the time, the size of shot, the dimpling effect, and other things?

A Yes, and I believe they had some test strips in the area to insure coverage and the extent.

Q That would be an Almen strip?

A Yes, it would.

Q And can you take that data and then make a calculation or an estimate as to the effective depth of the shot-peening?

A Probably an estimate could be made.

Q Have you done such an estimate?

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words of the answer?

MR. STROUPE: "Note, however, LILCO made available to us some, but not all, the photographs taken of the original shot-peening."

WITNESS ANDERSON: No, I believe that Mr. Christensen -- I believe that Mr. Christensen had something to do with this, and that we may have had discussions on it.

BY MR. STROUPE:

Q Well you are, in fact, an indicated sponsor of that answer, are you not, sir?

A (Witness Anderson) No, other than discussions, I don't recall having access to the photographs before last weekend.

Q Dr. Anderson, isn't this answer necessarily based upon an examination of the photographs?

A Yes, it is. That's what I'm saying that I did not have access to them and, therefore, I did not write that paragraph.

Q Well, are you saying now that you did not sponsor this answer?

A Well, no, I'm not saying that, because I did have access to the photographs. I did look at them, did find the faults that were addressed there, and do conclude that the answer is correct.

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Q Dr. Anderson, do you understand that the designation, which was served upon LILCO, indicated that you sponsored the entire answer to that question?

A No, I do not understand that.

Q Then that is incorrect: you would only sponsor the last sentence of that answer?

A No, that's not correct. I think we are defining the word sponsored. I have examined the photographs and I do sponsor the testimony and the previous question that we had. However, on the writing, I did not do that writing.

MR. BRIGATI: Judge, may I clarify something for the record at this point?

JUDGE BRENNER: No, because I don't want to put words in the witness's mouth. We will let you do it at some point in some appropriate way.

MR. BRIGATI: Thank you.

BY MR. STROUPE:

Q Dr. Anderson, I would like, please, sir, an answer to my original question as to whether or not you had seen the photographs referred to in this question prior to the time that the answer was written and filed on your behalf?

MR. BRIGATI: Objection. Asked and answered.

JUDGE BRENNER: No, I'm going to let him ask it given Dr Anderson's previous answer.

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Q Professor Christensen, have you seen copies of these photographs that Dr. Anderson and I have been talking about?

A (Witness Christensen) Yes, I have seen them at your office in the early part of September. It was either a Saturday, a Sunday or Labor Day. We came up there with Mr. Scheidt and I can well remember we were busy in the other office and we spent quite a bit of time there while they were finding the photographs. And I think your representative of your office in Washington said that there were some more photographs to be produced.

MR. STROUPE: I am going to move to strike the last portion of that answer as to what some representative of my office said.

JUDGE BRENNER: It doesn't matter.

Professor Christensen, you could have provided a shorter answer to that question. I am not interested in the human interest side of your visit, I am interested in the substantive side when answering a question like that.

BY MR. STROUPE:

Q Professor Christensen, you sponsor both of these answers that I have been talking to Dr. Anderson about, don't you?

A (Witness Christensen) I do, yes.

JUDGE BRENNER: Mr. Stroupe, before I try to

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shot-peening related to the diameter of the crankshaft as a ratio is very, very small.

MR. STROUPE: I'm going to interrupt, Judge Brenner, and ask that he be instructed to answer my question instead of giving me a dissertation.

MR. BRIGATI: Judge Brenner, I don't think that was a dissertation. I think that Professor Christensen does have a tendency to answer questions a little bit in the long form.

JUDGE BRENNER: He certainly does.

MR. BRIGATI: Well, I have tried to explain to Professor Christensen that you like short answers and that I like short answers. But he comes from Britain and I don't think British people speak as tersely as Americans do, and I hope we can bear that in mind.

JUDGE BRENNER: I would have thought it was the other way around.

MR. BRIGATI: No, Judge.

JUDGE BRENNER: Let me stop you right there and let's deal with this particular example.

Professor Christensen, that was beyond what I would consider a normally acceptable explanation, given the question. We see the connection but it was -- just as I said -- beyond the normal realm of an answer, given the question, which was a specific question. You cannot inject

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bearing would be on the Shoreham replacement crankshafts of the Shoreham EDGs?

A I cannot recall without looking at tables the temperature points of babbits because so much depends on the nature of the alloy, whether it is a tin-base alloy, a lead-base alloy, or other factors coming into the piece.

Q Professor Christensen, and Dr. Anderson for that matter, have you had a chance to review that portion of LILCO's crankshaft shot-peening testimony on page 21 thereof, relating to calculations as to thermal relief of shot-peening residual stresses at certain temperatures?

A (Witness Anderson) I have read that. It is true it's a time-temperature response phenomenon and it is linear with respect to the activation energy in the one over T, the log of the effect.

JUDGE BRENNER: Dr. Anderson, I'm sorry. I just didn't hear the end of your statement.

WITNESS ANDERSON: There is a linear Arrhenius relationship that exists and therefore, if you go down in temperature, the times for recrystalization take much longer.

I'm not familiar with the low temperature activation energy that was used. However, it does change at low temperatures, and there has been some recent work on that. It would be difficult to predict or extrapolate the

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what has occurred in the proceeding, we'll decide when you do tell us.

MR. FARLEY: Judge Brenner, may I add one thing?

JUDGE BRENNER: Yes.

MR. FARLEY: It is appropriate background, I think, for you to know this information. In connection with the Board's admonition on the 24th of September, we -- the parties have, as you urged, zealously endeavored to produce a number of volume of documents, beginning with the 24th, the 26th, and even this past Saturday. We represented to Mr. Dynner at the time we did that, that there were only two categories of documents -- and to Mr. Goddard, too -- there were only two categories of things or documents that he didn't have that we would make available to him in New York this week.

JUDGE BRENNER: You're talking about documents relating to the blocks?

MR. FARLEY: Yes, sir. And these were the original photographs and pieces of the old 103 block that were cut off -- cut up by FaAA for their examinations.

Unbeknownst to any of us, in connection with this confirmatory testing that Mr. Ellis had related to you, LILCO started to prepare the new 103 machine this weekend for this testing, and in the course of that -- which was confirmed yesterday, and I first learned about it this

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A There I converted a series of solid forge crankshafts which had failed in a certain area: that is at the after-web area we went from a solid-forge crankshaft to a shrunk-fit repair.

Q So that didn't really involve design of the crankshaft, I take it?

A It involved stress analysis because of the room available to carry out the repair.

Q You said it involved stress analysis?

A Correct.

Q Did it involve torsional stress analysis?

A That came later. The first part was that we got involved with the amount of area that we could leave around the eye that formed the shrink-fit in the web.

Q Mr. Eley, what has your experience been in the design of crankshafts for diesel engines?

A (Witness Eley) Once with a ship-building company called Austin and Pickersgill, which is part of the British ship-builders group, it was my responsibility to determine the adequacy of all of the equipment that went onboard those vessels, and that included the adequacy of the design of the main engines, the generating engines, the pumps, compressors, all of the equipment onboard the vessels.

I have also done, in my courses in UK, torsional analysis and vibration analysis on shafts, but they were not

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allowable horsepower?

A Yes, I was.

Not just the crankshafts, I might add, the whole engines also.

Q Other than that experience, have you had any occasion, Mr. Eley, to be involved in the design of a crankshaft from the ground up, so to speak, from the beginning of that shaft?

A I served an apprenticeship with George Clarke in Northeastern Raine, the engine builder for the Sulzer group, and I was responsible for fitting those engines right from the bedplate upwards, which included putting the crankshafts in there.

And once we had completed the engine build, I did assist with the setting up of the torsiograph as such, but I was not involved with the torsional section at that time. I did assist but I did not actually do the stress analysis.

Q So it is true, isn't it, that you haven't in fact been involved with the design of a crankshaft from the outset?

MR. BRIGATI: Objection, asked and answered.

MR. STROUPE: I don't believe I got a Yes or No answer to my question. He gave an explanation without giving an answer.

JUDGE BREWNER: All right. Let's get a precise

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a lot of empirical experience going into it. And to design it from first principles would be too costly.

But I can tell you today if you want to design a crankshaft from first principles, you can go to Lloyd's Registry of Shipping in London and they will do a design for you, based on input into a computer program which covers many, many areas. But nobody designs a crankshaft from first principles. It would be too costly for a commercial operation to start thinking about even.

Thank you.

BY MR. STROUPE:

Q Professor Christensen, are you capable of calculating or performing forced torsional vibration calculations?

A (Witness Christensen) I have worked in that area some years ago, yes.

Q What methodology would you utilize to do that?

A I would come right back to the first of all the natural frequencies. Then I would go for stresses in the areas of the natural frequencies. Then I would go for the stresses in the reasonance conditions, and follow on from there.

Q And what mathematical method would you utilize to give you the natural frequencies?

A I would do a Holzer tabulation.

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A (Witness Eley) May I just add there that it was either Mr. Yang or Mr. Beshouri. I'm not sure which one.

Q Professor Christensen, how would you calculate the phase relationship between two orders --

A How would I--

Q -- in arriving at forced torsional vibratory stresses?

A (Witness Christensen) Could you give me that question again, please?

Q Yes, sir.

How would you calculate the phase relationship between two orders?

A I wouldn't calculate it. I would look at the numbers of cylinders, the firing orders, and I would pull it out of a table.

Q Professor Christensen, so in summing the orders for purposes of making this calculation you would find the relationship of of a table. Is that correct? The phase relationship, I mean.

A In doing the phase relationship I would have to know the crank angles and the firing orders, and then I would bring in the phase relationship from tabular notations which are in any book on torsional vibrations.

Q Mr. Christensen, have you ever in fact performed forced torsional vibration calculations for crankshafts?

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Q Mr. Eley, would it be fair to say that you did not make any independent calculations with regard to DEMA for purposes of the Shoreham replacement crankshafts?

A (Witness Christensen) No --

Q This is for Mr. Eley, Professor Christensen.

A I beg your pardon.

A (Witness Eley) I did do some investigating with regard to DEMA, yes.

Q Well did your investigation include making any independent calculations?

A When I looked through the DEMA regulations -- albeit these are the marine book that I have here, I could not get hold of the stationary book at all -- so I contacted Mr. Bob Ecker to try and confirm this information, to get the actual stationary book and he advised me that --

MR. STROUPE: I am going to object to this answer and move to strike. I don't want to hear what he advised you, I am asking you what your knowledge is.

JUDGE BRENNER: I am not going to strike it. Just follow up with your next question.

Mr. Eley, you may proceed.

WITNESS ELEY: Can I continue?

JUDGE BRENNER: Go ahead.

WITNESS ELEY: Based on the information that was given, he advised me that the standards were outdated and

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objectionable, as we have discussed many times.

MR. STROUPE: I understand that but this might necessitate my getting involved in who he talked to and those people are obviously not here for purposes of cross-examination.

JUDGE BRENNER: Why don't you remind me of what your question was, if you can.

MR. STROUPE: I believe my question was....

JUDGE BRENNER: Bill, I guess you had better read back the question.

MR. STROUPE: Maybe we had better read it back.

MR. BRIGATI: Judge --

JUDGE BRENNER: Wait.

(Whereupon, the Reporter read from the record as requested.)

(The Board conferring.)

JUDGE BRENNER: Mr. Brigati, you wanted to say something in response?

MR. BRIGATI: I believe that he was in the course of explaining why he did not -- and why he could not get anything from DEMA, Judge. I know it is a rather long explanation but it is also a rather long story.

JUDGE BRENNER: Well it was a rather short question to which a short answer would have been appropriate. And we are going to grant the motion.

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we're talking about main propulsion engines or units or auxiliary engines on board ship, that these engines are subjected to much more severe operating conditions than land-based stand-by generators?

A (Witness Christensen) I would not agree with that, no.

A (Witness Eley) Neither would I.

Q And would bothe of you, one at a time, give me reasons for not agreeing with that?

A (Witness Christensen) Yes. First, we are talking of generators. They are not connected to the ship's propellor.

The next case is, diesel generators on board ship do not normally use the same low-quality fuel that the main engine uses.

The next variant between that and the main engine is that the generators are on a much stiffer foundation, their crankshaft length is shorter, and in no circumstances should we consider the generator in a similar manner to a main engine, because the conditions under which the generator acts are different.

The only variant in there would be the holding-down bolts holding the generator to its foundation. They will sustain more load than the holding-down bolts

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statements you made in your book "Lambs Questions and Answers on the Marine Diesel Engine"?

A Could well be; yes.

Q And don't you state, sir, in that book that as a wave passes along the hull of the ship, and as it crests, the increased buoyancy can lead to crankshaft misalignment on either main or auxiliary engines?

A I do state that, yes, but I think you're possibly taking it out of its context because here we've got to lookat a time factor as well. And we're getting into an area of complication where I want to give short answers but I'm precluded from doing to because we're moving into very, very complicated areas. But, believe me, I can well handle them.

Q Mr. Eley, do you have anything to add to that?

A (Witness Eley) No.

Q I'll ask this question of both you gentlemen.

Isn't it true that crankshaft alignment on board ship, whether it be in the main propulsion unit or in the auxiliary diesel generators, is a much more severe problem than that encountered in an enclosed nuclear standby generator room, where the ambient air temperature is controlled and the base plate is anchored into reinforced concrete, and there are no waves subjecting the area to any sort of distortion?

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an allowable horsepower calculation at overload?

A No. The Lloyd's formula, if you would like to call it that, for the scantlings of the crankshaft cover many, many inputs. I took the inputs from the crankshaft drawing and put them into the Lloyd's formulas. Then I transposed the formula and put a horsepower figure in there, and then came up with what the maximum pressures would be for those various horsepowers.

I also did the calculations which are shown in the testimony.

Q Well, isn't it true, gentlemen, that Lloyd's rules does not require a calculation at overload for allowable horsepower?

A There is nothing in Lloyd's rules, as you say, about that, but I looked to the thing in its entirety here.

Q Mr. Eley, do you want to respond to that?

A (Witness Eley) Lloyd's rules specifically specify that at 100 percent load, an overload period of 15 minutes would be permissible. Because of the fact that in this condition you have a two-hour in any 24-hour overload condition, this will be construed as in excess of that and consequently, one would need to use the 110 percent overload condition as the Maximum Continuous Rating.

I checked with another engine builder to establish that fact also.

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(Whereupon, excerpts from Lloyd's Rules re: Ship Classification was marked as LILCO Diesel Exhibit 41 for identification.)

BY MR. STROUPE:

Q Professor Christensen and Mr. Eley, are you familiar with the first part of this exhibit, the second page attached to the Part 5, Chapter 2?

A (Witness Eley) Yes.

A (Witness Christensen) Yes.

Q Is that in fact the empirical formula of Lloyd's for computing allowable horsepower of diesel engines crankshafts?

A First I would like to comment on your term "empirical formula."

It is not an empirical formula. It is based on the basics of crankshaft design with a large input from studying many, many crankshafts that have operated successfully, and a few crankshafts that have failed, and this is what that formula is based on. It is not wholly empirical.

Q Well, Professor Christensen, does it require anything other than making certain inputs as defined by these various numerical and letter indications under this

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(15 minutes) an overload power of not less than 10 percent."

BY MR. STROUPE:

Q Have you ompleted your answer?

A (Witness Eley) Yes.

Q Where does that 3.6.1 tell you to go back to section 3 entitled "Crankshafts" to make a calculation at overload?

A There is no reference back.

Q Well, do you know what the maximum continuous rating of the Shoreham EDG's is, Mr. Eley?

A Yes.

Q What is that?

A 3,500 kilowatts for one year with a two-hour in any 24-hour overload period of 10 percent overload.

Q Well, the overload is --

A I'm sorry -- 3,000 -- sorry. 3,900 kilowatts for two hours in any 24-hours.

Q You know, don't you, Mr. Eley, that the 3900 kw overload rating is not a continuous rating?

A No: I just specified it's two hours in any 24-hours.

A (Witness Christensen) Could I come in here with some interpretation to these rules. I am a former Lloyd's surveyor. I've also been engaged in the areas of design.

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a different context.

We'll take a break until 3:50.

(Recess.)

JUDGE BRENNER: Back on the record.

We are ready now.

Mr. Stroupe?

MR. STROUPE: Thank you, Judge Brenner.

BY MR. STROUPE:

Q Professor Christensen and Mr. Eley, if indeed section 3.6.1 that we have been talking about this afternoon in Lloyd's Rules, defines the maximum continuous shaft power as used in section 3 under "Crankshafts", would it be your opinion that section 3.6.1 would also require that the Shoreham EDG's be capable of operating at at least 10 percent over 3,900 for short periods of time?

A (Witness Eley) I believe the FSAR specifies that the engine should be capable of doing two hours in any 24-hours at 3,900.kilowatts.

Q What was not my question, Mr. Eley.

A I wonder if you would repeat the question, please?

Q Could we get it read back?

(The reporter read the record as requested.)

JUDGE MORRIS: Mr. Stroupe, by short periods of time, do you mean 15 minutes or so?

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earlier Lloyd's Rules are wholly associated with safety, as they're associated with safety, then any designer would see that that capacity is in the engine.

I don't want to digress, but I have been responsible for the overall design of many ships --

MR. STROUPE: I want to interrupt here, Judge Brenner. I asked the question. I believe he's capable of a yes or no answer about the 4,290 kw.

JUDGE BRENNER: Yes; I agree with you. Can we get an answer?

WITNESS CHRISTENSEN: I thought I gave the answer, but there is a "but" to it and I was trying to explain the "but" part of it.

JUDGE BRENNER: I didn't hear the answer, if you gave it, Professor Christensen. I wonder if you could do that and I will allow you to explain the answer.

WITNESS CHRISTENSEN: I said if any builder of a diesel generator set, wanted his engine to comply with Lloyd's Rules, the engine would have to be capable of meeting this requirement. And if it was the Shoreham engine, and the figures that Mr. Stroupe gave me are the correct ones, then it would have to be capable of meeting that. The but part of the thing is this: that Lloyd's Rules are wholly associated with safety. And as such, prudent designers -- and I'm citing my own experience here,

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JUDGE BRENNER: All right. You didn't make it clear to me you were now addressing it to Mr. Eley.

MR. STROUPE: I think I prefaced my question by saying Mr. Eley.

JUDGE BRENNER: I'm sorry, Mr. Stroupe, I apologize. I missed that.

MR. BRIGATI: I apologize to Mr. Stroupe, too. I misunderstood.

JUDGE BRENNER: All right.

MR. STROUPE: Accepted Mr. Brigati.

JUDGE BRENNER: Mr. Eley?

WITNESS ELEY: I believe I did answer it, Judge Brenner.

JUDGE BRENNER: All right. Why don't you answer it again and do me a favor?

WITNESS ELEY: Yes.

JUDGE BRENNER: Thank you.

Go ahead, Mr. Stroupe.

BY MR. STROUPE:

Q Professor Christensen and Mr. Eley, you are aware, are you not, as a result of previous testimony in this proceeding, that actual measured firing pressures in the cylinders of the Shoreham EDG's, are less than 1680 psi?

A (Witness Christensen) I have seen figures which state that, yes.

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may just look at the rule here, just to clear my mind because we are again in a complicated area.

(Pause.)

Yes, that rule is covered by the figure which they refer to as the Zed factor. You have a normal factor of 1. If you have a dieforged or a grain flow forging crankshaft, you are allowed a 15 percent increase in the Zed factor and if you have approved hardening systems -- and here the operative word is "approved" -- then you will be allowed a 25 percent increase on the Zed factor.

Q Can you tell me, Professor Christensen, what effect a 25 percent increase in the Z factor would have in terms of the allowable horsepower of the Shoreham EDG's at 3500 Kw?

A I couldn't tell you because I didn't work it out.

Q Is it linear?

A I would have to look at the formula to come up with an explanation there.

No, it is not wholly linear, it is somewhere possibly in between, I haven't worked the figure out to see if there is a curvature there.

For hardening obviously there is a 25 percent increase but that is multiplied by a DQ. I wouldn't like to say whether it is linear unless I sat down and put figures

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Q Professor Christensen and Mr. Eley, isn't it true that the CIMAC rules relating to crankshafts are proposed or draft rules?

A (Witness Eley) Yes, they are.

A (Witness Christensen) Yes.

Q And indeed, haven't they been proposed or draft rules since approximately 1978?

A I could not say the exact date when they came to be.

A (Witness Eley) I don't recollect either.

Q Did either of you hear Professor Sarsten's testimony with regard to how long the CIMAK rules have been in draft form?

A I didn't, no.

A (Witness Christensen) I cannot recall the actual testimony given by Professor Sarsten on that point, no.

Q You know, don't you, that they have been in draft or proposed form for some fairly long period of time?

MR. BRIGATI: Objection to the form of the question. Let's have a definition of "fairly long."

MR. STROUPE: More than five years.

WITNESS CHRISTENSEN: I couldn't say how long they have been in form, but if you ask me why they have taken a long time, that I can possibly--

BY MR. STROUPE:

1 AGBeb

Q That is not what I asked you, Professor Christensen.

A (Witness Eley) I don't know how long they have been in draft form.

Q Do you know, either of you, when the CIMAC rules first came out in any form?

A No.

A (Witness Christensen) I have been aware of them for some considerable time, but the exact date or the exact year I cannot remember now.

Q Are either of you aware of adoptation of the CIMAC rules by either Lloyd's, ABS or DEMA?

A I can give some comment on that in respect of the fact that in July of this year, Lloyd's and Bureau Veritas out of Paris were trying--

Q Professor Christensen, I didn't ask you about anything but ABS, Lloyd's and DEMA.

A Now I am trying to explain something.

Could I have the question again, and I will try to answer it with a Yes or a No?

MR. STROUPE: I will withdraw that question, and move on.

JUDGE BRENNER: You can come to a convenient stopping point for the overnight recess whenever you want to, Mr. Stroupe.

1 AGBeb

MR. STROUPE: I think I could ask maybe a couple more questions and be at a good point, Judge Brenner.

BY MR. STROUPE:

Q Gentlemen, isn't it true that neither one of you did any independent calculations with regard to CIMAC on the Shoreham replacement crankshafts?

A (Witness Eley) That is correct. Both Professor Christensen and myself did the checks on the CIMAC correlations using either the Beshouri or Yang correlation as we mentioned before. It is one of the included documents.

Q That is to say you did check calculations of TDI's CIMAC calculations?

A Yes.

A (Witness Christensen) We did, yes.

Q Did you utilize any other CIMAC calculations in reaching your opinions?

A I just used the calculations which I think have been offered as an exhibit here.

MR. STROUPE: Judge Brenner, I think we are at a good point to recess until the morning.

JUDGE BRENNER: All right.

We alluded to this off the record and also last week. I think some time before the end of the day tomorrow would be a good time to discuss the schedule over the next