

Wednesday, 14th June 2000

(10.30 am)

MR STONE: My Lord, I have asked my learned friend, Mr MacDonald, to go first because I am having an image copied.

MR SPENCE (continued)

Cross-examination by MR MACDONALD

MR MACDONALD: Mr Spence, good morning.

A. Good morning.

Q. Can you hear me all right?

A. I can, thank you.

Q. I just want to ask you very shortly about three topics. The first of these is ingress rates into the bow spaces. Could you be handed bundle Attorney General 16.4, please? Yesterday you were asked some questions by Mr Moran about the Marin May run of tests on bow ingress, and you expressed, I think, some reservation about the rates of ingress that were shown in those tests. I am sure you will recall that in January of this year Marin ran some earlier tests on orifices of 300 and 500 millimetres diameter, and in this bundle the results can be found at page 52, which is a pull-out sheet, a spreadsheet.

If you look on the extreme left-hand side of the page, there is a column with test numbers, and about

halfway down it there is an inset heading, "Ingress of water", and there then follow eight tests. If you move your eye to the right eight columns, you will see that the speed was zero knots to hove to. One column to the right, you see that the first four tests were with the bow spaces flooded or damaged and the second four tests intact, and three columns to the right you see the diameter of the orifices that were being tested: 300 millimetres to typify, I think, an air vent, and 500 to typify a mushroom vent.

If you go way over to the right-hand side of the page, the penultimate column is headed "Water ingress over two hours", and the measured ingress comprises the only figures in this column about halfway down the page, starting with the four damaged tests, 465 tonnes and so on, and then the four intact, 69 tonnes per hour and so on. In each case, the first two set of figures are for 300-millimetre orifices and the second two for 500-millimetre orifices.

My question is simply this: yesterday you expressed some reservation about the generally much higher figures which are shown in the more recent tests. Are the ingress rates per hour shown here more in line with what you would expect based on your experience?

A. Yes.

Q. Thank you. You can put that away now. I would like to ask you now a little bit about the bosun's hatch. Yesterday, in answer to my learned friend, Mr Thomas, you said that it was a hatch of a type which in practice was not a matter of concern to the crew but it needed attention, if I can put it that way. If the vessel had been fitted with a raised fo'c'sle, no doubt the aperture could have been fitted in the fo'c'sle brake bulkhead and so have been protected, but the assessors have suggested that, if not, there are two other possibilities. One would be to have an outright ban on such a hatch on the flat of the foredeck, unless it could be shown that any flooding resulting from its failure would be insignificant. The other is that it should be protected by a breakwater, so an outright ban or breakwater protection.

Do you have any view as an expert on either of those solutions?

A. Well, first of all, I cannot see how it could be banned. You need some access into the store, so there has to be a means of access. As you correctly say, if there is a raised fo'c'sle, then that is usually accommodated by a door, a simple door, a watertight door in there, and under those circumstances rope access is

usually gained through much smaller, probably circular, accesses.

Having a breakwater on the fo'c'sle I would not see as an immediately sensible or practical option because you have to handle ropes on the fo'c'sle. So it has to be relatively clear to allow you to do that. If you had a large breakwater, then it would place considerable constraints on that practical operation.

Q. So if indeed this is a type of opening that does need regulatory attention in the future, perhaps the best solution would be to have a raised fo'c'sle?

A. I would not like to go as far as that. That, I think, is extending my field of expertise.

Q. Very well. The last topic I wanted to ask about was the question of whether one could pump the bow spaces of a ship of this type if they did inadvertently flood. I will just focus on the forepeak tank, which is the largest void space.

Mr Malpass said that on the Derbyshire there were two valves which were relevant: a manual valve and a hydraulic valve. He said that when dry cargoes were being carried, the practice on the ship, I think he said anyway, was that the manual valve was left open so that if flooding occurred, the forepeak tank could be pumped by opening a hydraulic valve. Is it a good practice to

leave the manual valve open in that way?

- A. If you have two valves separation, as they had in that case, then I see nothing wrong with that principle of operation. As for the hydraulic valve, Captain Richardson was talking about damage to the actuating gear for the depth gauge system and for the hydraulics, and, in fact, on a ship such as Derbyshire, then that hydraulic actuating system would probably be led down along the duct keel to protect it.
- Q. As distinct from the teledip pipes?
- A. Yes. The teledip pipes in all probability went down there as well. The major problem with bulk carriers of course is you have grabs and things dropping on to the deck, cargo, when they are operating. So as much potentially susceptible systems as that would be led through the duct keel.
- Q. This two-valve arrangement, one hydraulic, one manual, would that be common or uncommon on this type of ship?
- A. It is not common in my experience, and I am trying to remember obviously a lot of ships and a lot of arrangements. My recollection is most of the ships that I have been involved with have got a single valve for that function.
- Q. So it would not be unusual, then, for the forepeak tank to be in a manually isolated state while the ship was at

sea?

A. No.

Q. In the case where the forepeak tank flooded in heavy weather, would it be possible to get men forward to open the manual valve? Presumably not?

A. It would be potentially very dangerous, yes.

Q. Is there any way that you can see of addressing this problem, other than perhaps by fitting the vessel with an underdeck walkway to the bow?

A. Yes, by fitting a manual valve and a hydraulic valve such as fitted to Derbyshire.

MR MACDONALD: Thank you very much, Mr Spence.

Cross-examination by MR STONE

MR STONE: Mr Spence, you helpfully drew the distinction between the store's space and the machinery space on what we have called the store's deck. I just have one or two questions perhaps to further develop that. Could we have image builders REF: 348, please? My Lord, this is going to be an image of what appears in the experts bundle at page 34.

Mr Spence, I think from this you can --

MR JUSTICE COLMAN: Before we go on, Mr Stone, when you say the experts bundle, do you mean BL3?

MR STONE: AG0.1, my Lord, page 34.

MR JUSTICE COLMAN: I see.

MR STONE: I thought it would be helpful. I think, Mr Spence, it is a somewhat complicated boundary line, the machinery space, is it not?

A. Yes, indeed.

Q. What I am going to do is to indicate, this space is constructed gas-tight, is it not?

A. Yes. I think we tend to lose sight occasionally of the fact that the Derbyshire was an OBO. She was able to carry hydrocarbon cargoes, and for that reason that is why it is a gas-tight space.

Q. What I was just going to ask you to do, could you either, with the indicator, or better still do you have that pad with a plastic pencil or something?

A. I have. I have never used it.

Q. Would you have a shot and see if you could just outline first of all the forward boundary of the machinery area, if I can call it that, perhaps starting over on the port side. I think it includes the electrical gear space, does it not? Thank you very much, Mr Spence. Could that be builders exhibit REF: 12? Have you completed the drawing?

A. Those are the boundaries of the machinery compartments to the best of my knowledge. What I have not marked in, of course, is this space here is the airlock, that I have just marked up now.

Q. Can you just look at that again? I am not quite sure that I agree with where you have -- you have gone right across. You should have gone in the centreline.

A. You are quite right, I apologise.

Q. Can you cross out -- that is right, there is an opening there.

MR JUSTICE COLMAN: How can you cross it out?

MR STONE: Crossing, as one would. Thank you very much.

MR JUSTICE COLMAN: It is the port side section of that area alone which is the airlock and not the starboard?

A. That is quite right, my Lord.

MR JUSTICE COLMAN: Not to the starboard of the centreline?

A. No, the centreline bulkhead is continuous there.

MR JUSTICE COLMAN: So it is only on the port side that you have the airlock section?

A. Yes.

MR STONE: Mr Spence, on the plan, just so we all understand it, on that starboard side there is a mark that looks like two diamonds point to point. That indicates an opening, does it not? In that bulkhead that you erroneously drew down, that is how we tell whether something --

A. That is entirely correct, yes.

Q. We also see, do we not, the gas-tight doors to which you referred which close aft?

A. Yes, those are the two gas-tight doors.

Q. I think you said in your evidence that Mr Williams had suggested that some sort of sloshing might have stoved them in, and you did not agree with that?

A. No.

Q. Do we see here that forward of the forward door there seems to be certain web obstructions, if that is the right expression?

A. Yes, there is a lot of structure inside that store.

Q. So it would not be right to think of water sloshing from right up in the stem coming right aft on to that bulkhead?

A. Absolutely impossible.

Q. Could we have builders image REF: 349, please? This is the same area, and if this could be exhibit builders 13. I want to go now to the ventilation of this space, Mr Spence, so the court has the full picture.

Mr Moran showed you last night, I think, from the photograph which I will come back to in a moment, the deck mushroom vent just to the starboard side of centreline near the mast?

A. Yes.

Q. Could you assist, do you see on this plan -- and unfortunately we do not have a construction plan with

enough detail to show where, but it does say over on the left-hand side:

"Mechanical air supply to hydropumps units, et cetera ...", which I think is referring to the machinery space?

A. Yes.

Q. Does that make sense to you?

A. It does. What you would have in a space like this, what you attempt to have, is a ventilation system that would induce air and pump it out -- circulate the air through the system, because there is going to be quite a lot of heat generated in this space, and the suction for that air supply and the discharge, in fact, would both be at a relatively high level.

Q. So somewhere -- we do not quite know where -- there is a means of mechanically drawing air into the space; is that right?

A. That appears to be the case, yes, although it is not obvious from the photographs.

Q. The deck vent would probably be the exhaust vent for that?

A. Yes.

Q. And in that way, of course, no gas gets into the store space and people can breathe in the machinery space?

A. Yes.

Q. Would that vent possibly be drawing from the store's space, that which is mechanically drawing air in? Would that come from the store space, most likely, or from the deck, do you think?

A. I would expect it to come from the deck, but it would not be impossible that it could come from the store space.

Q. If it came from the store space, presumably it is some sort of vent high up on a bulkhead somewhere round the perimeter that you have drawn?

A. I would expect that, yes.

Q. But there is no balance of probability one way or the other?

A. No.

Q. Just finally, then, on this same point, could you now go to BL3, the statement bundle, and pull out the excellent photograph on page 51 again. I think my Lord took you to this last night when we were considering the propeller, but I just want to come back to the foredeck, which is quite clearly shown. My Lord, it is page 51 of BL3.

I think on this photograph we can probably identify, can we not, Mr Spence, the mushroom vent that we are talking about?

A. Yes, it is just to starboard of the foremast.

- Q. I think, in your evidence, you said that it was to some extent protected when considering seas coming over the foredeck. Is that right?
- A. Yes.
- Q. Of course, it is further aft than some of the store space vents?
- A. Yes.
- Q. So to that extent it may be protected if heavier seas come further forward. But is it, in fact, protected from seas moving aft on that deck?
- A. It is afforded some protection by the windlasses and indeed by the mast. I am sure that is not intentional protection, but I think that it clearly is.
- Q. It is suggested to me that although that is perfectly true with the windlasses that, in fact, there may be some funneling effect; if you envisage water pouring aft on this deck, hitting the windlasses on either side, but the actual vent is not in line with either of them, there might then be some sort of funneling effect?
- A. I suppose there might be, yes.
- Q. I am just trying to put the whole picture before the court. So to that extent, that vent is protected by being further aft, but possibly exposed from not being protected by anything directly forward of it. Would that be fair?

A. Yes. That is assuming a wave coming essentially directly across the bow.

Q. Down the bow, yes. Thank you very much.

MISS BLANCHARD: My Lord, I have no questions.

MR MORAN: My Lord, I have one question arising from what has been asked. May I put that question, please?

MR JUSTICE COLMAN: Yes.

Further cross-examination by MR MORAN

MR MORAN: Mr Spence, looking again at page 34 of the experts' bundle, as it was called, RFI AG0.1 -- that is the diagram that was previously on the screen -- just a question about the gas-tight doors that you refer to in the airlock and really a point of clarification.

Gas-tight they are, but that does not necessarily mean that they are watertight, does it?

A. It does not necessarily mean they are watertight, no, but in being gas-tight they are likely to be very, very successful in preventing water coming through.

Q. I follow that. What I am getting at particularly is that they are not designed to resist hydrostatic pressure in terms of the securing devices on the --

A. Not at all. You are quite right.

MR MORAN: Thank you very much, my Lord.

MR JUSTICE COLMAN: Mr Howard, just before you re-examine, I have some questions I would like to ask Mr Spence.

Mr Spence, going back to the vexed question of spare propeller and starboard windlass which we discussed yesterday, assuming the vessel were to sink -- by that I mean put its head down below the surface at the commencement of the sinking process -- with the spare propeller secured in place, that propeller presumably could not become detached until the starboard saddle tank, or the deck above the starboard saddle tank, imploded/exploded?

A. I think that is the most probable time that it would come loose, yes.

Q. For the spare propeller to dislodge the starboard windlass and to do so by impact with it, in the general area on the inboard side of the whole structure which you have indicated, the propeller has to be detached from the deck and has to have an available unblocked approach route to that part of the windlass?

A. Yes, my Lord.

MR JUSTICE COLMAN: It has to be able to get at the windlass somehow?

A. Yes, my Lord.

MR JUSTICE COLMAN: The velocity through the water of the spare propeller, as I understand it, has to exceed the sinking velocity of the bow section by a value which, when multiplied by the mass of the propeller, will be

sufficient to impart to the windlass a force in excess of the yield strength of all three parts at the point of fracture shown on page 131 -- do you remember the mosaic photograph we were looking at yesterday?

A. Yes, my Lord.

MR JUSTICE COLMAN: Would you agree with that?

A. Not all three parts at once, my Lord. I mean, if it hit the main body of the windlass, it could break that free or part of that free, and as the structure was sinking, then it could impart -- the actual body, the gypsy itself, the main body of the windlass, could impart a lever action on the drum alongside it, ripping that off subsequently, and by "subsequently" I am talking about in a very, very short period of time. I do not believe it has to be an instantaneous failure of all the components.

MR JUSTICE COLMAN: Would it not be right that the forces attributable to the trigger impact of the spare propeller against the inboard area of the starboard windlass have to be the initiating forces which produce the lever effect?

A. That is correct, my Lord, yes.

MR JUSTICE COLMAN: You cannot get any additional forces from anywhere else, can you?

A. No, but you can get subsequent forces which could

produce the lever effect.

MR JUSTICE COLMAN: What are they attributable to?

A. By the actual thing becoming detached, and it imparting a force itself along the shaft on the bearings on the top of the drum. Possibly I am not explaining myself.

MR JUSTICE COLMAN: I think you are explaining yourself very clearly. Mechanically, you say, it is possible for there to be a greater force on the outboard sections than there was imparted to the inboard section by the impact of the spare propeller?

A. Not at all, my Lord. The forces that would be required to rip the bearing caps off the drum would be considerably less than the force required to actually detach the main body of windlass from its foundations.

MR JUSTICE COLMAN: You do not get the bearing caps off the drums unless the main body of the windlass has been detached by the initial force?

A. No, that is quite correct. I do not think that the initial impact was in way of those bearing caps, the starboard side drum, because, if it had been the case, I would suspect that the two pedestals would have been bowled over that they are actually standing on, and they appear to be absolutely upright and undamaged. It is only the caps that have broken off, and they look as though something has levered the drum up.

MR JUSTICE COLMAN: When the bow section is still attached to the main body of the vessel immediately upon the commencement of the descent, and when the spare propeller is still attached to the main body of the vessel immediately at that time, they are of course dropping at roughly equivalent velocity?

A. Well, if they are still attached to each other they are dropping at the same velocity, my Lord.

MR JUSTICE COLMAN: Absolutely. If they become detached, if both of them become detached, then whether one of them develops a velocity in excess of the velocity of the other must depend upon, as I think you accept, the relative buoyancy or the relative mass of the two separate matters under consideration, two separate items under consideration?

A. Yes, I accept that and also their form.

MR JUSTICE COLMAN: Can you please turn to AG0.1 at page 74? Just let me explain to you what this is. This is not a document to which you have signed up, as I understand it. It is an experts' meeting number 10, which took place on 11th April, and it is headed "Aspects regarding the bow structures and flooding". It contains a set of instructions to SSRC, paragraph 2, for carrying out certain calculations. It does not matter precisely what the calculations are, but those

are the set of instructions.

Now, the various values set out there show first of all sinking speed, and we are talking now about the bow section?

A. Yes.

MR JUSTICE COLMAN: And also show saddle tank collapse?

A. Yes.

MR JUSTICE COLMAN: If you look at, first of all, sinking speed, you will see that that is a range: 1.3 metres per second to 2.5 metres per second. If you look at the saddle tank collapse value, you then get a depth of 32 metres. There does not seem to be a range there at all. So presumably the experts were reasonably confident when they gave those instructions that that was a realistic depth?

A. I would assume that to be the case, my Lord, yes.

MR JUSTICE COLMAN: I simply infer that. Then you come further down the page and you see bulkhead 339 collapse.

MR HOWARD: My Lord, I am sorry to interrupt your Lordship. I am told that that figure was agreed as something to give to SSRC to carry out their calculations.

MR JUSTICE COLMAN: I appreciate that.

MR HOWARD: It was not an agreed figure for actuality in that at a later stage there was a revision among the

experts of the depth.

MR JUSTICE COLMAN: Is it a published revision?

MR HOWARD: My Lord, in experts' meeting 13, I am told.

MR JUSTICE COLMAN: Let us have a look at that.

MR HOWARD: I am sorry to interrupt you.

MR JUSTICE COLMAN: You were quite right, Mr Howard. That is on page what?

MR HOWARD: 133.

MR JUSTICE COLMAN: Mr Howard, you will have to tell me where I find it in this.

MR HOWARD: My Lord, page 136.

MR JUSTICE COLMAN: I am looking at that.

MR HOWARD: If we look at the saddle tanks, I think your Lordship will see about the third item, 35 metres above main deck and saddle tank hold number 1, the "32" -- so we are looking at saddle tank --

MR JUSTICE COLMAN: "32" has become "35"?

MR HOWARD: That is right, yes. To complete the picture, page 134.

MR JUSTICE COLMAN: Does that complete the picture in the sense that it changes the bulkhead 339 collapse values on page 74?

MR HOWARD: I was only going to say -- I will come back to your Lordship's question in a moment, if I may, my Lord -- if your Lordship looks at page 134 --

MR JUSTICE COLMAN: The answer is pretty darn clear, is it not? If you look at the top of the page at 136, you will see bulkhead 339 and then the various heads of water at the different levels. Are you with me?

MR HOWARD: My Lord, yes.

MR JUSTICE COLMAN: 25 ranged to 36.

MR HOWARD: Subject to the health warning that appears at page 134.

MR JUSTICE COLMAN: There is a health warning, is there?

MR HOWARD: Yes, paragraph 3. I am instructed there is a potentially large range of potential error in these figures, though they are the best the experts can do.

MR JUSTICE COLMAN: Shall we go on plus or minus 10 per cent?

MR HOWARD: I am told no.

MR JUSTICE COLMAN: Once you get above that, there is not much point in putting a figure down at all, is there?

MR HOWARD: My Lord, I think the lowest figure which is contended for is plus or minus 15 per cent, and there is a divergence of views among the experts, and many of them would take larger figures than that margin of error.

MR JUSTICE COLMAN: I see. Let us just do all this on a hypothetical basis, shall we, Mr Howard? Then you can come in on instructions in a moment.

MR HOWARD: Thank you.

MR JUSTICE COLMAN: Let us assume, Mr Spence, that -- if you just go back to page 74, please -- there is a sinking speed of a range of 1.3 metres per second to 2.5 metres per second, as per paragraph 2 on page 74, that the saddle tank collapse depth is a range centred around 35 metres?

A. Yes, my Lord.

MR JUSTICE COLMAN: Let us assume also that the bulkhead 339 collapse depth is a range centred around somewhere between 20 and 40 metres?

A. Yes, my Lord.

MR JUSTICE COLMAN: If those are the depths at which these various parts become detached, and those are the depths at which, hypothetically, the route to the starboard windlass opens up to the spare propeller, how in those depths does it have time to develop sufficient velocity differential?

A. The velocity differential -- it is a function of both the force -- the force is made up of speed and velocity --

MR JUSTICE COLMAN: I appreciate that.

A. Sorry, the speed and the mass, and the mass of the thing is very substantial, and the velocity differential, I believe, would be sufficient as a multiple of that to

cause some of those failures. It is an extremely large mass applied over a small area, the blade, and I believe that that would be sufficient to detach that. I have to say -- and you are obviously aware -- I have not done any calculations on this --

MR JUSTICE COLMAN: This is the difficulty I have with your approach to this, because we are looking at first of all a propeller which obviously has sharp edges -- there is no doubt at all about that -- which has to travel a substantial distance from its seating to the starboard windlass, which has very little time between the time it becomes detached and the time when the bow section becomes detached. But of course, both of them are moving?

A. Yes, my Lord.

MR JUSTICE COLMAN: The propeller is moving down and the bow section is moving down.

A. Indeed, my Lord.

MR JUSTICE COLMAN: It is the rate of movement, presumably that the bow section was moving more slowly than the propeller?

A. The propeller I consider it highly probable is moving in an entirely different motion than the rest of it because of the form of the propeller. The propeller, I believe, would start to spin and may move off at an angle and

then come back in again at an angle. The reference has been made several times recently to the sycamore seed effect. I do not find that improbable.

MR JUSTICE COLMAN: You think it could be moving horizontally?

A. Not horizontally, my Lord, no, but down at an angle and then possibly change its angle and come back again.

I do not find that improbable.

MR JUSTICE COLMAN: Like a top or something?

A. Like a spinning top, because it is of that very form.

MR JUSTICE COLMAN: I see. Thank you.

Re-examination by MR HOWARD

MR HOWARD: My Lord, I do not think I need go back over that ground.

MR JUSTICE COLMAN: Not unless you want to.

MR HOWARD: There are only two points I wanted to ask Mr Spence about. The first is in relation to some questions you were asked by my learned friend, Mr Thomas, Mr Spence, about problems which were experienced in the 1960s and 1970s with the governors. Were those problems in any way connected with the vortexing problem described by Captain Richardson?

A. No, it is a different subject.

Q. You talked about the lube oil system yesterday, and you said that it would have been examined at Sasebo, the

drydocking, in your expectation?

A. I said it may have been cleaned at Sasebo, yes, the sump tank may have been cleaned at Sasebo.

Q. I wonder whether you could look at the part of the invoice for the Sasebo drydocking which, my Lord, has been copied and I hope circulated to all parties and will be page BL3/110. I hope your Lordship now has an enlarged BL3 which will accommodate this extra page. Would you look at item 14 on page 110, please, Mr Spence?

A. Yes, I have read it.

Q. What does that indicate to you?

A. These are the two main engine lube oil coolers which featured in that chief engineer's letter that we were shown yesterday, the one I still have in front of me of 17th February, where the chief engineer is talking about a leakage and having identified it to being the after lube oil cooler. That cooler, and the forward lube oil cooler from this invoice, were overhauled at Sasebo.

Q. Would you expect there to be debris within the system after the conclusion of that operation?

(11.15 am)

A. There would be no debris within the coolers, no. They specifically refer here to rodding and blowing them through.

MR HOWARD: Thank you very much. I do not know whether your Lordship has any other questions?

A. My Lord, sorry, am I entitled just to -- may I, sorry -- there is something that has been bugging me overnight. I would like to qualify an answer.

MR JUSTICE COLMAN: Arising out of an answer you gave yesterday?

A. Yes.

MR JUSTICE COLMAN: Of course.

A. Thank you. Yesterday, Mr Thomas asked me if there were any circumstances under which the main engine could fail or break down at sea, and I agreed with him that that was the case, and I still agree with him that that is the case, that there could be unexplained catastrophic problems which would cause the main engine to close -- to stop at sea. But Mr Thomas raised one possibility, and that was the ship moving round in heavy weather and dirt being agitated in the sump. There was an inference from that, that that could have been one of the reasons.

In fact, I should have said at that time -- and I have thought about it overnight -- that, in fact, that is not likely to lead to a rapid shutdown of the main engine. If that did occur, then you would start to get blocking of the lube oil filters, which are duplex filters. The engineers would identify that and switch to the other

filter, the alternative filter, whilst they cleaned the first filter. So that sort of problem would not lead to an immediate shutdown of the engine.

MR JUSTICE COLMAN: Thank you. I do not know whether anybody would like to ask any questions arising out of the lube oil filters? No. Thank you very much indeed.

MR HOWARD: Thank you, Mr Spence.

(The witness withdrew)

May I recall Mr Byrne, my Lord?

MR JUSTICE COLMAN: Yes.

MR HOWARD: Mr Spence has already been sworn, my Lord.

DAVID BYRNE (recalled)

Examination-in-chief by MR HOWARD

MR HOWARD: Your Lordship has seen Mr Byrne's curriculum vitae, "career resume" is the English for that, as appears from BL2, page 129. The reason I refer to it again is that I omitted part of that curriculum vitae. I drew attention to Mr Byrne's practical experience, but I failed, I gather, to draw attention to his formal qualifications.

MR JUSTICE COLMAN: I have read them.

MR HOWARD: My Lord, thank you. You have produced two reports, I think, Mr Byrne?

A. That is correct, yes.

Q. One which we have at BL2 and the other at BL4, page 101

and following?

A. Yes.

Q. Are there any changes which you wish to make to those reports which you can summarise for my Lord?

A. In the broad thrust of the report, no. In the light of various experts' meetings which we have had, there were some detailed matters which I would modify, although they are, I think, few. They mainly relate to the postsinking scenarios, if you like, the collapse of various structural elements. I think in my main report I was perhaps a little more definite than was prudent. In the light of our extended conversations between the experts, I would probably be a little less definite now. That is probably the only thing that I would like to mention at this stage.

Q. Thank you. Then your conclusions, your summary, is set out at page 3. My Lord, I will with your Lordship's leave, go through the summary?

MR JUSTICE COLMAN: Are you in BL2 or BL4 at this point?

MR HOWARD: BL2, my Lord, for the foreseeable future.

MR JUSTICE COLMAN: Thank you, I have read that.

MR HOWARD: You have read the summary?

MR JUSTICE COLMAN: Yes.

MR HOWARD: I am sure your Lordship has read the whole of --

MR JUSTICE COLMAN: I have, twice.

MR HOWARD: Perhaps I can just ask you one matter which appears at the top of page 4:

"In the tropical revolving storm which the vessel encountered, the vessel would have finally found herself hove to, probably with the wind fine on the port bow in accordance with prudent seamanship. In these circumstances, 'hove to' would mean that the main engine was giving sufficient revolutions of the propeller to maintain the chosen attitude of the vessel -- in my opinion, about 4 knots of speed through the water."

Do you have any comment to make on the statement you make there?

A. Yes. This was a fairly broad brushstroke statement made with no calculations at the time, last November.

I think, again, in the light of both the navigation evidence, which I have seen, and some of the computations that I have seen, I would say that the maximum speed was more likely to be in a range between 3 and 4 knots. That is probably all I would say for the time being, in a range between 3 and 4 knots.

Q. You say the "maximum speed". Would the speed of the ship through the water vary in your estimation?

A. Yes.

Q. Can you give us some idea of the range?

A. I can give some idea, bearing in mind that, as we have

already heard, I think, from better qualified witnesses than I, marine witnesses, the tactic that one has to apply is to maintain the ship's head to weather broadly speaking, and that requires effort, the rudder and the main hull, where the rudder is acting, if you like, as a flap and the hull is acting as a wing. So one has to put effort in, one has to have the propeller turning, and the amount of effort depends on the severity of the weather.

So, paradoxically, it may be that one needs more effort in the worst conditions and less effort in the less severe conditions. So a more brief answer would be from time to time the speed may be down at around 1 knot or 1.5 knots. At other times, I think it could be above 3 knots.

Q. Lower down on that page you say:

"Based on observations of wave height made at the time and in the area of the casualty, together with subsequent analyses, the uniformly distributed head of water over number 1 hatch cover of up to 8.4 metres could be envisaged."

How does that figure stand up in the light of all the vast increase of information we now have about sea states?

A. If one lays that alongside the model testing data from

Marin, one would be immediately drawn to say that the number should be lower. That figure was based on information over very many years, but perhaps not as well qualified as the Marin tests. So it may be that the figure should be lower. However, that assumes that the Marin tests have suddenly, as it were, overnight become the gold standard. I am not absolutely sure that is the case. It is a very well-run facility and there are excellent engineers. So there is no criticism implied in my comment, but simply that usually with full-scale testing facilities, like any other measuring instrument, one needs time to calibrate them and gain experience.

So my belief is that the Marin tests are excellent, but not necessarily to gold standard, if I can put it that way.

- Q. Going on to page 5, about halfway down you have the comment made:

"If the store's hatch was broken open by the seas, the effect of even total filling of the available store's spaces is two orders of magnitude remote from the attack of the wave environment; that is, the reduction in freeboard due to store's flooding is only about 0.25 metres."

Is that based on the flooding of the whole of the

store's deck area including the hydraulic machinery space, or just of the remainder of the store's deck area?

A. That was based on a simple calculation of the whole volume.

Q. The reduction in freeboard makes allowance for the change in trim caused by the transfer of fuel over the voyage?

A. In this particular instance, the change of freeboard is entirely due to the addition of water in the store's deck.

Q. That is independent, is it, of any state of trim?

A. Absolutely.

Q. Then you say on page 6 -- I will come back to this:

"From close observation of the hatch cover wreckage [towards the bottom of the page] it appears that the fabric of the panels was in good condition, including the fittings and the rubber seal.

"Some of the heavy duty cross-joint hatches appear to have been engaged, whilst it seems that others were not. In some cases the catches cannot be seen. It is therefore not possible to determine their status.

"In any case, the weathertight integrity of the hatch covers was not impaired regardless of the status of the catches."

Perhaps I can come back to that later on.

You then have an introductory section which takes us to page 10 where you deal with the loaded condition of the ship, and I think the loaded condition of the ship is something you have reconsidered in the light of later information in your supplementary report, is it not?

A. Yes. Although there was, I think, a broad agreement between the experts at one of the early meetings. There was a discussion on some of the precision of the distribution of masses. So I produced my supplementary report which attempted to capture those considerations, and I believe was in due course accepted by the other experts as being a reasonable --

MR JUSTICE COLMAN: So far as you know, are there any aspects of the loaded condition of the ship material to anything that this investigation has to look at which are unagreed?

A. No, I do not believe so, my Lord.

MR JUSTICE COLMAN: Thank you.

MR HOWARD: Your conclusion on page 22 of your original report was that:

"Given the vessel's known trim and weights on board, it can be seen from estimate 1 that there would have been of the order of 2,600 metric tonnes [of fuel

oil] in the forward deep tank."

That is what everybody has now accepted,  
I think -- most of the --

- A. Perhaps I should comment on that. If one accepts the 0.5-metre trim by the stern, then if you like, the implication by mathematics is that there is 2,600 tonnes in the forward deep tank. It is physically possible for the stern trim to have been greater than .5 metres, and if one -- I believe the experts, again in discussion, saw the maximum stern trim was, from my memory, 1.1 metres by the stern, I think, in which case there would be perhaps about 2,000 tonnes of fuel oil in the forward deep tank.
- Q. Do you know of any reason why a master, situated as Captain Underhill was, would not be able to achieve the trim he needed to set out to achieve?
- A. If we assume that his tactic for the voyage was to achieve a half metre stern trim, and there is some evidence to suggest that, then 2,600 tonnes seems to be the most likely figure.
- Q. I think that is the figure which you repeat at, just for the sake of completeness, BL4, page 105, and you observed that the freeboard forward corresponding to the forward draught was 7.294 metres at the time of the casualty?

A. Yes.

Q. Section 3 of your report, which starts at page 24, deals with environmental conditions. At the top of page 25, you say:

"Similarly hindcasts have been made which suggest average values of significant wave heights of between 10 metres and 11 metres.

"The analysis of 'abnormal' waves reported in reference 4 suggests that significant wave heights somewhat greater than this may have occurred.

"Using conventional wave statistics, a useful rule of thumb is:

"Most probable extreme wave is 2 times highest significant wave.

"Highest wave likely to be encountered is 2.5 times highest significant wave."

Over what period are you talking when you say that the most probable extreme wave is likely to be twice the highest significant wave, or is it in any given period for which you can assess a significant wave height?

A. It is simply an extreme value from a distribution. It is the classic, if you like, 100-year wave that arrives today, and another 100-year wave arrives tomorrow. So there is no defined period for it, although in principle the longer the period of observation, the more likely

one is to observe a higher extreme event.

Q. You say:

"It is worth noting that, historically, the highest wave observed with some degree of reliability was 34 metres from the USS Ramapo in 1984. The highest wave measured with accuracy was 26 metres from the Weather Reporter in the North Atlantic."

A. Yes.

Q. In the penultimate paragraph, you say:

"In section 4 of this report, the capability of the hatch covers is discussed more fully, but in summary, a static pressure of about 4 metric tonnes per square metre will exceed the ultimate collapse load of the hatch covers."

Is that a precise figure?

A. No. I said about 4 tonnes per square metre. I think the subsequent analysis -- I think deeper in my report I mention 4.1 tonnes per square metre as being the likely collapse pressure. I think there has been further analysis done particularly by Lloyd's subsequently, to which I believe all the experts signed up, which used a figure for comparison of 4.3 tonnes per square metre.

Q. Then you go on at page 27 summarising your approach:

"In all of the above, the underlying assumption is of long-crested waves, more or less homogeneous in

direction. In the case of a rapidly moving depression, such as a typhoon, there would doubtless be rapidly changing wave propagation directions, with longer energetic waves moving ahead of the depression, causing crossing seas. A combination of long swell waves (perhaps as high as 4 metres) crossing high, wind-driven local waves will give rise to pyramidal waves or troughs with great potential for damage. In several cases studied by the author, this has been a common feature in damage or casualties. Reference 4 also provides helpful information on abnormal waves."

I think reference 4 is a paper by Professor Faulkner, is it not?

A. Yes, it is. I know it was not expressed as a question, but perhaps I could comment on that, if I may?

Q. Yes.

MR EDER: My Lord, may I say this? I rise in relation to these particular pages. It is entirely a matter for your Lordship at the end of the day, but a question does arise as to whether or not this witness has expertise in this area in terms of predicting weather, predicting sea conditions, and whether he does or does not have expertise, whether, given that your Lordship has already heard other evidence from experts who certainly do have much greater expertise, whether it is helpful for this

evidence to be adduced at this stage.

One of the problems, my Lord, is -- I think my friend may be coming to something else in a moment -- once this evidence is admitted in this way, the question is to what extent does it need to be cross-examined at any great length, and how much time is to be taken up in this way. I think, if it is unchallenged, will it be said at the end of the day that it is unchallenged, though there is a mass of other evidence from other experts who deal specifically with this?

MR JUSTICE COLMAN: I shall not put a great deal of weight on evidence which is adduced from scenario witnesses about areas of expertise in relation to which expert evidence is to be called from experts in the field.

MR EDER: My Lord, I am glad that your Lordship is saying that. I wonder, though, my Lord, whether it is right for my learned friend, in the light of that, to spend time seeking to adduce that evidence. It goes on the transcript and what do we do about that? I am coming to one other matter in a moment that I have discussed with my friend, and I will wait to see how my friend deals with it. That is all I wanted to say at this stage, my Lord.

MR JUSTICE COLMAN: Mr Howard, this was a sort of composite report, BL2, which was prepared for the owners' purposes

on a sort of broad spectrum of issues relating to scenario evidence. This part of it, as I understand it, is really in the report to provide background to the expression of scenario expert evidence, as distinct from being a part of the report which is heavily relied upon in its own right in the discrete areas of oceanography to which it refers.

MR HOWARD: Of course Mr Byrne would not lay claim to the same degree of expertise as the specialist oceanographers. It would be wrong to say he has no expertise in the field at all, but I am not sure that it would be right to say that there is any material dispute arising out of this part of the evidence.

MR JUSTICE COLMAN: I am just wondering about this, because the experts have been through all of this and agreed huge swathes of values. That is why you remember a short time ago I asked Mr Byrne whether there was unagreed anything about the loading condition as between the experts, and the answer was no, not so far as he knew. I think, generally, if there are areas of evidence which have been dealt with by the experts who have produced agreements, then in general scenario witnesses should only be asked to give evidence about the unagreed bits.

I am quite happy to accept the experts' agreement

as a good basis. They have expressed their reasons in their various reports and so on. It seems to me right that I should accept the experts' agreement on what I might describe as perhaps off-central issues.

MR HOWARD: Certainly, my Lord. I think that the areas with which my learned friend was particularly concerned were not areas on which there has been agreement, but on which expert evidence has been tendered.

MR JUSTICE COLMAN: That is another point.

MR HOWARD: Perhaps I can move on -- let me just ask Mr Byrne, do you understand Dr Cardone's evidence to differ from the approach you have taken to the meteorological evidence?

A. Yes, I do. My earlier attempt, if you like, at an intervention, was to hold my hand up and say that I would, in the light of his expert evidence, if you like, re-write that paragraph, which may have been helpful in the first place.

Q. In what respect would you -- I do not know whether Mr Eder will be content with that?

MR JUSTICE COLMAN: The re-writing of the paragraph presumably, Mr Byrne, would be to produce a view which was consistent, rather than inconsistent, with Dr Cardone's view?

A. I suppose the paragraph could be summarised by "See

Cardone", yes.

MR JUSTICE COLMAN: I think we can go on to the next subject, Mr Howard.

MR EDER: My Lord, I am sorry to interrupt again. My learned friend has passed over the bottom of page 27. If your Lordship could just cast your eye over that, I am not sure --

MR JUSTICE COLMAN: This is the "reference 5, appendix 8" bit.

MR EDER: It is, my Lord. I have asked my friend about this, and I am still waiting for a response finally. My Lord, it raises this difficulty: Mr Byrne refers here to another paper that he has written, together with Mr Evans, I think, where he describes there two case studies, in one of which the bulk carrier -- we think that particular ship is called the "Christinaki" -- was lost with all hands by the action of a storm wave breaking over the number 1 hatch covers. It is a case study that he refers to.

Now, my Lord, again, it is entirely a matter for your Lordship. The question arises as to whether or not your Lordship considers it helpful, desirable, for, in the course of this inquiry, there to be any debate, detailed debate, about how another ship either did sink or may have sunk or whatever. I have asked my learned

friend to indicate that.

My Lord, Lloyd's Register's position, I think, is this: if it has been suggested that any particular ship sank in a particular way, then it will require very careful consideration to consider whether that is right or not, but what Lloyd's Register do not want to happen is these odd comments to come in in a very halfhearted way without being considered in detail. There is no halfway house, in our respectful submission.

MR JUSTICE COLMAN: It is the old similar facts area in civil cases. Am I not right in thinking, Mr Eder, that we have been down this route before, before the start of the hearing, and I was asked to rule on this area? Am I not right in that, or is that my mistaken --

MR MACDONALD: Your Lordship is right in thinking there was an issue as to whether the Department was obliged to produce a report by this gentleman on the loss of the Christinaki, which the Department happened to have in its power. The ruling was, for one reason and another, that it should be produced, and it is in bundle DETR2.

Certainly our understanding -- we are expecting at the moment to have to put to this witness whether the aetiology of that casualty was as indicated in that report. It would certainly be useful to have that clarified.

MR HOWARD: Perhaps we could look at the report for the moment, and ask Mr Byrne what significance we can draw from it. Then we can see whether my learned friend Mr Eder wants to persist with his objection, and if so, whether the objection has any validity in the light of the --

MR EDER: My Lord --

MR JUSTICE COLMAN: Can I just ask Mr Byrne a few questions about this?

MR EDER: My Lord, certainly. May I just explain one matter, my Lord? What is exhibited to this report, and the reference at page 27, is an article written by Mr Byrne and a Mr Evans.

MR JUSTICE COLMAN: I have read it.

MR EDER: Separate from that is another report where Mr Byrne acted for the owners of the Christinaki in litigation, in quite separate litigation, concerning the loss of the Christinaki. I am not sure whether that was an arbitration or a court case.

In the course of that he produced a long report, an expert's report, instructed on behalf of the owners of the Christinaki, as to the cause of the loss of the Christinaki. That is the document that came into the possession, as I understand it, of the DETR. A question arose as to whether or not, in the hands of the DETR,

that was discloseable or not.

Lloyd's Register took the view, that whatever documents exist, and if it is being suggested it is at all relevant, it should be disclosed simply for the purpose of transparency. I think your Lordship ruled that that document should at least be disclosed.

One of the problems was the owners of the Christinaki, who had been instructed I think by Ince & Co, basically told the DETR -- and I will be corrected if I am wrong -- that they did not give their permission to the disclosure of that report, and that was the only real issue that your Lordship decided.

So at the moment, there is this report, this article, from Mr Byrne, together with Mr Evans, that is exhibited that your Lordship has read, and there is the separate long expert's report that goes into considerable detail of why Mr Byrne says that the Christinaki sank or not.

I would be grateful to know at the earliest possible opportunity where we are going on this kind of material, because if we are going to take up time in relation to that, it will take, I think, necessarily a considerable time, or potentially a considerable time, because basically your Lordship will be, as in all similar fact evidence, having to consider an inquiry

into the Christinaki.

MR JUSTICE COLMAN: A similarity issue.

MR EDER: Yes, and does your Lordship want to go down that route or not? Ultimately it is a matter for your Lordship to decide where to go.

(11.45 am)

MR JUSTICE COLMAN: Did I not say in the course of that hearing about the Christinaki -- I think there was a hearing about it --

MR EDER: It was done on paper.

MR JUSTICE COLMAN: It was all done on paper, was it?

MR EDER: Certainly my recollection is -- and I think everyone is agreeing -- that it was done on paper, my Lord.

MR JUSTICE COLMAN: Does the paper -- which must be somewhere -- not say that when the disclosure had taken place, which I ordered, something else must happen?

MR EDER: I cannot recollect. I see others checking. We can check that if necessary, my Lord.

MR JUSTICE COLMAN: It may have been just a bare order that the documents should be disclosed. I had a feeling --

MR HOWARD: I recollect, my Lord, the only issue was whether or not legal professional privilege attached. All the parties who were present before this inquiry were indifferent, or wanted the document in. It was only the

outsider who --

MR JUSTICE COLMAN: I see.

MR MEESON: If I could explain, the owners of the Christinaki no longer exist. So one had the bizarre situation where Ince & Co were defending a client they no longer had because they ceased to exist, but were saying that they were not prepared to release the document. So, not surprisingly, since the only person who was objecting, in fact, could not object because they did not exist, your Lordship decided that the document should be produced.

MR JUSTICE COLMAN: One of the easiest points in this investigation.

MR MEESON: I do not think it troubled your Lordship for a great deal of time.

MR JUSTICE COLMAN: In so much as I made that order, I cannot now remember the date. It must have been some time at the beginning of this year, perhaps, or last year.

MR MACDONALD: Your Lordship will find the ruling in RFI AG0 at pages 71 and 72. I think it was probably 3rd April according to the fax header, and at page 72, paragraph 6, your Lordship will see that you reserved expressly any view on the probative value or relevance of the report.

MR JUSTICE COLMAN: Did you say page 72?

MR MACDONALD: Yes, 71 and 72 of AG0. It is tab 19.

MR JUSTICE COLMAN: This is all about television cameras in the court in my bundle.

MR MEESON: Your bundle is the same as ours, my Lord.

MR JUSTICE COLMAN: I think it must be a wrong reference.

MR MACDONALD: It appears I have a different AG0 to others.

It is the same as Mr Cooper's. That probably does not help much.

MR JUSTICE COLMAN: I think it must have been in the course of 1999 at some stage, before Christmas.

MR MACDONALD: I think it was shortly before the hearing was due to begin, as I recall.

MR JUSTICE COLMAN: Let us not waste time on that. It seems to me, when making that order, my assumption was that if anybody was going to make anything positive out of the Christinaki evidence, they would have made it at the very latest by the commencement of the hearing.

What we have now, if I may with all due respect to Mr Byrne say, is a very brief reference at the bottom of page 27 to the case studies, and in particular to his appendix 8.

This is in the report but, as I understand it, has not been, so to speak, taken up as leading this investigation anywhere. Absent it not being taken up,

I just really wonder whether at this stage any purpose would be gained by going into this at all.

Mr Howard, what is your position on this?

MR HOWARD: My Lord, I was proposing to take Mr Byrne to the outline of this case study, which appears at page 215 of bundle BL2 and just to look at his conclusions.

MR JUSTICE COLMAN: For what purpose? Before you do this, I would like to be very clear what you are going to use it for.

MR HOWARD: My Lord, Mr Byrne is conducting the examination of two cases and some general statistics, which led him to the conclusion that there is need for care in relation to the protection of forward hatches. This, of course, was something which arose completely independently of this inquiry and before he was involved in any way with the investigation into the loss of the Derbyshire. It is, therefore, in my submission, material to know what a man who knows a great deal about hatch covers and is a naval architect has, from his general experience and from specific cases, formed views --

MR JUSTICE COLMAN: Is it going to get any further than the following propositions: (1) that if bulk carriers encounter sea conditions which impose upon the forward hatches hydrostatic or hydrodynamic forces which exceed

the yield strength of the forward hatches, there is likely to be a disaster; (2) that in deciding on the design of bulk carriers, it is relevant to take into account the frequency of exposure to such sea conditions and whether the design ought to be directed to avoiding disasters of that kind in sea conditions which may be more or less frequent?

MR HOWARD: It goes a little further than that, because it provides some sort of indication of the level of risk. The level of risk is not put forward as a very high level, but perhaps one which has been overlooked. That would, in any event, be Mr Byrne's evidence, as I understand it, and it would seem convenient to look at it in this form, without reference necessarily to the details of the Christinaki, which is not, in fact, mentioned by name in this report.

MR JUSTICE COLMAN: If you think you will get anything out of it on the basis of the level of risk without the investigation of the details which led to the sinking of the Christinaki, do by all means take it. But at the moment one's instinct is that without a nuts and bolts investigation of the reasons for the sinking of the Christinaki, it is difficult to derive anything material from this, is it not?

MR HOWARD: The sort of investigation which I propose to

carry out with Mr Byrne is a high level of generality. It will not take up a lot of time. I think it may be of use to your Lordship. If your Lordship thinks it ought to be conducted at a more particular level, then that of course can be done.

MR JUSTICE COLMAN: Are we in a recommendation area here? We are looking at the recommendation field here, are we?

MR HOWARD: Not specifically, my Lord, no. We are looking to see what is the level of risk to which the Derbyshire was exposed.

MR JUSTICE COLMAN: How does that work, because the level of risk to which the Derbyshire is exposed must surely depend upon an analysis of the sea conditions which prevailed at the time at which she was making her voyage?

MR HOWARD: My Lord, there are two different kinds of investigation one can carry out. First of all, there is the very minute investigation which involves the calculation of each successive wave crest so far as that is humanly possible, and the time at which it impacts on the ship, and the strength of the structure, and indeed the exact degree of wear which the hatch covers will have experienced over their life. One can take it down further and further with more and more finite element

analyses.

At the other extreme, one can look at the totality of seagoing experience to see a broad picture, which is not necessarily obvious just by looking at the fact of a single casualty. That would not be valuable if it did not emanate from a person who has relevant experience in relation to casualties, to hatch covers, and to naval architecture. I respectfully submit that the broad picture is as important to your Lordship as the detailed picture, especially given the fact that there are large areas of uncertainty inevitably in all the calculated parts of the case. One cannot get sort of spurious precision merely because one can put numbers on things which all have built in variables which are to a greater or lesser degree.

MR JUSTICE COLMAN: Does any other counsel have any submissions to make about this? I have heard you, Mr Eder. I do not think I need to trouble you again.

MR MORAN: My Lord, only to say this: the experts advising the DFA did look at the Christinaki, and it was felt, without a full exploration of all of the facts, that it would really be of little assistance and indeed might confuse, so we have deliberately not deployed it in the presentation of reports and evidence. We take the view that your Lordship's approach expressed just a few

moments ago is the proper approach.

MR JUSTICE COLMAN: Mr Stone, do you have anything to say?

MR STONE: No.

MR JUSTICE COLMAN: Mr MacDonald?

MR MACDONALD: My Lord, I broadly support the position adopted by Mr Eder, and I would invite your Lordship to be wary of going into a detailed examination of any one specific casualty.

There are some very general statements within the Byrne and Evans article which relate to the general level of risk, particularly at page 321 of the bundle. It may be that they could be taken without any objection, relating broadly to the overall casualty statistics picture. I suspect it may be one of these areas in which it would be quicker to cross-examine than to debate whether the evidence should be adduced in the first place.

We would suggest that your Lordship should not go into the detail of the Christinaki. Mr Cooper, who will be cross-examining, will certainly go into the detail if it is raised as a specific casualty, at least to some extent.

MR JUSTICE COLMAN: Thank you. Mr Thomas, do you have any public interest submissions to make?

MR THOMAS: My Lord, the only point I have to make is

Mr Williams, in a recent document which has been distributed, which he calls, I think, a "Framework of latest thinking" --

MR JUSTICE COLMAN: Framework of what?

MR THOMAS: Latest thinking, my Lord. Your Lordship will recall that when we were considering prior to other experts being called on scenarios in advance of Mr Williams, you directed that before Mr Williams went to the Shetland Islands he should indicate his latest views on scenarios. That is done in that document.

My Lord, in that document, he does refer to the Christinaki and does so, I think, not to rely upon it, not to make any point upon similarity, but to make the point, having considered that and two other cases, as he concludes, that there is no ship of this size -- meaning the Derbyshire -- that has been lost due to cargo hatch cover collapse over the 22-year period he was reviewing, except possibly the Derbyshire.

So, in other words, he is noting the Christinaki. Whether he is putting any particular significance upon its cause, I do not know, save that it is obviously something to do with hatch cover collapse, but puts it on one side as a very much smaller ship, quite apart from many other differences that there are. On that basis, he treats the Derbyshire, as I understand it, as

one on its own. In that sense, it seems to us that there is no purpose in pursuing the analogy of the Christinaki.

MR JUSTICE COLMAN: Is there anything else you want to say, Mr Howard?

MR HOWARD: Only, as I indicated at the outset, I am not relying on the Christinaki as a specific analogy, as the general conclusions which Mr Byrne expressed at pages 320 and following of his report --

MR JUSTICE COLMAN: Mr Howard, I am not going to exclude any general comments which Mr Byrne may have made in the article about ship safety, but I am going to exclude both any detailed investigation over what happened to the Christinaki and any detailed comments which depend upon a detailed investigation as to what happened into Christinaki.

At that point I think we will have a break, which will be slightly extended this morning for a quarter of an hour.

(12 noon)

(A short break)

(12.15 pm)

MR HOWARD: My Lord, having had a few minutes to consider it, I am going to go straight on to hatch covers and am not going to pursue that at all.

Page 28 of BL2 contains a brief description of the hatch covers. One can see there rolling hatch covers, hatches 1 and 2 being sizes peculiar to themselves and hatches 3 to 9 all being the same size. You give details of their construction, and you say on page 29:

"The weathertight and oiltight integrity of the hatch covers relies on a rubber seal which is continuous around the periphery of the hatch cover and is also fitted across the cross-joint."

That you say appears in figure 4.1, which I think is at page 331 of the bundle. Page 331 is illustrating the compression bar. What can we see there in that diagram of the quick-acting cleat?

- A. This figure, 4.1, was really illustrating two separate ideas. One is simply to point out where the seal is in relation to the side of the hatch cover and where the compression bar is in relation to that seal, and secondly to show, as it were, diagrammatically what a quick-acting cleat looks like.
- Q. On the following page there is a diagram of the cross-joint?
- A. Yes.
- Q. That shows a similar arrangement, does it?
- A. In effect, yes. The weathertightness of the hatch is achieved by the penetration of the compression bar, in

this case a 50 metres by 20 metres flat bar, the penetration of that bar into the rubber when the hatch cover is closed.

MR JUSTICE COLMAN: Could we perhaps have a common understanding as to what we call these cleats? They have a whole range of names which I have found in the papers. What is the most acceptable description of these, because I have always been calling them "centreline cleats"?

A. The peripheral cleats I think are clear enough. They are called "quick-acting cleats".

MR JUSTICE COLMAN: No problem.

A. The three heavy-duty catches are correctly called "catches" because they do not have any resilience in their design. So they are not cleats. They are simply catches. It is a fine distinction.

MR JUSTICE COLMAN: What ought we properly to call them? Centreline catches?

A. "Heavy-duty cross-joint catches" is the rather congruous name, I am afraid, or "heavy-duty catches", for a slightly shorter.

MR HOWARD: I will try to refer to them --

MR JUSTICE COLMAN: We will call them "centreline catches".

MR HOWARD: You say in relation to the quick-acting cleats that in the hatch covers under consideration, this would

have been 30 millimetres plus or minus 3 millimetres. It was actually set at 16 millimetres on the Derbyshire. How does that figure of 16 millimetres get reached?

- A. Physically how it is reached on a hatch cover is the overall hatch cover steelwork design is arranged such that when the rubber is in place, you achieve 16 millimetres of compression. So it is not, as it were, left to chance. That geometry has to be very strictly controlled by what is generally referred to as steel to steel contact.
- Q. How do you set the degree of penetration?
- A. It is set at the new building stage in the shipyard when the hatch covers are presented to the ship. The fittings which locate the hatch covers are very carefully aligned and set up by the shipyard personnel, assisted by the hatch cover manufacturers, specialist installation engineers. It perhaps is worth mentioning that although hatch covers are often large in the physical extent, and therefore could be mistaken for being rather dumb steel lids, they require a substantial amount of precision, both new and in service, to keep them weathertight.
- Q. You describe their motion at a later stage while they are in place. At page 29 you describe their mode of

operation. Would it be a convenient course, my Lord, just to demonstrate briefly the mode of operation by use of the vertical reality model?

MR JUSTICE COLMAN: Certainly.

MR HOWARD: (REF:) Would you talk us through this, Mr Byrne?

A. I will try.

Q. One can see the centreline catch there?

A. I will try to point with the laser, but that is the centreline catch, as it were, engaging itself and disengaging itself. So we are looking at the top of a hatch cover. Now we have flown away to a position that is forward starboard of the hatch cover. The hatch covers are closed. The hatch covers have lifted on the hydraulic jacks or pot lifts and are now able to be rolled outboard. I think we now see them rolling back in again, so each hatch cover is now supported on four wheels being driven hydraulically together.

At this point, the eight hydraulic pot lifts lower, and the hatch covers now are supported on their skirt plates, or sides plates, all the way round, and importantly are located by the wedge-shaped locator devices fore and aft of the hatch cover on the centreline of the ship. In this condition, even without the cleats on, the hatch cover should be weathertight.

Q. When you say "without the cleats", do you mean without any cleats at all?

A. In harbour, in this condition, the hatch covers ought to be weathertight.

MR JUSTICE COLMAN: By "without the cleats on", you mean without the catches on and without the quick-acting cleats?

A. Yes, my Lord, without --

MR JUSTICE COLMAN: Without anything at all?

A. With no more intervention at this time. If one were to do a hose test, a well-maintained hatch cover should pass that test.

MR HOWARD: Could you indicate again where the wedges you have been talking about are? They are moving at the moment?

A. On the coaming, because the hatch covers have moved away helpfully. There is a centreline stop which I am indicating there, which is a fairly robust block of steel, and then two wedge-shaped devices, one on each side of it. As the hatch covers come together, and as they now drop, you will see there is a wedge-shaped block on each panel which engages in that apparatus on the coaming, and is very carefully set up to drive the hatch covers together and to give the 16 millimetres of compression that we mentioned earlier.

- Q. Is there anything else we can draw from that illustration, Mr Byrne, or shall we move on?
- A. Nothing that is particularly material, I do not think. There are some details which I do not think are particularly relevant.
- Q. Then you deal with securing and locating devices at paragraph 4.2 on page 30. You distinguish between the dry cargo mode and the oil cargo mode, saying:
- "The hatch cover should be viewed as a dynamic object, able to 'float' or slide on the coaming, free of the stresses and distortions which affect the main hull girder."
- You go on to say:
- " The practical objective in the dry cargo mode is to keep the cargo dry."
- As far as dry cargo mode is concerned, the position is, is it not, that the ship is entitled to sail with half the quick-acting cleats in place?
- A. That is correct.
- Q. The question then arises as to the horizontal restraint. You deal with that at page 32. You summarise --
- A. I hope so. The driving principle of hatch cover design is that the hatch covers should never see main hull girder stresses. They are certainly not designed to

experience those. So the hatch cover is required to float or at least slide as the coaming of the ship deflects, because of course the ship -- any ship -- will change shape as it traverses waves. So the coaming is constantly changing shape through cargo loading or the effect of the ship sailing through oblique waves; for example, it bends and it twists.

So the hatch covers are required to be held in place and maintain weathertightness, but at the same time need to be restrained horizontally in such a way that it does not pick up main hull girder stresses. So the design of locators is something that needs very careful attention, and the positioning of those locators also. So it is no accident that on a ship like the Derbyshire, the locators are positioned on the centreline, forward and aft, where the relative movement between the hatch cover and the coamings should be least. So the horizontal restraint, apart from friction, self-weight and so on, is mainly provided by those locators.

- Q. Are those locators also sometimes referred to as "fingers"?
- A. No, sorry.
- Q. What are the fingers?
- A. The fingers or pegs, as they are usually referred to,

are, if I understand you correctly, the ones fitted across the cross-joint between the two panels.

- Q. In the longitudinal and the athwartships plane, the cleats act as a constraint on the periphery of the hatch covers?
- A. Yes, they do, in practice. Sorry, perhaps I should amplify, the cleats do provide some restraint, but only in so far as they are applying frictional forces to the side plate, because the quick-acting cleat is able to move in a vertical axis. So they only provide a limited amount of restraint. The primary restraint is from the quite robust steel locators.
- Q. You say in your report that in the majority of bulk carriers and OBO vessels fitted with side rolling hatch covers -- and we are now looking at athwartships restraint -- these centring devices, also known as battening devices, provide all of the athwartships restraint. That is no cross-joint cleats, bolts or catches are fitted?
- A. That is correct.
- Q. I think you have provided a very detailed account statistically backed in appendix 5 of your report, showing the relatively low proportion of bulk carriers which do have centreline catches?
- A. That is correct.

Q. My Lord, unless somebody wants to take that point up, I will leave it at that.

You then deal with the cross-joints and you then turn to the oil cargo mode. You refer to the internal loadings which arise from hydrostatic forces, hydrodynamic forces and inert gas pressure:

"To resist these vertical forces, additional quick-acting cleats are fitted; in the case of Derbyshire, twice as many cleats as would be required for the dry cargo condition ...

"The rationale here is that oil cargoes require a higher standard of seal tightness in order to properly contain the cargo and to maintain a gas-tight condition.

"It is the same consideration of assured oil and gas-tightness that informs the design of the cross-joint security catches.

"On Derbyshire, an additional facility was provided to position 40mm diameter bolts at intervals along the cross-joint to guarantee even greater gas-tightness. It is understood that these bolts were never used in practice."

Then you summarise the reference to this in appendix 5, in table 4.1, which shows the numbers of OBOs and dry bulk carriers with no cross-joint cleating,

by which I take it you mean no cross-joint catches, and "about two-thirds of all bulk carriers across the size range were not fitted with cross-joint cleats at all"?

A. Just in my own defence, the fitting of cross-joint catches is unusual, and I think after this particular class of ships, to the best of my knowledge, it was never done again. Instead, and before, cross-joint cleats were used, i.e. some sort of device at the cross-joint on OBOs which gave restraint and some resilience. So it is actually correct. It should say cross-joint cleats in that paragraph.

MR JUSTICE COLMAN: So the position is that there were perhaps only about one-third of all bulk carriers that were fitted with cross-joint cleats or catches?

A. Yes.

MR JUSTICE COLMAN: But of the one-third, very few of them indeed were fitted with cross-joint catches, as distinct from cleats?

A. That is my clear understanding, my Lord.

MR HOWARD: The general purpose of these cross-joint catches was a very specific one?

A. Yes. One practical difficulty with OBO ships, whatever their design, is their propensity to leak, one hopes modest amounts, but nevertheless amounts of gas from the

cross-joint. So a variety of measures were there required or used to try to stop that happening. These heavy-duty catches was one design approach which I can quite see was attractive to the designer, albeit in practice they were difficult. So, in other words, they were really fitted to try to guarantee gas-tightness at the cross-joint in the OBO condition.

- Q. I think you summarise this at pages 44 onwards, where you express that view and also refer to discussions you have had with the designer of these particular hatches which were installed on the Derbyshire?
- A. Yes.
- Q. As I understand it, he confirmed the view you had formed independently?
- A. I spoke to him after writing my initial report because, having recognised his initials on the drawings, and knowing where he lived and worked, I thought it would be quite prudent and proper to discuss it with him, and, yes, he did agree entirely.
- Q. Going back to page 36 at 4.2.2, you set out the MacGregor Hatch Cover Manual and you say that the terms in the operating instructions in section II suggest that catches are only essential when oil liquid cargoes are carried, and it is to this section that a chief officer would look for guidance on operation.

Then you point out that in section V of the same document there is a reference to heavy-duty cross-joint securing catches:

"Important -- to be fastened at all times, NB during carriage of oil, bulk or ore cargoes".

You observe that there appears to be a risk of confusion in the content and the placing of these two statements?

A. Yes, I do.

Q. Is that based on practical experience of the way ships are, in fact, operated?

A. Yes, it is. I have to say it is also in that sense an assumption on my part. My experience is, both at sea and more latterly visiting ships with hatch covers and problems, that the chief officer is mainly interested in getting them open and closed and routine maintenance, and it is probably fair to say that the engineers are more interested in the hydraulic actuation, and the electrician and so on. So it may well be that each of those two parties looks at a different place in the manual.

Q. Thank you. You then deal with what happens when there is heavy weather, and you suggest that if the ship is in dry cargo mode, it helps neither to attach more cleats or to tighten up the cleats which are attached.

A. Yes, on the first point, it really is unnecessary to add more cleats. On the second point, it is not uncommon -- perhaps more particularly on hatch covers which have deteriorated in service -- in, let us say, a desperate attempt to maintain weathertightness to tighten up the nut on the quick-acting cleat on the principle that by tightening it up, it should be better.

In fact, this is, as I have observed in my report, a mistake. It can lead to the cleats becoming rigid and, therefore, parting.

Q. I think you conducted some finite element analyses to see what would be the effect for preventing hatch cover collapse under weight of water with different conditions of cleat attachment or catch attachment.

A. Yes, I did.

Q. Your conclusions are at page 40 in relation to quick-acting cleats, where you say:

"It was found that there was no difference in the results of the analysis for the condition when all 102 quick-acting cleats were fastened, as opposed to every alternate cleat, including corner cleats."

On page 41:

"The main finding is that the presence or absence of the cross-joint security catches has no measurable effect on the stresses or deflections of the hatch cover

up to the point of collapse, where much of the structure has entered the plastic region (i.e. if the load were removed the structure would not return to its starting condition)."

That, I think, was on the assumption of a 4.1-metre head, which was the figure you were then working on?

A. That is the collapse head that I calculated, yes.

Q. What is the collapse head which the experts are now generally agreed on?

A. I believe it is 4.3 tonnes per square metre.

Q. Does that affect significantly the finite element analysis you have conducted?

A. No, I was fairly happily surprised at the congruence.

Q. Then you deal at the conclusion of this section, at page 45, with Bibby's planned maintenance system. Was there a satisfactory maintenance system in place at Bibby's?

A. As I understand it, there was. I make a reference in my appendix 2.1.1. There was a maintenance card which listed tasks and frequency of tasks, including hatch cover maintenance. So to that extent I understand there was a planned maintenance system, yes.

Q. The vessel was surveyed at Stavanger in 1979 and the eight hatch covers were hose tested, as one can see from

page 46.

"The hose tests should have been carried out with all cleats and catches off -- demonstrating clearly the manner in which weathertightness is obtained. At the same drydocking, the ship received an Inert Gas Safety Certificate.

"The overall impression gained from the above is that the hatch covers were in satisfactory condition with a planned maintenance scheme in place.

"The next section of the report includes comments on the condition of the rubber seal ..."

MR EDER: My Lord, I do not want to stop my learned friend adducing any evidence which your Lordship may think is of any assistance whatsoever, but I do submit, in the light of your Lordship's ruling, either yesterday or the day before, that much of this morning is perhaps of not very great relevance or assistance to your Lordship.

MR JUSTICE COLMAN: Is the securing of the hatch covers actively in play?

MR HOWARD: If my learned friend tells me that it is not actively in play, if he assures me that there is no question that any point is going to be made about the way the hatch covers are secured, or there are no relevant consequences for the fact that some of the cross-joint catches can be seen not to have been

fastened, therefore it will shorten matters.

MR JUSTICE COLMAN: My understanding is at the moment, at any rate, that such issues as arose, or such questions which were debated as to the quick-acting cleats being deployed and the centreline catches being deployed, have either been resolved or, alternatively, have been considered to be immaterial to water ingress. I had got to that point, but I do not know whether it was a correct point or not.

MR HOWARD: My Lord, that is a general impression which your Lordship would be well justified in forming. The problem is that when you do not have unequivocal commitments to particular positions, and the documentary evidence suggests that there may still be points at issue, it is necessary to cover the ground.

In fact, I have nearly concluded. I was going to show your Lordship at the end of this section -- one other respect in which it is relevant is in relation to various scenarios which allege that the crew of the Derbyshire were in some way guilty of some fault which contributed to the loss.

MR JUSTICE COLMAN: The only contribution to the loss that could possibly arise would be a contribution that was material to water ingress.

MR HOWARD: That is so.

MR JUSTICE COLMAN: If the issues or questions relating to the quick-acting cleats and the centreline catches which were originally raised have now been resolved, then it would not seem to me at any rate that investigation of what the crew may or may not have done about them is really very fruitful.

MR HOWARD: Your Lordship will appreciate that we are somewhat sensitive as to this because of the suggestion which has been made as to the way in which the foredeck access hatch was not merely not secured, but said to have been retained in the open position.

One of the other allegations which has been made in the assessors' report is the quick-acting cleats at the aft end of number 9 were simply left off. I was going to deal with that shortly.

Apart from that, the only other matter I was going to raise was the point which appears at page 47. It is material for your Lordship to know about this because it is relevant to the question of whether there is cargo shift, because your Lordship at any rate ought to be reassured that cargo shift was in the highest degree improbable. It may be that it will still be put forward as a possibility. We, for our part, understood that this was regarded as a serious possibility.

It is certainly, I think, still in play formally.

It is, therefore -- given the diagram which Lloyd's Register have put forward in their documents -- material to know what is on the next page of Mr Byrne's report, page 47, where he points out that:

"... if in extreme weather conditions some minor amount of water escapes past the cross-joint seal, then a so-called double-drainage system is fitted which, firstly, conducts water at the cross-joint seal to a drain at each end of the hatch panel and, secondly, carries any seepage past the seal down a channel to the transverse coamings, where it drains along the coaming channels to the non-return valves at each coaming corner. This system is quite universally used on hatch covers having rubber seals and has proven effective in service, whether cross-joint cleats are fitted or not."

My Lord, there is a diagram which perhaps I do not need to show your Lordship, which your Lordship has already seen at 332, which shows that double-drainage system. Assuming that my learned friend, Mr Eder, does not refer to bundle LR3, page 147, where there is a diagram provided by Messrs Lloyd's which appears to show something different, then I am content to leave it at that.

MR JUSTICE COLMAN: Mr Eder, are you going to refer to it or not?

MR EDER: My Lord, this is a different point from the point I was making. I am happy to address your Lordship on it.

There is a report from Lloyd's Register which says we do not say that there was a gap or there was not a gap. In the assessors' report, there is some reference as to the assessors were unable to calculate how much water ingress there would be if there was a gap. That is all. Lloyd's Register did spend some time simply saying "If there is a gap, this is the amount of water ingress that would get into hatch number 1". We have written a letter saying that we are not saying there was a gap at all. All we are seeking to do mathematically is to calculate, if there was a gap, what the conclusion would be. We have asked everyone to say if anyone disagrees with that. We have not been told that any party disagrees with that. It was not our intention -- we have written I think two letters or three letters. I think that is the position.

So in the light of the fact that my understanding is that no one disagrees with Lloyd's Register's calculation, simply if there was a gap, then it would not be my intention to put any of that material to Mr Byrne.

In due course, I may simply refer to it. Perhaps

what I have done now is sufficient simply for the record for that material to be there, but, my Lord, that is as far as I go. I do not go any further at all.

MR HOWARD: Your Lordship will have noticed my learned friend still has not said whether he accepts there was no gap. Mr Byrne's evidence is that there was no gap. If my learned friend accepts that evidence --

MR JUSTICE COLMAN: Mr Eder is not adducing evidence that there was a gap, and, as I understand it, he is not introducing any evidence to refute Mr Byrne's evidence either.

MR HOWARD: If that is the position, and it is common ground among all the parties, that there was no gap, then I do not need to take it further. I am bound to say that, of course, I am not necessarily just having to deal with Mr Eder because one does not know what the position --

MR JUSTICE COLMAN: I do not suppose Mr Stone is going to argue there was a gap, and I do not suppose Mr MacDonald is either. I should be most unlikely to find that there was a gap.

MR HOWARD: It is something that is expressly asserted in the document. I take my friend's point that it has subsequently been put forward on this hypothetical basis, but it is --

MR JUSTICE COLMAN: Shall we proceed with the investigation

on the basis that there was no gap?

MR HOWARD: If you please, my Lord. Perhaps it would be a convenient moment just to look at one video still in relation to cleats, since we have been talking about cleats. That is video still number REF: 185. This is the aft end of number 9 hold, Mr Byrne.

A. Yes.

Q. I think we can see that the cleats are not in the position they would have been in if 50 per cent of them were in place on the surface. Do you have any comment to make on that?

A. Perhaps just in terms of what I think I can see -- forgive me if I look at this monitor. It is a little bit more clear than the screen for me, although it is difficult in this particular video still to be clear, it looks like you can see the top of most of the quick-acting cleats with perhaps one or two exceptions that are still visible in the hole in the coaming bar. The evidence there tells us nothing more than that, simply that those cleats are -- some of them anyway -- are there.

Perhaps, just to make it plain, if one could physically go to a ship like the Derbyshire and take off one of the quick-acting cleats, all one does is simply let it go, having disengaged the rotating head, and it

drops down through gravity back into its little slot, the hole in the coaming.

So firstly it is no particular surprise to find the quick-acting cleats lying in this position, just under gravity. Of course, there could be surprise if you said "If every second cleat was engaged, why do we see them all in this position?", and I do not really think this particular evidence tells us anything useful about whether they were engaged or not, because the action of rotating the side plate and perhaps collapsing it -- at the very least rotating it -- is very likely to allow the quick-acting cleats to simply drop off anyway. So I do not think this helps me to say whether the cleats were on or were off as simply a matter of visible evidence.

Q. If we can turn to section 5, which deals with the damage observed at the wreck, at page 48 of BL2. It deals separately with the bow section and the hatch covers, and your conclusion on the bow section at the end of paragraph 5.1 is:

"... the observed damage is a consequence of the sinking process and not an initiating cause."

That is by reference to diagram 5.1, which appears on page 353, I think.

A. Yes.

- Q. In referring to the damage, are you referring to the damage simply on the fo'c'sle head, if I can call it that, or all the damage which you can see?
- A. No, I was particularly drawn to the damage on bulkhead 339.
- Q. So far as that damage is concerned, you have done a more elaborate drawing at page 354?
- A. Yes.
- Q. You give reasons for your conclusion that the vent which we see at the 40-foot level occurred after the ship sank. Perhaps I ought to take you to page 50. You say:  
"The bow has sunk as a unit with two 'wings' made up of sections of the double skin side structures. This unit would likely have flown to the seabed in a fairly stable manner and would have dropped through a cloud of debris and flying plate/structural pieces."  
What sort of attitude do you intend to convey by that for the bow section as it travels towards the sea bottom?
- A. My expectation would be that it would drop to the seabed with an extremely steep glide angle, if you like, perhaps not dropping vertically -- I think more or less in line with the general description that Mr Williams gave earlier with reference to the Titanic; in the sense that it would fall to the seabed in a directionally

stable way, at an angle of about 8 or 10 degrees, which is the cone angle of the wreckage that we see on the seabed.

- Q. You say it would have dropped through a cloud of debris. The debris consists of the fragments of the ship as it breaks up?
- A. Yes, now that I read that sentence it sounds perhaps colourful or dramatic. It was meant to convey, I suppose, more succinctly that I do not know except that it would be dropping down to the seabed at the speed that I do not know, through a cloud of debris, plates, again whose behaviour I do not know. I can imagine in that sort of situation that it is very difficult to predict the behaviour of individual elements, except the large pieces like the bow.
- Q. So far as damage on the foredeck is concerned, would you anticipate that that would be caused at all by the cloud of debris through which the bow section was passing?
- A. I think some of the damage could be caused that way. Some of the observed damage to deck plating is much more likely to have been caused as a by-product of the flooding or implosion processes, and of course it is entirely possible that some of the damage observed took place on the surface. So the evidence on the seabed is, in general, not particularly helpful in telling us

precisely when it occurred.

- Q. So far as the starboard windlass is concerned, can you envisage the starboard windlass having been detached from the foredeck by wave action?
- A. I find that most unlikely, vanishingly unlikely, if I can put it that way. Based on my experience and my expectation of the likely loadings, the strength of the windlass and so on, I find that difficult to envisage.
- Q. What mechanism do you envisage as having been sufficient to detach the starboard windlass?
- A. In the broadest possible terms, it has been hit by something heavy, I think. It is possibly worth restating what may have been already stated, that the windlass in a sense is not one machine. It is more like three machines joined together by shafts and clutches. So, in terms of knocking it off, it is entirely possible to imagine a part of it being knocked off and other parts falling off afterwards and so on. So even the mechanism of the windlass damage is none too clear to me. But my expectation is that it was forcibly removed by some large heavy object -- sorry, to be more clear, striking it during the course of sinking.
- Q. Can you imagine the windlass detaching itself if the bow section had capsized in the course of sinking?
- A. No. Perhaps can I add in terms of relevance to the

previous question, I think it is fair to say that the wreckage of the windlass, which I believe was discovered, as it were, by London Offshore, is fairly close to the bow where it rests on the seabed, at least parts of it are, and it is most certainly in the wreckage field which, if it were swept away by the sea, would be a most amazing turn of events to have the windlass swept away by the sea at the moment of sinking the ship. So it tends to suggest that it was removed during the sinking process forcibly.

Q. Have you any candidate in mind as a possible large object which achieved this result?

A. In my report, I did not go that far, but in the sense that it probably has to be large and dense to have the mass that my Lord mentioned earlier, one would look for things like other winches or, as I heard this morning, the spare propeller by some hydrodynamic means that I have not yet entirely determined, but it is a candidate.

MR JUSTICE COLMAN: Shall we adjourn at that point, Mr Howard?

MR HOWARD: If it please my Lord.

MR JUSTICE COLMAN: 2.05.

(1.05 pm)

(Luncheon adjournment)

(2.05 pm)

MR HOWARD: You will recall, Mr Byrne, that Mr Williams' thesis was that the relative lack of damage to the bow section implied that the bow section must have been flooded before the ship sank?

A. Yes, I recall that.

Q. Do you accept that view?

A. I think the correct answer is not necessarily.

Q. Perhaps you would like to explain what you mean by that?

A. Based simply on the evidence on the seabed, it is possible to conjecture that the forward deep tank was completely flooded and the stores were completely flooded, and that the forward deep tank was partly flooded. So the evidence, if you like, could be consistent with that. As a matter of fact, I can also say that the evidence does not help us in any respect to say that it was or it was not.

So perhaps inverting that, the seabed evidence does not tell me that it was fully flooded on the surface and it does not tell me that it was not.

Q. So far as the breach in bulkhead 339 is concerned, how does that impact on the question of whether or not the ship was flooded when she left the surface?

A. That is about the only significant piece of evidence that we have that tells us that at least one of the

major volumes in the forward end was not completely flooded on the surface, because that bulkhead shows clear signs of hydrostatic overload which, by inference, means that there was sea water on one side and at least some unoccupied volume on the other side.

Q. Is the breach which we see in bulkhead 339 capable of producing equalising forces within the bow section to prevent implosion/explosion effects in the shell of that bow section?

A. There are a family of breaches in bulkhead 339, one at the 40-foot level is in the nature of a split, a breach, a complex breach, just under the store's deck at the upper level of bulkhead 339. There are assorted damages down the port and starboard side, where at some stage the top side tank and associated side structures have disappeared.

So the answer to your question is not in the least bit straightforward, because the answer depends on the stage at which each or any of those damages occurred, and the sequence.

Q. When we look at page 334 of bundle BL2, we can see the breaches to which you have referred.

A. Is that 354?

Q. 354, thank you.

A. Yes. Perhaps I should mention at this point that this

figure which I produced some time ago misses one vertical crack in the bulkhead, around the centre of the bulkhead, and has been updated by other versions of the same diagram.

In the general thrust, it is still reliable, but we miss a vertical crack from the complex damage at the top of 339 down to the 40-foot split.

Q. There one can see the mooring rope protruding from the upper breach?

A. Yes.

Q. Can one tell anything about whether there has been implosion or explosion at work in the store's deck from the presence of that mooring rope?

A. No.

Q. How does it come to escape from that part of the cofferdam?

A. It tells me that there has been a rupture of the store's deck to permit the rope to project through it. The mechanism of that rupture I do not think I would describe as implosion/explosion. Having said that, I do not have before me the evidence to say what the mechanism was, except it seems clear that there has been a rupture of the store's deck.

MR JUSTICE COLMAN: What are the characteristics of that breach which exclude implosion/explosion?

MR HOWARD: To which breach is your Lordship referring?

MR JUSTICE COLMAN: The one Mr Byrne has just referred to.

A. In the store's deck, my Lord?

MR JUSTICE COLMAN: Yes.

A. I think, principally, firstly, because I cannot see it, I am not really able to do anything but make assumptions. It seems to me that the more likely mechanisms of structural failure are due to hydrostatic loadings rather than some complex implosion/explosion mechanism, particularly because the stores are relatively well ventilated externally, making it less like a closed box than, say, a tank might be.

MR HOWARD: I think the thesis which you advance as to the cause of the failure at bulkhead 339 is generally accepted by the experts. There is one difference of detail in relation to the curvature at the upper section of the bulkhead, where there is said to be a deeper indentation, as opposed to a regular concave shape. I think that is Mr Williams' distinction.

A. Yes, I understand his view, I think, that the curvature there is greater than he would have expected by classical computation. It certainly is a significant curvature. I am, however, drawn to the real difficulty of forming a view as to some of these damages based on the seabed images. It is quite difficult, I am sure as

everybody has experienced, to interpret them. So I am not absolutely as sure that the curvature is greater than one would expect because of the shadowing and so on. It encourages you to believe it is perhaps larger than it is.

Secondly, I think, again thanks to London Offshore Consultants, there was a feature of the damage on the bulkhead which had escaped me when I did this diagram, namely the partial vertical collapse of the deck and the associated cofferdam which, to some degree, releases the membrane of bulkhead 339, allowing it to deform perhaps more than ordinary computation would suggest.

So in summary, I still see that simply as being evidence of hydrostatic overload, and I have drawn no other inference from it than that.

- Q. How much of the data do we derive, from the images we see of the foredeck, is affected by the speed of the impact of the fore part of the ship with the sea bottom?
- A. Damage to the foredeck?
- Q. I said "foredeck". I meant to the fore part of the ship.
- A. I think a substantial amount. Again, in my original report, I was looking for mechanisms which might help me understand what had gone on immediately prior and post the onset of sinking, and I think I neglected to

consider what would happen when this unit hit the seabed. Thanks to the discussions between experts, I have been drawn to the view that this impact at some reasonably high speed would naturally give rise to a very substantial amount of energy absorption, crushing of the lower part of the bow, which would cause the injection of a lot of fluid from the forward end. So it is entirely possible that some of the damage we see is caused at impact time, rather than in the 100-metre damage layer.

So whereas in my report I think I postulated that some of the damage might be due to implosion/explosion mechanisms, of which I would say I was quite vague, I think I say now that it is more likely that it is possible that some of those damages were caused at impact time.

- Q. Does that apply to Mr Williams' hookiness as well, or is that a separate phenomenon?
- A. I think it is a separate issue happening at a separate time. As in so much, I think it is quite impossible to be definitive; in fact, it is possibly dangerous to be too definitive.
- Q. You indicated, when you were first called to give evidence, that there was one change you wished to make to your report?

A. That was it.

Q. Pardon?

A. That was it, to walk backwards away from the implosion/explosion mechanism causing the complex fracturing near the top of bulkhead 339. I would have to say that seems to be less likely now, and more likely to have occurred at the time of impact or, conversely, to have been a hydrostatic failure during sinking, but not implosion/explosion.

Q. At pages 52 and 53 you deal with the fo'c'sle deck. I have already asked you about the starboard windlass machinery. You point out that there is consistent but probably coincidental damage to the port bulwark. Then you point out the port windlass has been impacted in the direction shown in figure 5.5, and there is also damage to the starboard bulwark, it being folded outboard, which may be consistent with the same cause.

Does this involve there being impacts in two different directions visible in the sights of these two windlasses?

A. I believe so, but again, at the risk of sounding vague, it is not possible to demonstrate that. It just suggests to me it is consistent with two different directions of blow.

Q. Are they blows of the same orders of magnitude?

- A. Again, I think the correct answer is I have no idea, except that in one instance the starboard windlass has clearly disappeared, I think during the sinking process, for the reasons I mentioned earlier, whereas the port windlass is still in place, albeit leaning at a slightly drunken angle from port to starboard, but in so far as -- that is all one can say. I do not think one can be any more definite.
- Q. If we can look at page 53, you start to deal with hatch covers on the seabed, and that is a passage running to page 111. This is a careful analysis, if I may say so, of the bits of debris in the wreckage field, which in effect has been accepted by all parties. The main live question is in relation to the status of HR, which is the starboard panel of number 1 hatch. You deal with that at page 58.

In the penultimate paragraph on the page, having described the damage which is seen, you say:

"All of the above is consistent with an overpressure failure of the structure, causing structural collapse and rotation of the failed structure into the open hold. There are no special indications of impact or partial panel loadings. I do not accept the view of the assessors that this panel can be seen to have suffered a failure caused by dynamic wave impact."

Does that remain your view?

- A. Yes. What I meant by that, what I mean by that, is that I think the assessors were definite, quite definite, that it was a dynamic loading with, for the time being, no definition of what precisely we mean by "dynamic", and second it was different qualitatively to perhaps all of the other panels.

It is necessary to say that, of course, all of the hatch panels failed, as far as we can deduce, in a dynamic way, that they were attacked by a rapidly changing load and therefore it is dynamic. All of the static and quasi-static analyses are helpful but do not tell us precisely what is going on dynamically.

I felt, though, that the assessor was making a point that it was, in effect, in the metallurgical sense dynamic, i.e. very rapid indeed, causing a special kind of failure, and that is possible, but it is not necessary to deduce it from the evidence.

So my view is that dynamic, in the sense I think the assessors meant it, is possible, but one cannot necessarily deduce it, I believe, from what one sees on the seabed.

- Q. You were able to see, rather surprisingly perhaps, the condition of the hatch seals on the sea bottom. Did you form a general view about the quality of the hatch

seals?

- A. Yes. In looking at, I think, all of the footage available on the hatch covers, there were a number of places where one could get a good look at the rubber. In some places, it was surprisingly perfect. In others, it was more like what one would expect of a ship in service having some so-called permanent set or grooving in the rubber.

Because of, I think, the helpful nature of the video footage, it was possible for me to form a view as to the extent of that permanent set, and it was quite modest -- certainly in my view -- well within normal replacement limits. So in short, such seal as I could see was in good condition.

- Q. Perhaps we can look at video still REF: 380, and if it is possible to do it simultaneously, REF: 425.
- A. The left-hand image shows an image of a starboard cross-joint, and although it may not be too clear in this image, it does show the cross-joint seal quite flat, in a very good condition, the part we can see.

In the right-hand image, we can see some rubber seal still in its retaining channel, and that does show some permanent set, a groove. In flying around -- the still pictures are not as helpful as the video footage, because the video footage gives you a more, as it were,

stereoscopic view, but that was of the order 3 or perhaps 4 millimetres of permanent set, in my opinion.

The normal criterion for replacing rubber, or the correct criterion for replacing hatch rubber, should be when the permanent set reaches half of the design compression it should be replaced. There is certainly, in my view, no way that any of the permanent set that I saw reached 8 millimetres, which would be the replacement point.

Q. If we can go on to page 112, you give an analysis of the damage. You say at the bottom of the page:

"Once the number 2 hold is flooded, the ship is effectively lost."

I think that ties in with what we have heard as to the point at which the ship starts to sink.

A. Yes, there were some lengthy discussions between experts as to what we meant by "sinking". So there was, I think I am right in saying, a definition which was developed, which said that technically sinking occurred when number 3 started to flood. At that point the ship was technically doomed, as opposed to when number 1 was stove in and it was just a matter of apparently being inevitable. The sinking technically started as number 3 was stove in.

Q. On page 115 you deal with the consequences of the

collapse of bulkhead 339 and sump tanks. You say at the end of the first paragraph:

"It would appear that quite near the surface the ship ceased to be a ship.

"The bow section, however, appears on the face of it to have been spared this disintegration.

"It is not necessary to deduce from this that the forward spaces were flooded prior to the bow section leaving the surface, for the reasons now given."

You say:

"If the store's hatch were left open, as has been postulated by the assessors, the flooding of the fo'c'sle store's spaces which are free to flood would change the freeboard forward (even if all the available spaces were fully flooded) by only about 0.25 metres."

This was when you were assuming the whole of the store's deck was flooded, was it not?

A. Indeed, that was my recollection. Yes -- sorry, I do beg your pardon, "which are free to flood", "all the available spaces", yes.

Q. "The scale of onslaught by the waves is about two orders of magnitude greater than this change.

"The same comment is true if the store's hatch were torn off by the seas.

"It may be, of course, that the store's hatch was

forcibly removed during the sinking process.

"The possibility exists of vents being damaged in heavy weather, especially on forward deck areas. Such damages could lead to water ingress. The rate of flooding would, however, be expected to be fairly slow."

I do not know how up-to-date you are on the Marin data on this topic?

- A. Well, that seems to be the case. There are two extreme views. One is fairly slow and the other is, to my mind, astonishingly fast.

If you like, my comment was based on no size, no calculation, on an expectation only. So in that sense it does not carry much technical weight. It was just a view that my expectation was that downflooding through damaged vents would be at a modest rate. I was surprised to find calculations which gave us rates at about 2,000 tonnes per hour through damaged vents. It is the sort of rate of ingress that pump manufacturers can only dream of.

That, again, is based on firstly my instinct, and secondly on a primitive calculation which suggests that to get those sorts of rates of ingress, one needs more or less a permanent static head over the apertures of perhaps 8 or 10 metres, which I find a little surprising, but I do know from discussions that Marin

have gone to great lengths to review their testing procedures and can only report what they find truthfully.

(2.30 pm)

Q. Thank you. On the following page, you say give the effects of flooding of number 1 and number 2 hold, and the rupture of bulkhead 339 would follow. You say:

"The effects of these more or less concurrent failures would be as follows ...

"(a) The cofferdam at the store's level would very rapidly flood from each side, port and starboard. The loss of local deck plating in the cofferdam is consistent with this.

"(b) The fuel oil deep tank would rapidly flood causing damage to boundary bulkheads including the upper part of bulkhead 339, as observed, and the store's flat deck, plus (possibly connected locally) the boundary into the deep tank."

Mr Williams has expressed his surprise at the lack of visible oil in the area of the bow. Do you find that surprising in the light of this analysis?

A. No, not surprising for a number of points of view. I think what happens to oil -- if there is any oil down there, at these temperatures and so on, I have no idea. It is possible there may still be oil on the wreck.

I was drawn to -- if I recall correctly -- some evidence, I think, from Mr Williams, that oil was seen coming to the surface when the vessels were engaged in the survey.

So it is, I suppose, possible that the oil was very slowly leaching out over a long time. I am not surprised that we do not find vast amounts of oil visible around the wreckage, on the wreckage.

Q. Then you say:

"The latter two boundary ruptures can reasonably be postulated as there is clearly a spatial interconnection between the store's flat and the number 1 hold space, post-damage, as there are mooring ropes making an appearance through bulkhead 339.

"The fact that the outer bow shell is intact also implies that an internal implosion/explosion rupture has occurred, probably in the top of the forepeak tank. It should be noted that the supporting structure to the bow shell is massively constructed.

"The construction photographs and the virtual reality model testify as to the massive construction supporting the hull plating. This may be compared to the relatively light structure of bulkhead 339."

Mr Spence yesterday gave some evidence about the difference between the English Bridge and the Liverpool

Bridge in this respect. Would you explain to my Lord what the significance for the sinking process is of this unusually strong structure?

A. I think, for the sinking process -- sorry?

Q. I was going to say for the condition of the ship as we now see it.

A. Right, yes, for the condition of the ship at the forward end as we now see it, on the face of it, it is less surprising that the forward end has retained its shape because of the relative strength of the main hull boundary, as opposed to some complex form of collapse or the flooding of the inner bow, inside the bow. Whether the English Bridge would have looked the same for its own special set of circumstances, I could not postulate, but it is, I think, quite sure to say that the Derbyshire is very massively constructed in terms of its outer shell.

Q. The bow section is what you describe, at page 117, in the middle, as having had a "fairly violent impact with the sloped seabed":

"Two 'wings' appear to have fallen backwards, pulling off parts of bulkhead 339 plating."

In the next paragraph:

"The other damage to equipment on the foredeck are, in my view, consistent with the bow unit flying

through a debris field for some 4,000 metres vertically, where individual items of debris, some large in area and in mass, would be also flying hydrodynamically in diverse directions."

Then you go on to the hatch covers, and at the top of the next page you say:

"Although there is some variation in the observed condition of the panels ... there appears to be some consistency in what might be termed the 'primary' structural collapse modes. That is, a distinction can be made between the damage occurring at or near the sea surface and that occurring during the descent and upon impact with the seabed ..."

You then describe that, and there is a table at 5.2, at page 121, where you analyse the observed primary structural failures. You give an account of the vacuum collapse of hatch covers on the English Bridge. What is the significance, for our present investigation, of that short section on the English Bridge?

- A. I thought it might be helpful to the inquiry to include that, only because a vacuum collapse of a hatch cover, although the causative mechanism is entirely different, it is still in effect an overload collapse, a uniformly distributed overload collapse of the structure. So I thought it would be helpful to include a short

description and the photograph of that, because it clearly shows a primary mode of failure is a lateral buckling of the top plate, accompanied by a deflection downwards of about, let us say, 1.5 metres or so.

I think the one important difference, of course, with a vacuum collapse and a collapse because of a sea load is that the vacuum collapse stops as soon as the vacuum is broken, virtually immediately. So we have a moment frozen in time with a vacuum collapse, which tells us about the primary mode of failure of the structure. That is the only reason it was put in, just to illustrate that, if you like, the calculations that various parties had done were qualitatively correct.

Q. Thank you. After the table at page 121, you say:

"In many areas, the quick-acting cleat snugs were apparently undamaged."

In the next paragraph:

"The rubber seal was observable at a number of locations around various hatch covers. It was generally in good condition. In a few areas a permanent set was visible but, based on my experience of surveying such seals, the permanent set appeared to be within the usual replacement criterion ...", as you have mentioned:

"The locator wedges at each end of the cross-joint provide the primary control of weathertightness. Any

wear on these wedges will tend to reduce the control of compression of the cross-joint seal. The wedges which could be observed closely showed no such wear."

Then you give a table of the cross-joint catches and which ones can be seen to have been engaged and which not and where it cannot be known whether they were engaged or not.

Then you conclude:

"The general impression of the hatch covers and the associated fittings and the rubber seal is of a very well-maintained vessel."

That is on page 124. Have you changed your view at all since you wrote this report?

A. No.

Q. Then you set out your conclusions which I think have all been discussed in the course of your evidence in chief. Those are my questions. Thank you very much, Mr Byrne.

Cross-examination by MR MEESON

MR MEESON: My Lord, before I cross-examine Mr Byrne on the evidence that he has given this morning, I would like to lead some further evidence for him for work that he did for the Attorney General, which is his evidence that we have in bundle 2A at page 116.

Mr Byrne, this is a report that you prepared on the effect of procurement costs of increased sea loading

capacity on hatch covers. Is that correct?

A. Yes, it is.

Q. It is dated 16th November 1999 and signed by you on page 117. Are the contents of that still correct as far as you are concerned?

A. Yes, they are.

Q. What you have done is this, is it not: you have considered a possible range of sea loads for which covers could be designed ranging, at the bottom of the range, at 1.75 tonnes per square metre, to a top of the range at 15 tonnes per square metre, and then considered the incremental cost of upgrading covers to meet those various standards above the lowest one, first in relation to a new building and then subsequently in relation to a retrospective improvement of an existing hatch cover?

A. Yes, that is correct.

Q. Those loads are set out, for example, at page 124, in paragraph 3.5?

A. Yes.

Q. It says:

"The required range of sea loads is given by the client as follows ...", and they are there set out.

It says:

"1.75 tonnes per square metre, basis 1966 Load

Line Convention criteria."

As I think you have already said this morning -- and as the experts have agreed -- that 1.75 tonnes per square metre which appears in the convention is a notional figure, and, in fact, in this case equated to somewhere between -- I think the experts have agreed 4.1 and 4.3 tonnes per square metre.

In relation to these other figures, 5.2, 7.5, 10 and 15, are they actual collapse values or are they again notional values?

- A. No, these are, as I understood the brief, as it were, when I was asked to do this work, to keep a consistent incremental loading. So if we take the 5.2 tonnes per square metre, that is directly comparable to the 1.75 tonnes per square metre. So each of these loadings is based on the same criteria as the Load Line Convention, i.e. a nominal load factor, as it is called, I believe, 4.25, but a computer collapse load, which might be something like half of that. So in case I have made that less than clear, they are all based on the Load Line Convention criteria.
- Q. I think you have gone through and considered, certainly in relation to a new building, two different ways of building hatch covers: a European design and an apparently more efficient Japanese design. Is that

correct?

- A. Yes. They are the shorthand descriptions used in the hatch cover business. I am not sure I give our Japanese colleagues full credit for coming up with the idea, but that is a generally accepted shorthand term.
- Q. You have set out the various incremental costs and I think you have concluded, for example, on page 126, in paragraph 3.9, that if one were to take, for example, a nine-hold Panamax bulk carrier and were upgrading the first two hatch covers to, for example, a capacity of 7.5 tonnes per square metre based upon this notional loading, then that would represent an increase in total price of roughly 8.5 per cent?
- A. Correct.
- Q. Then, over the page at 127, we have the same exercise carried out for 170,000 dead weight tonne bulk carrier, and we get a figure there of a little under 8 per cent increase?
- A. Yes.
- Q. Then I think, finally, for existing ships, section 4 begins at 128, and you have considered the possibility of retro-fitting, and there you have considered the results that you have set out in a tabular form at page 130.
- So, for each of the smaller hatch panels, that

same figure, 7.5, one has an additional cost per panel of a little over £35,000-odd, or for the larger hatch panels of just under £42,000?

A. That is correct.

Q. I think otherwise the report is fairly self-explanatory, I would hope.

If I can then turn to the evidence that you have been giving this morning, I just have a few questions on that.

In bundle BL2 at page 52, you refer to some observed damage on the fo'c'sle deck. The third bullet point up from the bottom is:

"The deck over the store's machinery room adjacent to the cofferdam is set down on the port side, indicative of a differential pressure. However, the adjacent outward-folded ruptures appear to suggest an internal to external release of the pressure.

"Conversely, the damage to the duct in way of the sealed hydraulic machinery spaces is from external to internal."

That observed damage, is there any conclusion that you ever draw from that, or is that just an observation?

A. I think my present status is about the same as when I wrote the report. I am confused by it because one is looking for at least some sort of consistency. Even if

one is vague, one looks for consistency, and here we have adjacent to the port windlass apparently an inward-going damage, and very nearby an energetic outward-going damage, where the plate has been folded virtually flat back on the deck. So I do not know.

Q. I think you have produced a sketch of that at page 358. Is that right?

A. Yes.

Q. Where there, on the left-hand side, you have "deck imploded inwards", and then "deck depressed", and then a bit to the right of that we have "deck folded up"?

A. Yes, it seems to be two quite separate types of mechanism there. I am not sure that I am alone in being confused, but I am confused by it.

Q. The next point was in relation to the removal of the starboard windlass, where I think your evidence this morning was that you envisaged that occurring during the sinking process and the disintegration of the vessel, and it being struck by some large dense object. The question I have for you is: is that consistent with the images that we have of what is left of the starboard windlass, which do not appear to show any particular impact damage?

A. I think it is. It depends on the angle of impact, I believe. I do agree that, from what we have seen, the

remains of the bed of the windlass, there is no obvious -- in fact there are very little signs that I could see of movement from port to starboard. The windlass has been forcibly removed and it is possible that blow was in a longitudinal or slightly vertical direction. So it is not possible for me to be definitive about it. I think the remains that we see is not inconsistent with it being removed by a hard blow, perhaps more than that, but a hard blow.

Q. I was thinking also of the images that we have of it on the seabed, or the parts on the seabed.

A. I beg your pardon, the pieces on the seabed, my recollection of those -- I think three main pieces -- was that I think they do show some signs of damage, which is what one would expect, but I do not recall massive fracturing or signs of sharp impact, but they are damaged, but not in a way that helps me to deduce what happened.

Q. That was the point.

A. I finally got there.

Q. I would like to ask you about the damage to frame 339, and in particular the horizontal crack around the 40-foot level.

In your report, you gave an explanation for that based upon some finite element analysis that you had

carried out, that suggested that that would fail assuming that, if you like, behind it -- in other words forward of the bulkhead -- there was fuel to about that level or a little bit more, and after the bulkhead there was cargo to about that level. I think your calculations suggested that a hydrostatic pressure measured from main deck level of about 20 to 25 metres would be sufficient to cause a failure at about that point?

A. Yes.

Q. I think it is correct that that accords with the subsequent work carried out with EATEC, who come out with a figure, I think, on the same basis of about 25 metres?

A. Yes. Happily the analysis I did was really rather simple. It was firstly to assure myself, and then the inquiry, that any theory about splitting at the 40-foot level was not just again an assumption, it was borne out by some facts. So my simple analysis laid alongside their rather more complex happily gives a similar result.

Q. On that basis, would you say that the EATEC results or analysis are reasonably accurate?

A. They are about as accurate as mine, which means they are not that accurate in this sense: that to do those

computations, one has to make firstly mathematical assumptions about the way one calculates things, secondly, the modelling, how well one models the assumed structure, and then there is the real structure itself, how it will behave.

So there are a significant number of possible sources of error. That is why I think in my report I was perhaps at the risk of being habitually vague, about 20 metres or 25 metres, because I think it is quite difficult and wrong to be too precise.

So the numbers are, I think, a very good indication, but if you were to ask me "Will it fail at precisely 20 metres or precisely 25 metres?", I would have to say that I do not know. It is going to be somewhere around that level.

- Q. Are you prepared to put a margin on it? I think Mr Williams has suggested a plus or minus 15 per cent.
- A. I am not sure how he arrived at that, and the margin depends on structure. Some are simple structures, like the hatch covers, relatively simple structures -- and we found that each of the computations was remarkably similar because the computations and the assumptions were relatively few, but if one goes to more complex 3-dimensional structures like tank boundaries, for example, and complex bulkheads, then I think the error

bands can be quite large, larger than 15 per cent in my view, and the answer to your question is it depends on the structure.

- Q. Since you wrote your report, EATEC have done further work including report 2320 that we have summarised at AG0.1, page 136, if I can identify it in that way. It is the last tab.

On this table, the second location down is bulkhead 339 cracked at 40-foot level, and that is report number ER2320. It says:

"Calculated load to cause onset of collapse (metres of water)."

Then it says:

"Water surface at main deck level: 0 metres."

If I have understood this work correctly, that is trying to model the residual strength in the bulkhead, assuming that it is now cracked along the 40-foot level, and the result is that it does not really -- at least as measured from main deck level -- have any residual strength. So that, if there is a pressure applied to it, it will simply flap away effectively. Is that a correct understanding of what that is intended to show?

- A. I believe that is exactly what it is intended to show, yes.
- Q. The result of that, if correct, is that although in its

intact condition, if we take the 25-metre value -- in a sense it does not really matter what we take -- that in order for the bulkhead simply to have cracked along the 40-foot level and moved however many metres or centimetres it has moved that we can see on the video, whatever pressure was on it has to have been instantaneously removed otherwise it would have simply continued?

- A. It has to be removed quite rapidly, yes, indeed, not only the hatch cover vacuum I mentioned earlier. Alternatively, before that bulkhead splits, if indeed it does split at that time, before that occurs there has to be some initial partial equalisation by water ingress into that tank.
- Q. So if it were to be a case of pure hydrostatic loading as the vessel sunk to, say, around the 25-metre level, then this further EATEC work suggests that that is unlikely, does it not, because one could not have a sufficient equalisation because we are still going to be 25 metres above, and we have to suddenly go from a crack to a pressure equalisation behind the bulkhead to stop the bulkhead being carried away completely?
- A. If one was relying only on the crack, yes, indeed. How water would get on to the other side of the bulkhead, it is possible that a partial explanation could be water

ingressing through collapsed saddle tanks, or if the forepeak tank were flooded, possibly flooding through from the forepeak into the forward deep tank. So there are a variety of mechanisms beyond simply the 40-foot horizontal crack and, indeed, even the complex damage at the top of the bulkhead. It is possible that that is hydrostatic collapse also.

- Q. Is it also possible that it is a combination of factors at work?
- A. I would really be quite surprised if it was not a combination of factors. There are a number of mechanisms possible, and what I deduce from the excellent work done by EATEC is that when one considers the various error bands, whatever they may be, one is drawn to the view that most of the collapse events are happening at about the same time. They are, in this fairly narrow band, between 20 metres and 35 or 40 metres, and also of course, with passing waves, changing the loading. So in that very narrow band of space and time, most of the events are occurring, and so I do agree with you that it is very likely to be complex and to be more than one thing happening in the event, if you will.
- Q. Is one possibility that it did not, in fact, crack at that stage, but was perhaps weakened and then finally

cracked when the bow hit the seabed?

(3.00 pm)

A. I think one has to say that is a possibility, yes.

Q. Would it be fair to say that you do not really have a settled view on quite how that occurred?

A. I have a view, which is more or less as reproduced in my report with the variations that I mentioned earlier in examination in chief. I still think that the hydrostatically loaded bulkhead is relatively weak compared to virtually all the other boundaries in the ship. If it is going to fail hydrostatically, I would expect it to fail at the 40-foot fillet weld level for the reasons we have already discussed. If you ask me can I prove that definitely in some way, the answer is no, I cannot, it is just what I believe most likely.

MR MEESON: Those are all the questions I have.

MR JUSTICE COLMAN: Thank you. Yes, Mr Moran?

Cross-examination by MR MORAN

MR MORAN: Mr Byrne, can I continue a while on that topic and start where Mr Meeson left off? He was, in effect, asking you to accept that, if there was a fracture at the 40-foot level, that if it had occurred at the surface, in effect it would have carried on and gone through, as it were, and that there must have been something restraining it?

A. If it had happened at the surface?

Q. I am sorry -- in the early course of sinking. I beg your pardon.

A. Yes, indeed, that was the thrust of his question.

Q. What you were indicating in summary, if I can just try to clarify it for our purposes, was that there are a number of potential mechanisms whereby forces, as it were, forward of this bulkhead could have been present, equalisation, if you like, of pressures, by reason of other means of ingress for water into the spaces forward of the bulkhead. Is that correct?

A. That is correct.

Q. When you first wrote your report -- and this is not a criticism of you at all, please understand -- you had not appreciated some significant features that were later observed by London Offshore Consultants. Two parts in particular are relevant to this question. The first is that there was actually a setting down of the bow, the cofferdam, above bulkhead 339. You accept that that is there, present and visible now it has been pointed out to you?

A. Indeed I do, yes.

Q. What you had noticed, however, was a cracking, a vertical cracking, on the face of that cofferdam, extending down to the complex blown-out area of damage

in bulkhead 339, which we have all looked at and I am sure the court is well familiar with?

A. That is correct.

Q. You have seen that?

A. Can I just mention, in case I forget to mention it in the same context later, that complex damage appears to be in the nature of first an inward-going, bellying inwards, and then, presumably, subsequently outward-going.

Q. Would it be fair to suggest to you that the vertical crack down to what you now see as the blown-out damage, but which was previously a forced-in damage, if you like -- that the vertical crack downwards to that area occurred before the blowing-out damage that we now see?

A. Yes, I believe so.

Q. The other thing that you did not appreciate on your first observations was that not only, as you did observe, the vertical crack went down to that complex now blown-out damage, it actually extends right down to the 40-foot fissure, split, in the bulkhead, does it not?

A. It does.

Q. So we have literally a split from top to bottom -- not bottom, but top to 40-foot level of this bulkhead, within the middle of it is what is now a blown-out

damage, but which you believed first of all was a pressed-in damage, if I can call it that way?

A. Yes.

Q. The extent of damage associated with the first pressing in -- do you follow me -- of this vertical crack, that would have admitted a substantial ingress of water from number 1 hold into the spaces forward of it, which were either -- not empty, but only partly full?

A. Into the deep tank?

Q. The deep tank.

A. Yes.

Q. Again, bearing in mind what you have told us about the proximity in time and sequence of events when these structures would be failing, it is certainly at the very least feasible that if there was this -- what I would suggest to you a very substantial inrush of water through the vertical crack and the inblown damage in the bulkhead in 339 -- that there would be a very early pressure compensation on the other side of the bulkhead which would restrain further movement of the bulkhead forward at the 40-foot level. Do you agree?

A. In general, yes. The rate of ingress I have not calculated, but I agree it would be very substantial and we would be looking for retardation of the bulkhead 339 forward movement, if you like. We would be, I assume,

looking for at least half of the ullage space to be filled.

Q. Very rapidly?

A. Very rapidly.

Q. Extremely rapidly.

A. Which is something in the order of 1,000 cubic metres.

Q. So you would not expect, then, in those circumstances, as it were, the total pushing in of the bulkhead at the 40-foot level and the sort of damage that you see, the movement in. The extent of movement in at the 40-foot level is quite consistent with the mechanism that I have just taken you through, with the associated vertical fissure, the blowing in of the top part of the bulkhead and the ingress of water following from that?

A. In that scenario, yes, I accept it entirely.

Q. It is not suggested for a moment by London Offshore Consultants that the bulkhead definitely did not fail at the 40-foot level in the early course of sinking, and they accept that that is certainly a possibility. What I would like you to consider with me please, if you will, is this further proposition: when the bow of the ship hit the bottom, you know -- and you have told us -- that there is a substantial compaction of the structure at the bottom of the bow, as it were. Is that correct?

A. Yes.

- Q. And associated with that compaction, there is a leaning forward of the bow -- in other words, sort of pulling it away from the area at that 40-foot level?
- A. Yes, there is quite a remarkable change of direction, if you like.
- Q. An angle. We can see it in the --
- A. Indeed there is, yes.
- Q. We have looked at it on the images section of this investigation. Do you accept that with that kind of force at work as well occurring, that that would further open up the aperture between the bottom of bulkhead 339 at the 40-foot level where it is separated; in other words, moving it further forward from its originally fixed position? Do you follow what I mean?
- A. Yes, I think so. I think both mechanisms are possible. There was a split at the 40-foot level, perhaps limited between the longitudinal bulkheads, and when the ship hit the seabed -- it is relatively weak at that point -- and then there was a larger-scale break at the 40-foot level, which is evidenced by the nature of the cracking at each side of the ship.
- Q. Indeed.
- A. Alternatively yes, as you describe it, it is possible that it actually happened at impact.
- Q. I have just a couple of points about the windlass, if I

may, Mr Byrne. You appreciate from my cross-examination yesterday -- I do not know whether you were present yesterday, perhaps not -- that whilst again London Offshore Consultants do not deny the possibility that the windlass was struck by a heavy object in the course of the sinking, their favoured mechanism for the loss of the windlass is by repeated heavy wave action, dislodging the windlass foundations. Do you follow?

A. I follow.

Q. You favour the heavy object striking the windlass, we know.

A. Yes, I do.

Q. Can you tell us, please, what sort of mechanism, in terms of the striking, and what sort of damage to the unit as a whole, do you envisage by the impact you have in mind from any of the candidates that we have looked at, such as the spare propeller?

A. Well, I would expect that it would be firstly an object of substantial mass and density, as already mentioned, and that it would have to strike in more or less a horizontal or perhaps slightly upward-going angle.

Q. Scythe it off, as it were?

A. Yes, precisely, rather than an end impact. For the reasons already discussed, there are no signs of lateral disturbance to the remaining stools. If it is going to

be knocked off, it is going to be knocked off in that fashion, I think.

Q. So you are thinking of one impact, in effect?

A. Only because that is the simplest way to think of it. The reality could be three separate impacts. I would not postulate three separate impacts, but for now I am happy just to say it was hit once and hit hard, removing it.

Q. Would you anticipate in those circumstances, the one impact, that the whole assembly would be dislodged and dispatched to wherever it might end up as a unit?

A. No, I have to say firstly, as you will notice in my report, I have not dealt with it in anything other than passing detail, but my understanding of the construction of the windlass is that, as mentioned earlier, it is in effect in three parts. There is the inner and the outer drum, both capable of being separated, physically separated by a dog clutch, as I understand it, and one of them driven with a gear wheel and motor, and then the main shaft also driving another gear -- clutched geared windlass gypsy. Depending on how you disintegrate the supporting components, I could quite see it breaking into three separate parts, or one part being destroyed and the other parts being weakened.

(3.15 pm)

Q. Indeed, that is the way London Offshore found it, as you know, in the vicinity of the bow on the seabed?

A. Yes, as a matter of fact, yes.

Q. You have accepted that the condition of those pieces of the windlass, in answer to my learned friend, Mr Meeson, do not really assist you in your advocating your theory of an impact with a heavy object, do they?

A. Not as I recall the images.

Q. You had some difficulty explaining in your report -- this is at page 52, Mr Meeson asked you about it -- damage to the foredeck. These are the two bullet points that he took you to on page 52 of your report:

"The deck over the store's machinery room adjacent to the cofferdam is set down on the port side, indicative of a differential pressure. However, the adjacent outward-folded ruptures appear to suggest an internal to external release of the pressure.

"Conversely, the damage to the duct in way of the sealed hydraulic machinery space is from external to internal."

I wonder, could you look, please, at RFI DFA2? The bundle will be provided to you. I am sorry I have not cued this image. It is something that came up just a moment ago in your evidence and I am seeking to assist the court. Page 156 in that bundle, it is consolidated

image number REF: 58, if that is possible. There it is on the screen. This is the area that you were --

A. Yes.

Q. Obviously your concern was with the variance of the pressure forces that you thought might be at play here in the two different types of damage?

A. Yes.

Q. Can I put to you another possibility here for your consideration? There may also be the perhaps more simple mechanism here at play of metal being torn away by other structures. You see, there is quite an area of deck structure, cofferdam structure exposed there, and it could simply be the consequence of deck plating being torn away in various directions?

A. I entirely agree with that for everything but the flap that we were talking about earlier. Most of the ragged edges, it is quite plausible that they are simply that, ragged edges left after the deck has been torn away or blown off. But the particular flap -- perhaps I should point to it, this particular area here (indicating).

Q. The one to the upper side of the aperture that you are pointing at is the one I am --

A. This here?

Q. No, the flap that is, as it were, folded back on the deck.

A. There?

Q. Let me get my pen. That one.

A. Yes. Although it is not entirely clear from this view, I think other views show that plate to be quite remarkably flattened onto the deck, as opposed to the other edges which are at various angles and just bear witness to being raggedly pulled. That one does show -- I think it shows that it has been folded back, it would appear, more violently.

Q. Can I ask you about bow flooding? This is something that you did not consider to any great extent in your original report?

A. That is correct.

Q. You have accepted that, though it surprises you, the rate at which some of these spaces may have filled through the apertures which were available. And you have no reason to doubt and -- and am I correct in this -- no expertise to challenge the findings of Marin?

A. Certainly no reason to doubt it. I am sure that their experiments as described to us and the great care they have taken -- because I think it may be fair to say that even they were surprised at the rates of ingress. Perhaps I should leave them to say that, if indeed they do say that. So I have absolutely no reason to doubt

the model testing technique or their analysis. But I think I am qualified to discuss downflooding rates. As a naval architect, I hope I am.

- Q. In terms of actual model testing and the extent to which that replicates real life, as it were, that is something that they are certainly better qualified than you to deal with?
- A. Absolutely, yes.
- Q. Let me then come into your area of expertise. Would you accept, especially bearing in mind what you know of this particular vessel, Derbyshire, and her sister ships, the Sir Alexander Glen and the Kowloon Bridge, that there is clearly the potential of flooding to these forward spaces by damage to the ventilators located forward?
- A. I am aware that there is experience on sister ships of damage to ventilators with the inevitable consequences, yes.
- Q. In terms of the rate of flooding, you have not performed any calculations as to what that might have been, leaving aside whatever Marin have produced?
- A. Only recently I have done some rudimentary calculations of water ingress through apertures of different heads and so on, and still remain surprised at the rate, although in terms of impact on the loss, as it were, all that happens is we say that the forepeak fills in one

and a half hours or three hours or five hours. I am not sure that it is causative. I am not sure it changes any aspect of causation.

MR MORAN: Very well. Thank you very much.

MR JUSTICE COLMAN: Does anybody else have any questions?

MR STONE: I have no questions.

MR JUSTICE COLMAN: Do you have any questions?

MR EDER: My Lord --

MR JUSTICE COLMAN: I think we will have a break here, if people have further questions, of ten minutes.

(3.22 pm)

(A short break)

(3.34 pm)

Cross-examination by MR EDER

MR EDER: Mr Byrne, just a few questions, if I may.

Can I ask you to look at BL2, your main report, at page 4, please, of the bundle? You were asked some questions by Mr Howard in the middle of that page, starting:

"Based on observations of wave height made at the time and in the area of the casualty, together with subsequent analyses, a uniformly distributed head of water over number 1 hatch cover of up to 8.4 metres could be envisaged."

Do you see that?

A. Yes, I do.

Q. You were asked some questions about that by Mr Howard. Do you recall that?

A. Yes.

Q. May I quote to you the main part of your answer? What you said in relation to that -- and the question was, broadly speaking, "Is that still your evidence?" -- you refer to Marin and then you said:

"So it may be that that figure should be lower. However, that assumes that the Marin tests have suddenly, as it were overnight, become the gold standard. I am not absolutely sure that is the case."

Look at the sentence on page 4 again just for a moment. Would you care to reconsider your answer that you gave my Lord earlier today as to whether or not that figure of up to 8.4 metres could be envisaged as a reliable figure or not?

A. Perhaps two parts to my answer, if I may. I think almost as soon as I said "the gold standard" I wished I had not said it because it was vague. What I should say, to be more precise, is that there has developed over years full-scale experience, computational experience, albeit with limitations, and so on, which has led to quite a wide variety of predictions for green water loading. When I mentioned 8.4 metres in my

report, I recognise it is a very high loading, but it is consistent within that scatter of previous experience. The Marin tests done in this particular sea state have given me somewhat surprisingly low levels of green water on deck. That is not to say it is the correct "surprisingly low" to me.

In order for me to simply abandon all of that previous experience and accept the new experience, it presupposes that we accept, without any question, the veracity of the Marin results. So instead of me saying that it is a new gold standard, it would have been more precise to say that it may be necessary to consider, as it were, calibration of the Marin results in the longer term.

Q. I am keen, Mr Byrne, if I may press you just a little, to try to make sure that my Lord, at the end, has very clearly your evidence, your expert evidence with regard to this.

So far as this figure of "up to 8.4 metres could be envisaged" is concerned, that is a figure that you have calculated; is that right?

A. No. It is a figure based on just a great deal of previous experience -- published experience, not my experience.

Q. I am just trying to understand, so that my Lord

understands, what speed is the ship supposed to be doing to arrive at that figure? You give various examples in various papers where the ships are doing, say, 5 knots or 10 knots. In arriving at that figure of 8.4 metres, please tell my Lord what is your assumed speed of ship?

- A. In my report, I wrote, at the top of that page, about 4 knots. In fact, as I already mentioned today, I think it would be more correct to say between 3 and 4 knots would be the maximum speed.
- Q. There are other experts who have given evidence. It may be that the ship may have been doing up to 3 to 4 knots in the earlier part of the storm, but when encountering the worst conditions, the other expert evidence that my Lord has heard is that the likely speed of the ship would be substantially below that, and figures have been given perhaps of 1 knot or between 1 and 2 knots at most.
- A. Well, firstly, the speeds given by other witnesses, I believe up to now, have been based on a marine aspect rather than any computation that I know of. Secondly, as I mentioned earlier today, the slight paradox is assuming you have available power on a laden ship like a bulk carrier, you may need more speed in the severe conditions rather than less speed to keep the ship's head up to weather.

Q. Mr Byrne, I do not want to take up unnecessary time on this, because other experts have given evidence in this area, but you just told my Lord, firstly -- you made two points:

"The speeds given by other witnesses, I believe up to now, have been based on a marine aspect rather than any computation that I know of."

What on earth does that mean, Mr Byrne?

- A. What it means is, as best I can remember, from what I have seen on the transcript, it has been given by mariners rather than, as I understand it, no computations of the actual heavy weather achieved speed has been done. At least I have not seen it.
- Q. It has been given by various mariners. It has been given, I think, by Mr Hook, who was called by Swan Hunter, who produced an extensive report by reference to charts and where the various ship messages had been given, and where the ship ended up to arrive as best -- a huge amount of work, I think, had been done on that -- to arrive at a likely speed. The figures I think that I have given you now, of between 1 and 2 knots at the relevant time, I think are based at least in part on what Mr Hook said.
- MR BRYAN: My Lord, it may assist. I think the evidence was 1.5 to 2.5, plus or minus half a knot.

- A. Indeed, although I have not read the transcript of that evidence, I know of it, yes. One finds -- as I understand it -- in the later stages of the casualty that the achieved average speed over the ground was about something like 2.5 knots from memory. The overall achieved average speed. Now, for that to occur there must have been occasions when it was going faster and some occasions when it was going slower.
- Q. Over what period of time are you taking that average speed? That is the problem, is it not, Mr Byrne?
- A. Well, we have to --
- Q. What we are concerned with --
- A. Can I answer your question?
- Q. Yes.
- A. That is from the last reported position of the casualty to the position of the wreck, with a reasonably well-established idea of how long it took.
- Q. In order to consider what you have said there, whether that is at all reliable, you would want to consider the likely speed of the vessel at the time of the worst conditions. Is that not right?
- A. Yes, absolutely.
- Q. And taking an average over a longer period does not necessarily tell you what that speed is, does it?
- A. No, it does not.

Q. What I would suggest to you -- I know you said that Marin are not necessarily the gold standard -- but it is fair, is it not, that the work that has been done at Marin -- I am not sure whether you have considered it or not -- over now something like nearly a six-month period, there have been a series of tests. The latest tests, I would suggest to you, are the most reliable basis for assessing the likely head of water, likely maximum head of water over number 1 hatch. Would you agree with that?

A. Yes.

(3.45 pm)

Q. On that basis, the position is, as you may know, that in the tests that have been carried out in terms of what other evidence there is as to what was likely to have happened in terms of speed of ship in the relevant conditions, there is not a single test result that has produced what might be described as a breaking hatch wave. Do you understand what I mean?

A. Indeed.

Q. In all the tests that have been carried out, which are in any sense realistic, there is not a single test that has produced any conditions which resulted in a head of water over number 1 hatch capable of collapsing the number 1 hatch cover when the ship is in an intact

condition?

A. That is correct, in all the short-term tests, yes.

Q. On that basis, what I suggest to you is that -- I know this figure of 8.4 metres was produced at a very early stage -- in effect this court, my Lord, can disregard your figure of 8.4 metres. You say, in fact, that up to 8.4 metres could be envisaged. My Lord can effectively disregard that as completely outside the range of any realistic possibility whatsoever?

A. Based on the Marin results, I agree entirely.

Q. Based, as you have agreed with my Lord, that those are now -- I forget exactly how I put it, but the most reliable, I think I suggested to you, tests that we have. Therefore, on that basis, you would agree with me that, as I say, on that basis, that that figure of up to 8.4 metres could be envisaged, that formulation can be disregarded as being outside the realm of any realistic possibility whatsoever?

A. Yes, I believe I answered the question. Yes, absolutely.

Q. Thank you. Can you close that now? May I then ask you some brief questions, please? If you could go, please, to bundle AG2A at tab 5? This is your report, Mr Byrne, concerning -- you described them as procurement costs both for new ships and for existing ships?

A. Yes.

Q. And again Mr Meeson asked you some questions about this earlier. I do not think there is any great difference, I think, between you and Lloyd's Register on this, but could I make sure on a number of points?

May I ask you first of all to go to page 125 of this bundle? On this page you set out two tables, table 1 and table 2, depending upon the size of the hatch cover. Do you see that?

A. Yes.

Q. And depending upon whether you adopt what you describe as a geosim assessment or what you describe as a tailored assessment, the additional weight of steel that would have to be introduced, this is in the context of new ships to, so to speak, upgrade the hatch covers?

A. Yes.

Q. So far as hatch panel -- the first one is concerned in table 1, let me take it quickly. There is a figure there for a sea load of 7.5 tonnes per square metre. Do you see that figure?

A. Yes, I do.

Q. What Lloyd's have done, they have tried to calculate the cost of upgrading hatch covers from the 1966 Load Line Convention standard to UR S21 standard. Do you understand what I mean?

- A. Yes, I do.
- Q. Your figure of 7.5 tonnes per square metre, which is the middle figure, is broadly speaking approximately, I think, what UR S21 would require for the Derbyshire. Do you know that or not?
- A. Yes, I do.
- Q. Do you agree with what I have said? Slightly below. That is why I have used the word "approximately".
- A. No.
- Q. Do you want to answer my question, Mr Byrne, or not?
- A. UR S21, by my calculation, lay somewhere between 5.2 and 7.5.
- Q. It is somewhere between the 5.2 and the 7.5?
- A. Yes.
- Q. That is right. Again, looking at the figures -- I am looking at it very broadly. We are not looking at detailed figures, you would agree with me. We are trying to find some ballpark estimate to assist the court, I think, in identifying in economic terms what the cost of upgrading to those levels might be?
- A. Yes.
- Q. Now, Mr Byrne, therefore the first panel listed table 1, if you go back a page. I think each panel there weighs 22 tonnes?
- A. Yes.

- Q. So if you then turn back to page 125, I am going to ignore the geosim line, just for a moment. Looking, therefore, between the 5.2 and the 7.5, the total weight of the new hatch cover panel would be somewhere between 28.6 and 32.5 tonnes?
- A. Yes.
- Q. And, if one looks at somewhere between the two, if we said around 30 tonnes, just for a moment, would you agree with that as a fair approximation for present purposes?
- A. Yes.
- Q. Thank you. One is looking therefore, simply in terms of steel weight, to an increase in steel weight of, you say, about 8 tonnes?
- A. Yes.
- Q. Thank you. Therefore, that is per panel?
- A. Yes, it is.
- Q. And then you are looking at rolling hatch covers here, so for each hatch cover there would be two panels. So effectively the increase per hatch cover, if you are looking at number 1 hatch, would be 16 tonnes?
- A. Exactly.
- Q. Thank you. Then if you go over the page, therefore, if you look, please, at page 126, this again is for new ships. The cost that you give is based upon -- is this

right -- you multiply the additional steel weight by a factor of £2,000 in each case, being your broad assessment of the additional cost on steel weight. Is that right?

A. Yes, that is exactly it. The number changes at the higher levels, perhaps one might say they are not realistic levels, but on the lower levels it is around £2,000.

Q. It is around £2,000 per tonne. Therefore, on your figures -- again, I am looking over the page, at page 126, just to get a ballpark figure -- if one is looking somewhere between the 5.2 and the 7.5, one is arriving at a figure, say, of £17,000 per panel?

A. Yes.

Q. Therefore the cost, for example, of upgrading on a new ship, say number 1 hatch cover and number 2 hatch cover, if we look at those two just for a moment, that would be approximately, say, £35,000 per hatch cover, which is around £70,000?

A. Yes.

Q. For number 1 and number 2 and again, if you can just help me, if you convert that into dollars, that comes out at a figure of about \$110,000 or so?

A. In dollars?

Q. In dollars.

A. Yes.

Q. Lloyd's Register have done their own calculation. They base it upon a cost per tonne of \$4,000 per tonne rather than £2,000 per tonne. There is a slight difference there, but it is accepted there is a range. I think Lloyd's Register would estimate that at the lower end one might, in one particular country, get a cost of, I think, \$1,500 per tonne and in the other country the other extreme is \$4,000 per tonne. Would you agree with that kind of range?

A. I think I can see why Lloyd's Register do not sell hatch covers. That is a very high rate. But, yes, in broad terms.

Q. I am looking at broad terms. On that basis, Lloyd's Register arrive at a figure of about \$150,000?

A. Yes.

Q. That explains partly the difference between your figure in the way I have arrived at it of \$110,000 -- this is for upgrading both hatch number 1 and hatch number 2?

A. Yes.

Q. But in broad terms, on the basis that I have told you, would you agree that your figures and Lloyd's Register's figures are broadly in the same ballpark?

A. Absolutely.

Q. Thank you. That of course applies -- so my Lord

understands, you are there dealing with, and my questions have been concerned simply with, rolling hatch covers?

A. Yes.

Q. And you have not considered what possible costs might be involved in upgrading, so to speak, either folding hatch covers or another form, I think, of stacking hatch covers. Is that right?

A. Indeed, yes. There are a number of generic types of hatch cover in use. This study was entirely limited to bulk carriers with side rolling covers.

Q. So you have not addressed those at all?

A. No.

Q. Thank you. That is all in the context of new ships?

A. Yes.

Q. Before I leave new ships, so far we have been looking simply at the additional steel weight of the hatch covers themselves --

A. Yes.

Q. -- you have not considered there -- perhaps I should ask you to look at paragraph 2.7 of your report at page 122. You say in paragraph 2.7:

"Side rolling covers rest on the hatch coamings when they are closed, and consideration would need to be given to the strength of the coamings and coaming

support structures with the higher sea loads being considered in this report. At the highest sea loadings, there could be significant additional costs associated with the strengthening of these structures."

That is quite a difficult assessment to make, but you, in calculating the costs that we have identified, have not taken into account the additional cost associated with increasing the strength of hatch coamings or the surrounding structure?

A. That is correct.

Q. Have you attempted to estimate those or not?

A. No, I have not. At the lower, if you like, UR S21 level, if I can put it that way, the increase in loading on the coamings ought to be manageable at a cost which is, again in terribly broad terms, not unreasonable, whatever I exactly mean by that.

At the very high load sphere, the 15 tonnes per square metre, on the basis of the Load Line Convention we would be putting fairly astronomic loads into the coaming on the deck, and I have not attempted to try to calculate what one would need to do with the deck structure.

Q. Anyway, that is an unknown factor, both even at the lower levels and the higher levels at the moment, that you have not carried out an estimate for?

A. That is correct.

Q. Thank you. Secondly -- again I am still in the context of new ships -- in your calculation, perhaps if you look at paragraph 2.8 of your report, you say:

"In general, for the lower sea loads, it can be assumed that the wheels, hydraulic lifting devices, cleats and drive systems would not change. In the case of the higher sea loads the cost of changes to the drive system and other fittings are included in the reported estimates."

A. Yes.

Q. Can you help me on new ships? When you are increasing the weight of the hatch covers, one would have to consider whether or not there should be, as you say, any corresponding increase to the other parts of the system that you refer to?

A. Yes.

Q. In the context of new ships, if you want to go back to page 126, what part of those figures relate to that factor?

A. What I did here was, at the lower increases in capacity, I assumed that there would be no discernible change in the wheels and pins and the drive motors and so on. At the very high sea loads, I included an amount, a notional amount, an estimated amount, for increasing the

size of the drive motors and pins and bearings and so on. Right at the minute I would be very hard pressed to remember what that amount was, but it was a reasonably consistent addition to the steel weight.

(4.00 pm)

- Q. May I just put to you, in terms of assessing what addition -- you agree with me, is this right, Mr Byrne, that you would have to consider whether the cost of those other items would be increased because of the additional weight of the hatch covers that they would have to deal with?
- A. It is absolutely necessary in terms of engineering, and to the degree of limited accuracy of the figures it is included in this analysis.
- Q. What I would suggest to you simply -- and then I think I can leave it -- is how much that would cost may require some further rather detailed consideration?
- A. If I can call them at the practical levels of upgrade, I think it is really a very modest change indeed. We are talking about a change of hydraulic motor drive and perhaps increasing pins and bearings on four wheels. It is relatively trivial at the level we are talking about.
- Q. Then turning to existing ships for a moment that you deal with at pages 128 and 129. On page 129, I think I can take this more quickly, again one sees the

corresponding tables that we have looked at before. Do you see that on page 129?

A. Yes, I do.

Q. And what you have here is an absolute increase in weight of each of the different types of hatch covers. Is that right?

A. Yes.

Q. The actual figures are slightly different from a new ship. They are slightly lower, I think, or slightly smaller figures?

A. Yes.

Q. Again, if we are looking at the difference between -- if one looks at a line, so to speak, between say, 5.2 and 7.5, if you are with me, one is looking at a figure here on your calculation of perhaps something like 7, maybe 7.5 tonnes per panel on the first one. Is that right?

A. It is, yes.

Q. And on the second one, possibly 9 or very approximately about 9?

A. Yes.

Q. The total, if one again is looking for the additional steel weight, if one were upgrading existing ships to that kind of level, both hatch number 1 and hatch number 2, if one takes a figure of, say -- I am trying to look at broad figures -- it comes out at a figure of

about 30 tonnes increase in steel weight, maybe 35, something of that order?

A. Yes.

Q. Thank you. Again, pausing there, at page 129, for the higher levels here, for the higher upgrading, you have written in "N/A", because it is your view, as explained elsewhere in your report, that you consider that it is not practicable, really, to upgrade beyond the kind of levels that you have indicated there?

A. Yes.

Q. Then, in terms of overall cost, one sees the overall costs on page 130. Again, just taking the first one, one is looking here at upgrading existing ships. If one looks between the 5.2 and the 7.5, one arrives at a figure in the low £30,000 per panel. Is that right?

A. It is.

Q. So, for two panels it would be £60,000-odd, and for hatch number 1 and hatch number 2 on that it would be something of the order of £125,000 or £130,000, and in dollar terms that works out at somewhere between \$200,000 and \$250,000, something of that order?

A. Yes, I would say, just briefly, that it is well worth reminding ourselves of the caveats -- the cautions -- associated with the existing ship upgrade for the reasons laid out in my report.

- Q. You set them out. I am coming to that in a moment. Equally, if you look at the bottom panel, which is a slightly different size of hatch panel, the corresponding cost is going to be slightly higher?
- A. Yes.
- Q. As you say, one has to bear in mind that there are a whole lot of caveats with regard in particular to existing ships, that is right, as you set out in your report. One of them, I think -- I am not sure you set it out as clearly as perhaps we would suggest to you, Mr Byrne, and it is fair that I put it to you -- if you are carrying out this upgrade, that will involve additional welding on the hatch covers themselves. Is that right?
- A. Yes, as envisaged in this --
- Q. As you envisage. You envisage in different kinds of ways. There are different possible ways of doing it, but it will necessarily involve, on how you envisage it, additional welding on the hatch covers?
- A. Indeed.
- Q. That indeed, I would suggest to you, is very likely to give rise to practical difficulties in terms of distortion of the hatch covers and possible difficulties in fitting them back in due course?
- A. Up to the words "practical difficulties" I entirely

agree. It is an infernal business modifying hatch covers. Distortion ought not to be one of those difficulties if it is undertaken carefully; the welding is undertaken carefully and designed perfectly, and so on. But, yes, practical difficulties no doubt.

Q. Lloyd's would say, I think, that there are major practical difficulties involved in upgrading existing hatch covers.

A. I think that is fair to say, that is fair to say.

MR JUSTICE COLMAN: What difficulties are you putting which go beyond providing that there should be no distortion or some other difficulties?

MR EDER: My Lord, it is the distortion work that is being done. My understanding -- is this not right -- you may suggest others, I do not know, Mr Byrne -- is the hatch covers would have to be taken off?

A. Almost certainly.

Q. Almost certainly they would have to be taken off?

A. Yes.

Q. They would have to be taken ashore?

A. Yes.

Q. The relevant work would have to be done ashore in some workshop or repair yard or something like that?

A. Yes, that is usually the most convenient --

Q. They would then have to be brought back to the ship and

reinstalled again?

A. Yes.

Q. All of that will also involve downtime in terms of the ship. Is that not right?

A. This is exactly the area that existing ships become much more difficult, because it depends when you do it. If you dedicate time simply to upgrading the two sets of hatch covers, then you have to pay for that time. If the time is part of a routine drydocking elapsed time, then you do not pay for that time and so on.

I agree with you earlier, when you said that there are substantial practical difficulties, and there are, but I am still ---- I do not think there is a great difference between us, but I do not think those practical difficulties are principally about distortion. Distortion should be manageable, but there are practical difficulties.

Q. If you have in mind other practical difficulties, then please tell my Lord what they are, if they are anything different from what I am suggesting to?

A. Simply retro-fitting anything to existing hatch covers is quite difficult: measurement accuracy of the pieces you are going to attach, assuming they are some kind of (inaudible) structure, the quality of the welding, the fact that you do have to dismantle the hatch covers and

take them ashore, yes, but distortion per se ought not to be a problem.

After all, very many hatch covers that have old hatch covers, that have to have say the cross-joints renewed during the life of the ship, do that at a cost but without a particular problem of distortion.

- Q. I am not suggesting, Mr Byrne, that it may not be possible to surmount the problems if one is very, very careful; all I am suggesting to you is, as you have agreed with me, there are practical difficulties, and one of those is the risk of distortion.

Mr Byrne, the other thing, though, is in your report all the figures that we have been looking at in the context of existing ships do not give, or take into account, any downtime at all?

- A. They do not.
- Q. In terms of assessing downtime, it may be possible to arrange this work to be done whilst other work is being done to a ship. That is right?
- A. Yes.
- Q. But it may be very difficult to do that. Is that not right, having regard to the ordinary trading pattern of the ship?
- A. One would hope, unless there was some reason to believe there was extreme urgency required -- possibly there

might not be -- if there was not extreme urgency, then it could be scheduled, one would think, for the next drydocking.

Q. In an ideal world, that is what should happen, but it may not be possible to arrange that. That is all. Would you agree?

A. I have some difficulty. Perhaps I have a limited vision in this, but I have some difficulty imagining why one could not wait until the next drydocking, slot in hatch cover upgrades at the same time, as you are maintaining the outer hull of the ship, and all those normal things.

Q. All I was suggesting to you, Mr Byrne -- and I will leave it there -- is in an ideal world that is indeed what should happen. Whether or not that will be achieved or not is a matter of some uncertainty.

A. I do agree. I mean, if there was a reason for urgency, then yes, absolutely.

MR EDER: Thank you very much, Mr Byrne.

One final point, if I may? We were dealing again with the additional upgrading of the hydraulics and the other associated gear. If one did have to upgrade those hydraulics as well, and the other associated gear with it, then that would be more expensive for old equipment, in terms of retro-fitting on board existing ships, rather than incorporating more powerful gear in

hydraulics on a new ship. Do you agree with that?

- A. Perhaps marginally, because on an old ship you would probably end up replacing pipework as well, and practical things like that, but not at the level we are talking about. I think the difference in cost would be between a new existing ship and an old existing ship, I think the difference in cost would be fairly marginal. There would be some, I agree with you, but not a very large amount of money.

MR EDER: Thank you very much, Mr Byrne.

MR COOPER: My Lord, on the basis that most of the matters I intended to canvas with Mr Byrne have already been covered by those who went before me, principally, Mr Eder, I have one or two short questions on his paper for the Attorney General, and then, if I may -- as I understand it, this is the last time that Mr Byrne will be called to give evidence -- I would therefore like to ask him one or two questions on the topic of recommendations.

MR JUSTICE COLMAN: Certainly.

Cross-examination by MR COOPER

MR COOPER: Mr Byrne, just staying for the moment with the upgrading of hatch covers for existing ships, we were talking about practical difficulties, and I think you identified some practical difficulties in relation to

the hatch cover panels.

For where one is increasing substantially the weight of the hatch covers, would there not also be practical difficulties for existing ships in relation to upgrading the support structures for the panels, say, for example, the coamings, the hatch end beams, possibly the wing tank girders?

- A. Yes, I think that perhaps takes us back to an earlier answer. I think at the lower levels of upgrade, at the UR S21 sort of levels of upgrade, although I have not done any structural calculations on this, I believe the impact on the ship structure would be modest. At the higher levels that were looked at in this report, at the very highest levels, I think the effect on the structure would be massive.
- Q. That was effectively going to be my next question, at what point you think there would be significant requirements for changes to the structure, what level of increased hatch cover loading?
- A. I think the correct answer is I do not know because I have not calculated it, but from the way the weights and the costs were behaving, it looks like you start to go very steep indeed in terms of weight and cost, but around about 10 tonnes per square metre, based on the Load Line Convention basis.

- Q. But it might be lower?
- A. But it might be lower.
- Q. That is assuming that the possibility of making those changes is, in fact, feasible. Is there a danger that for existing ships it may not be feasible to make such changes to the structure?
- A. I think the simple answer is yes, there is a danger that it is not feasible on some existing ships.
- Q. Presumably the cost of those changes is another cost that would come in additional to the costs that you have looked at in your paper?
- A. Yes.
- Q. Can I turn now to the question of recommendations, and ask you, if I may, to take up bundle DETR1 -- sorry, Mr Byrne, one more point on hatch covers before I ask you to look at Professor Vassalos' first report, which is simply this: we have dealt with the feasibility to changes of existing ships and indeed the cost to existing ships of upgrading hatch covers, but would I be right in assuming that you would say, if such changes were necessary to enhance the safety of the ships, that that is something that would simply have to be grappled with?
- A. Yes.
- Q. Can I then ask you to turn, first of all, to page 60 in

bundle DETR1, where you will find the first page of a report prepared by the SSRC for the Department of Transport, the Environment and the Regions. You will see that it says it is a supplementary report for the DETR, IMO-related work and recommendations. Then, if I can ask you to turn to page 69, you will see at the bottom of the page a heading, "Recommendations for the future"?

A. Yes.

Q. And then, in paragraph 18, Professor Vassalos, who is the main author of this report, goes on to set out in subparagraphs (a) to (g) of the report a series of recommendations. I do not propose, unless the court would like me to, to read each of them out. Instead I would invite you to read them to yourself. (Pause)

In so far as they fall within your area of expertise, are there any of those recommendations that you would either disagree with or wish to comment on?

A. Perhaps if I skate through them item by item, prefacing any remarks by the fact that I have not considered these in terms of -- I had not prepared myself, as it were, to talk about recommendations, but I am quite happy, I think, to do it now, rather than to delay.

Item (a) --

MR JUSTICE COLMAN: Mr Howard, do you have any comment about

investigation of recommendations by --

MR HOWARD: We have no case as to particular recommendations, my Lord.

MR JUSTICE COLMAN: I am sorry?

MR HOWARD: We have no case as to recommendations, and Mr Byrne has not been asked to consider them.

MR JUSTICE COLMAN: Of course, you appreciate Mr Byrne is now being asked to go through in some detail these recommendations put forward by Professor Vassalos. I just wonder whether it is going to be fruitful at all.

MR HOWARD: From the court's point of view, I have no doubt it would be helpful to have Mr Byrne's input. From Mr Byrne's point of view --

MR JUSTICE COLMAN: He has not had an opportunity of considering this at all.

MR HOWARD: I was going to say it might be fairer to Mr Byrne and more helpful to the court in the long run if he had an opportunity to think --

MR JUSTICE COLMAN: I think he ought to have an opportunity -- I do not know whether Mr Byrne is going to be available at some subsequent stage in this hearing, but if he is going to be asked about recommendations, I think he ought to have the opportunity of considering them.

MR HOWARD: I respectfully agree, my Lord. There are

certainly going to be times when Mr Byrne will be available, and presumably questions about recommendations, if they are to be put, would not take very long.

MR JUSTICE COLMAN: Mr Cooper, if you want to pursue recommendations of this kind with Mr Byrne, I think he had better be recalled. You have to take whatever view you think is appropriate.

MR COOPER: My Lord, I was only seeking to put it to Mr Byrne on the basis that I did not want it said that later on he had not been given an opportunity to comment on recommendations in circumstances where he should have been. If he feels, or if Bibby Tankers feels, that it is not necessary for him to speak to these recommendations, then --

MR JUSTICE COLMAN: It is quite difficult for him to do this on the hoof, I think. He has dealt with the costings aspect, which of course is material to recommendations, but the broader scope recommendations which are set out here -- and some of them are very broad indeed -- seem to me to be something that he might want to think about and which he should not really deal with on the hoof. I do not think it is likely to be useful evidence unless he has had an opportunity of thinking about it.

MR COOPER: My Lord, perhaps we could leave it like this --

MR JUSTICE COLMAN: I think he had better be recalled.

MR COOPER: He can go away and think about it, and if there is any point he wishes to particularly comment on, he can be recalled if necessary.

MR JUSTICE COLMAN: That puts the onus on him. I think, if you want to pursue this material with Mr Byrne, he had better formally be recalled at some stage further, later in the hearing. He can indicate if he agrees with them all, in which case he does not have to be recalled.

Mr Eder, do you have anything to say?

MR EDER: My Lord, the only comment I have to make is we are at the stage of the inquiry, for the first time, really, where we are considering recommendations, and your Lordship may like to reflect on the best way forward for this. Certainly Lloyd's Register have comments on this. One possibility is that other parties may have comments. It may be a good idea, my Lord, to consider anyway some kind of procedure because the experts have not met with regard to considering recommendations.

MR JUSTICE COLMAN: I know.

MR EDER: One possibility may be that your Lordship may consider it appropriate -- I am not sure to direct formally -- that there should be a meeting between experts, and that this report from Professor Vassalos is perhaps a convenient starting point. If anyone has

comments to make with regard to that, both in general terms and more specifically in terms of actual formulation of wording, it may be quicker and easier for the experts to meet and see how far they can agree.

MR JUSTICE COLMAN: There is a slightly unrealistic aura about evidence relating to recommendations when there are huge question marks as to actually what happened to this vessel. Any recommendation one puts forward is going to be a recommendation, so to speak, on certain hypothetical assumptions which may, in the event, prove to be completely misconceived.

MR EDER: Your Lordship is absolutely right. I think this morning, my Lord, we received from the Treasury Solicitor -- or I think it was last week -- a list of the recommendations that the Attorney General will be asking the court to consider by reference to the assessors' report. Since we received that, I think it was last week, Lloyd's Register will be producing a document really commenting on those, because at some stage we will have to address those.

I only rise at the moment, my Lord, simply to say we are at this stage of the inquiry, and it is a matter for your Lordship as to how best to proceed.

MR JUSTICE COLMAN: I cannot help feeling that the evidence as to recommendations would carry much more weight if it

were given after the various experts on scenarios have concluded their evidence on the scenario side. My reason for saying that is that I am quite sure that, in the course of the giving of the scenario evidence, points will fall away or become diminished, at least so that the need for recommendations, or the ability to identify particular areas in which recommendations ought to be made, will be much more soundly based at the end of that evidence than they would be if they were given at this stage.

I am therefore rather of the view, subject to anything anybody else may say, that if a witness is able to be recalled later in the hearing for the purpose of simply dealing with recommendation areas, that ought to be the approach. If he is not capable of being recalled, then he will have to give his evidence straightaway.

MR EDER: My Lord, obviously what your Lordship says has much force.

MR JUSTICE COLMAN: This is a classic case, really, of a witness who, as the way things have worked out, is suddenly confronted with a list of quite complicated recommendations and has not really had an opportunity of considering them at all. I do not think that is really a fruitful --

MR EDER: Absolutely right. My only purpose in rising, my Lord, was in a way to look ahead -- and I hope this has been a useful exchange -- to see where we are going on recommendations and the best way forward.

MR JUSTICE COLMAN: Mr Thomas, do you have any submissions to make?

MR THOMAS: My Lord, originally we had proposed that scenarios and recommendations should be two distinct chapters.

MR JUSTICE COLMAN: That is right.

MR THOMAS: That would have entailed experts who have something to say on both topics coming back a second time to deal with it in the last part. We were then made aware of the fact that one or two experts had a lot to say on one topic, and practically nothing, but just a little to say on the other, and it might be more conveniently dealt with in one session covering both.

There are some witnesses, I think, we shall be calling who will be only dealing with recommendations. Professor Vassalos is an example of a witness who is going to be dealing with scenarios and later some time also with recommendations.

My Lord, I think our thinking has shifted a little bit. We started off thinking they should be two separate watertight compartments. We then thought that

in the interests of economy, we should try, so far as we could, to merge the two so that a witness might find it convenient to deal with both or might not, and we would simply go through all the ones that can deal with scenarios with or without something on recommendations, and then go to witnesses who have only recommendations to speak to.

My Lord, I endorse entirely the idea that there might be some experts' meeting to discuss recommendations because that does seem desirable. What I am not so sure about is that it is necessary, as Mr Cooper was proposing, to put to a witness who might be qualified to speak to recommendations a list of recommendations for his comment. It does not really seem necessary that everyone who might have something to say should be asked in open court whether he wishes to say something, but only that witnesses who wish to say something, wish to advance a view about recommendations, should do so. Obviously that is a matter for each party and each witness as he comes forward to give evidence.

So, my Lord, in short, I endorse the suggestion that there should be a meeting on recommendations. Professor Vassalos' list is one starting point, and the other that Mr Eder has referred to is Mr Williams, who was proposing to speak to particular parts of the

assessors' report identified in that context.

We also have an expectation of a paper that Professor Faulkner will produce. We have been promised it today specifically on recommendations. That, I regret to say, is still not available. Then we also had proposed to call Dr Drake, who has evidence to give specifically on recommendations. Not all of that is available to the parties at present.

My Lord, I would now propose that your Lordship should continue hearing the various witnesses on scenarios, that we should only get into recommendations if there is some very good reason for doing so, because a witness cannot be available later, or because he has just got one thing he wants to say and it would be convenient to have it said there and then. Subject to that, we should simply move to a second phase on recommendations, ideally after there has been some discussion between experts and the various contenders from the various witnesses in their proofs that have been identified.

MR JUSTICE COLMAN: There it is. Mr Cooper, the appropriate course in this case is for there to be a meeting between experts on the recommendations, and subsequent to that, there will no doubt be a minute, and subsequent to that, subject to such instructions as you may have, you may

wish to ask Mr Byrne questions about recommendations if he has participated in the experts' meeting. If he has not, it does not seem to be appropriate that he should be asked because the owners are not putting forward any positive case on recommendations.

MR JUSTICE COLMAN: Does anybody else have any questions to ask of Mr Byrne?

MR HOWARD: I was going to ask one or two in re-examination, my Lord.

MR JUSTICE COLMAN: I will have to rise in about five minutes. Does that give you enough time?

MR HOWARD: I will do my best, my Lord.

Re-examination by MR HOWARD

MR HOWARD: You indicated in answer to Mr Meeson that there is a possibility that the crack in bulkhead 339 at the 40-foot level may have opened on impact rather than at an early stage in the sinking process?

A. That is correct.

Q. How do you rate that possibility on a scale of probabilities, by comparison with your own preferred view that the fracture opened close to the surface?

A. I think it is much more likely that the split at the 40-foot level at least partially occurred, as I mentioned earlier, between the longitudinal bulkheads in the near surface condition, and was further opened upon

impact with the seabed. That is, to me, an entirely plausible view. I am slightly less convinced that the total split occurred on impact with the seabed. So I am afraid what I think is my preferred solution is more likely than the impact solution. I cannot give you any probability in any sense.

Q. Turning to the question of speed, you have referred at page 4 of your report in BL2 to a speed of 4 knots, that you changed to 3 to 4 knots in the light of further investigation. That is 3 to 4 knots through the water, is it?

A. Yes.

Q. When the ship is making headway through the water, she may be making lesser speeds over the ground in these conditions?

A. Yes.

Q. Indeed, I think there is some evidence from mariners that she may even be being driven backwards?

A. Not unless there is an unusual, as it were, tidal stream or current. Normally, as the ship is making way through the water, it will also make way over the ground, unless the body of water is moving.

Q. So far as you are concerned, do you regard your figure of 3 to 4 knots still as a plausible figure?

A. I think as an upper limit, as I think I mentioned

earlier, somewhere in the region of 3.5 knots as an upper limit.

Q. In calculating your figure of 8.4 metres as the highest wave which might be expected to be experienced, is that figure consistent on the method you used with

Dr Cardone's figures for significant wave heights?

A. It is consistent with the significant wave height, yes.

Q. I think the method you set out is at page 25, where you refer to the conventional wave statistics.

Assuming the Marin tests provide a gold standard, then I understand you to say that the 8.4 metres you have taken at page 4 of your report would no longer be valid for the sort of wave which could be experienced by the forward hatches?

A. Yes.

Q. What figure shall we substitute for 8.4 if the Marin tests were treated in that way?

A. I think the answer to that question regrettably lies in the sort of dark territory that is inhabited by Weibull and Gumbel. The answer is I do not know. There are measured values of short-term tests by Marin which are about -- the equivalent of about 2.7 tonnes per square metre without an inertia component, an acceleration component, as I understand it, which is to say that in addition to the measurement, one has to add the

acceleration due to the ship's pitching.

However, if we accept for the moment the 2.7 tonnes per square metre in the short-term test, there must be a probability of encountering a higher wave than that in due course on top of the hatch covers. How high that wave is, I think, is still subject to some debate, although I notice -- if my memory is correct -- that even the latest Gumbel statistics from Marin give us a probability of 12 per cent of a hatch-breaking wave. If we assume the Cardone plus 10 per cent and 70 per cent of maximum forward speed, one still gets a small but finite probability of hatch-breaking waves, and one assumes that the probability will be small, otherwise we would be losing bulk carriers every month.

MR HOWARD: Thank you very much, Mr Byrne.

MR THOMAS: Tomorrow is Dr Dallinga. He will begin at 10.30. My Lord, we did circulate a paper last night saying that there are a number of pages of his evidence which we shall not be adducing in evidence. They have been circulated into the bundle. 16.5 is the bundle which contains the evidence on the recent tests. Your Lordship knows we do not intend to call him as a statistician or statistical expert. It is true, as a matter of fact, that he has done statistical work, but

he will not be asked to justify those views as a  
statistician.

MR JUSTICE COLMAN: Very good. So it is Dr Dallinga and  
only Dr Dallinga tomorrow?

MR THOMAS: My Lord, it is assumed that he will take all  
day, or most of the day. If he does not take the whole  
day, Mr Squire will be the next witness.

MR JUSTICE COLMAN: Very good. Thank you. 10.30 tomorrow,  
then.

(4.50 pm)

(Court adjourned until 10.30 am the following day)

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