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Wednesday, 30 January 2013

(10.00 am)

DR NEVILLE ANTHONY ARMSTRONG (on former oath)

MR SHIEH: Good morning, Mr Chairman and Mr Commissioner.

THE CHAIRMAN: Good morning.

MR SHIEH: Dr Armstrong, thank you for coming back.

THE CHAIRMAN: Before you resume, may I remind you that you continue to testify on the basis of the oath that you took at the outset.

A. Thank you, sir.

Examination by MR SHIEH (continued)

MR SHIEH: Dr Armstrong, just to pick up on a couple of points that we touched on yesterday. It may be my fault in not following it through. Maybe it's the syndrome of a long afternoon. There is a part of the transcript that I would like to clarify with you, because I'm not sure the answer was followed through.

Could I ask you to look at the transcript for yesterday, Day 25, 29 January, page 161.

Dr Armstrong, could I just put you in the frame, so to speak, as to the purport of this line of reasoning, starting sometime yesterday afternoon.

We had reviewed the evidence so far, and obviously I'm not pre-empting the view that the Commission is going to take at the end of the day, but the view,

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a view, is that the absence of a watertight door at frame 1/2 had an important bearing or causative effect on the sinking of the vessel. I mean, we've been through this, the various scenarios. If only tank and engine flooded, but steering did not flood, then the vessel would only tilt but not sink. So the absence of the door had a rather significant effect, and that is the view that has been put forward, Dr Armstrong. Do you follow me?

A. I understand, yes.

Q. So the purport of this line of questioning is to see whether or not at any time in the inspection or approval process, whether or not there are any particular parts of the applicable regime, be it any rules, requirements as to aft peak bulkhead, margin line calculation, et cetera, or incline experiment or visual inspection, any chance which could have prompted those in charge to realise that, "Oh, a door is missing", contrary to some regulation, and which the fixing of a door would cure a certain problem. So we are looking at various possible scenarios where people might be prompted to realise the problem.

Do you follow me?

A. Yes.

Q. One such area or one such requirement which might prompt

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people to think, "Ah, why is there no door?", is the requirement of an aft peak bulkhead in the Blue Book.

A. Yes.

Q. Which is the subject matter of our discussion at this particular part in the transcript. You remember the context. I'd put to you Mr Ken Lo's evidence, that he regarded the bulkhead between tank room and engine room to qualify as an aft peak bulkhead, and you have disagreed with him. Do you remember that?

A. I remember that, yes.

Q. You took the view that aft peak bulkhead had a particular role to play, a particular function, and you talked about the historical origin of the aft peak bulkhead and the fact that near the aft of a vessel, there could well be breaches of the ship's structure by either propeller or rudder, and in the case of Lamma IV it was the rudder which went straight up to the steering gear compartment.

A. I recall that, yes.

Q. Yes. So at this point, from line 14 onwards, I was putting a suggestion to you, playing the devil's advocate; I was putting to you the potential counter-argument, a counter-suggestion, against using frame 1/2 as an aft peak bulkhead.

The argument would run as follows. You don't need

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a watertight aft peak bulkhead at frame 1/2 for the reason that any potential adverse effect caused by flooding -- let's say there's a gigantic hole caused by the rudder and the whole steering gear compartment is flooded. The counter-argument is going to be it doesn't matter, because ordinary requirement of stability booklet calculation, you know, margin line immersion and all that, one-compartment flooding, 0.1L, satisfaction of those criteria would have ensured safety of the vessel.

So as long as a ship, on a hypothetical one-compartment flooding scenario comprising steering gear compartment plus tank room, passed let's say the margin test and the GMT test; it's fine. So it's not a big concern that you really need a watertight bulkhead at frame 1/2, because even if no door, steering gear and tank room all flooded, as long as passed margin line test, it's fine. And in 1996, it passed. So you shouldn't really be too bothered about whether frame 1/2 is watertight or not. That would be the sort of argument put against any suggestion of, "Oh, there really needs to be a watertight bulkhead at frame 1/2 to count as aft peak bulkhead".

A. Yes, I understood that yesterday.

Q. Right. The answer you gave is -- I made that point

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yesterday and you said, "Yes, you're correct."
Then I asked you:
"What would you say about that sort of argument, which more or less eliminates the need for an aft peak bulkhead?"
You follow the line I'm getting at? Because if that argument is correct, you don't need a specific requirement for an aft peak bulkhead, because the general requirement as to bulkheads and 0.1L and one-compartment flooding would have done the trick.
A. You don't need --
Q. You then gave an answer about 10 per cent, et cetera, which I'm not sure I entirely followed through, and I'm also a bit puzzled by the earlier answer of "Yes, you're correct". Because if you say, "Yes, you're correct", it means that you are agreeing with that argument. But it seems to me that it runs contrary to your earlier rejection of the idea that the bulkhead between tank and engine could qualify as an aft peak bulkhead.
A. My apologies for the confusion. It was a long day, as Mr Chairman mentioned.
Q. I hope I've made my line of questioning clear and I hope I've made the purpose of the question clear this time.
A. There's no question in my mind that there is some truth in what Mr Lo has presented, that from a damage

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stability perspective, then the door perhaps was not needed because you had to consider both compartments flooded. But there were other requirements for having a watertight bulkhead. Having an aft peak that was watertight there specifically --
Q. Pausing here. Pausing here. You mean having a watertight aft peak bulkhead is not just for the purpose of satisfying the damage stability calculations?
A. Correct.
Q. Right. Can you tell us what other self-standing significance there is about a watertight aft peak bulkhead?
A. Well, of course, sir, there's a -- well, there's a requirement in the Instructions for a watertight aft peak bulkhead, as I read it, in chapter II, possibly section 12 under "Bulkheads".
Q. Yes. I think Mr Chairman actually asked for a reference to that. It is actually in your first report where you helpfully set out the table. I think we can quickly turn that up. Expert bundle 1, the helpful table where you compared the two sets of instructions. It's page 421. Under the Blue Book, it's chapter II, regulation 12. Under 1995, it's chapter II, 5.1 to 5.3. "Peak bulkheads at both ends".
A. One has to ask why is that requirement there. It's

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perhaps not obvious, but I doubt it's there for watertight subdivision or floodable length reasons because there are already detailed requirements for that.
Q. Yes.
A. So it's there for some other purpose.
Q. Yes.
A. I can only speculate as to what that purpose is, but I believe one of the possible reasons is because there are other flooding scenarios, such as, for example, what happened with Lamma IV where the engine room and the tank room were flooded, and if that happened the vessel was going to sink, because there was no buoyancy in the after part of the vessel at all. So in that case, the aft peak would provide some buoyancy at the after end, and indeed calculations show that it would have survived in that condition.
So I think whoever wrote the original versions of SOLAS were aware that there were other requirements for buoyancy at the after end other than could be calculated directly with the floodable length calculations.
Q. So in other words, satisfying floodable length calculations and also -- well, basically satisfying schedule 1 and schedule 3, margin line not submerged, GMT, it's not the be-all and end-all?

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A. It's not the be-all and end-all, and why would they write this requirement into the regulations if it was the be-all and end-all? There was a purpose that it was put in here.
Q. You mentioned those who write SOLAS would not have included this requirement had it not served some purpose. We've looked at the wording of the relevant SOLAS rule yesterday. I understand that it actually has been imported into the relevant Hong Kong rules. It's legislation bundle 2, tab 11. Regulation AM. Regulation 7.
A. Subparagraph (4).
Q. Over the page. Yes.
"Every such ship shall be provided with a watertight after peak bulkhead and with watertight bulkheads divided the space appropriated to the main and auxiliary propelling machinery and boilers, if any, from other spaces. Such bulkheads shall be watertight up to the bulkhead deck ..."
So it actually reflects the language of the SOLAS rule that we looked at yesterday.
A. Yes.
THE CHAIRMAN: These are the 1984 Regulations?
MR SHIEH: This is Cap 369AM, Ships Built On or After 1 September 1984.

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THE CHAIRMAN: Thank you.
MR SHIEH: Mr Chairman, you can see it's originally LN 325 of 1991, so it is the applicable set of regulations but for the fact that Lamma IV is not ocean-going. So qua legislation it doesn't apply because it applies to ocean-going vessels, but the point I'm going to ask Dr Armstrong perhaps makes the reason why I'm bringing him here.
THE CHAIRMAN: Yes.
MR SHIEH: Now, Dr Armstrong --
THE CHAIRMAN: Where do we see the applicability provision for this legislation?
MR SHIEH: It's in the old Cap 369. I think it's in the text of the actual Ordinance.
THE CHAIRMAN: Do you have a reference?
MR SHIEH: We can locate that. Mr Chairman, we will look at the provision in the enabling primary legislation which stipulated that it is for seagoing vessels.
THE CHAIRMAN: Thank you.
MR SHIEH: Because I think it is the evidence at least of the witnesses that qua legislation, the Ordinance doesn't apply to local vessels. I think this what I may call gap was only plugged by recent legislation, but that was not done at the material time.
Legislation bundle, tab 5. That is the primary

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legislation. Merchant Shipping (Safety) Ordinance, Cap 369. If we turn to the "Application" section, which is section 3:
"Save as otherwise provided in this Ordinance or in regulations made thereunder ..."
Mr Chairman, perhaps I should actually have more time to reflect about the actual provisions because it may well be this is actually not the one. Perhaps I'll come back to that.
THE CHAIRMAN: Yes, please do.
MR SHIEH: Dr Armstrong, looking back at regulation 7 that we were looking at just now at tab 11, you can see that regulation 6 is the regulation about watertight subdivision which was actually brought in by the Blue Book and also the 1995 Instructions.
Regulation 7 has actually not been brought in by either the Blue Book or the Instructions.
A. Correct.
Q. That is a point that you have commented on in your report.
A. Yes.
Q. Be that as it may, since regulation 7 is part of the set of regulations, part of which the Blue Book has imported, would you think that any authority or person administering let's say the Blue Book or the 1995

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Instructions would be helped by the description of an aft peak bulkhead at regulation 7, in particular the need for it to be watertight?
A. There are a number of requirements under subsection (4) that's on the screen, for example it requires watertight bulkheads at each end of the propelling machinery. It doesn't say why they are needed, and those same provisions are carried across into the Blue Book. Just like the requirement for an after peak bulkhead is carried across into the Blue Book. An interested hypothetical surveyor may well question why is there a need for such a bulkhead, or he may just follow the regulations blindly. But whichever way he goes, there is a requirement there for it. In the case of machinery, as I mentioned yesterday, it's probably for completely different reasons such as a fire or smoke.
I think it may not be obvious to some hypothetical surveyors that the aft peak bulkhead is there for buoyancy purposes or to restrict flooding, but nevertheless there is a requirement there and they should be aware of it because it's quite clearly spelled out in the Blue Book.
Q. It's a self-standing requirement on top of reaching floodable length requirements and all that?
A. Correct.

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Q. Thank you. The reason I'm going into this is that yesterday I took you to the wording of the Blue Book and the 1995 Instructions, which we have looked at. It simply says "Peak bulkheads at both ends". It doesn't actually say "Watertight peak bulkheads at both ends".
A. No, but there would be no point in having a peak bulkhead that was not watertight.
Q. Yes, but that is one point in favour of the view that even if it doesn't expressly say "watertight", inherent in the idea, it should be watertight. So that is one potential argument.
A. Yes.
Q. What I am inviting you to consider is a further possible argument that, "Oh, it should be watertight because the hypothetical interested surveyor considering the relevant regime would say to himself 'Although regulation 7 has not been imported expressly by the Blue Book or by the 1995 Regulations, it does form part of the local legislation prevailing at the time. Regulation 6 has been imported and regulation 7 basically follows the SOLAS rules'." So all these would inform his view as to whether or not a peak bulkhead should be watertight, because regulation 7 says "watertight". What do you say to that?
A. I'm of the same opinion as you have just expressed, yes.

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Q. Thank you, Dr Armstrong.
Could we now come back to where we stopped yesterday, which is your second supplemental report and the calculations that were set out in the tables there.
Page 928. Always remembering the purport of this exercise is to try to identify what I may call, loosely, opportunities for spotting the problem, meaning the absence of a watertight door.
In 1998, after ballast had been added, in a scenario assuming flooding of both tank room and steering gear compartment, the result is that margin line test failed, as you can see in the middle.
A. (Witness nods).
Q. I just wish to recap. If the hypothetical Marine inspector were to send the whole thing back and say, "Sorry, you failed", if Cheoy Lee or Hongkong Electric were to try to solve the problem, try to make the vessel pass the margin line test -- I thought we discussed it previously -- the problem is not to be solved by spotting the absence of a door and adding a door there, because the exercise of one-compartment flooding requires you to ignore that frame 1/2 anyway.
A. The floodable length requirements could not be met by adding a door, correct.
Q. Could not be met. As Mr Chairman actually indicated

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yesterday, interjected, at page 166 of the transcript:
"The problem at this stage is the added lead."
A. It's the added weight of the vessel, which was more than 30 per cent of the previous weight, which is a very large amount, in my opinion. It's not a trivial increase.
Q. So again, thinking about a hypothetical person trying to tinker with the vessel or tinker with the ballast situation to make it pass the margin line test, what would be the sort of thing that would occur to such a person, to make it pass the margin line test? Obviously you could not add the ballast, but apart from that? Add less ballast, maybe?
A. That's quite a tricky thing to answer. Less ballast, yes, would have assisted. Alternatively it is possible to add buoyancy in the shape of foam or something similar. Other than that, you have to start thinking of major alterations to the vessel, such as putting buoyancy boxes behind the transom. I have seen buoyancy boxes behind the transom used to solve this problem.
Q. But these would not involve spotting whether there's a door there and adding a door?
A. They would not solve the floodable length problem. If a conscientious hypothetical surveyor had noticed there was no door, it would have solved the section 12, Blue

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Book requirements.
Q. The aft peak bulkhead?
A. The aft peak bulkhead.
Q. But not the floodable length?
A. But not the floodable length issue.
THE CHAIRMAN: When you say adding 30 per cent of the previous weight, you are looking at the whole, namely the lead plus the extra weight on the vessel, the 15 tonnes; is that right?
A. I am, Mr Chairman. The vessel was inclined after the lead was added, and the vessel weight increased by some 15 tonnes, which represented about 30 per cent of the lightship weight of the vessel; that is, the weight of the vessel with no passengers or fuel.
MR SHIEH: But there is a small point about 1998 that I want to pick up with you before moving to 2005. You see, in 1998 there is a scenario of tank room flooded with watertight door. The margin line test would have been passed. But the presentation of these calculations in 1998 would have been a paper exercise, would it, because it actually doesn't involve people actually flooding the compartments to see whether or not it sinks. It's actually a paper exercise of calculating.
A. Yes, it's two hypothetical cases, usually one with the vessel full of passengers and full of fuel, and another

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one full of passengers with 10 per cent fuel.
Q. Let's say those responsible for presenting the calculations in 1998 presented a set of calculations on the basis of "tank room only" flooded, because they assume that there's a watertight door.
A. Which they did.
Q. Which they did, actually, all throughout all these years. They would see the result: "Oh, margin line test passed." Would this have actually prompted anyone, or should it have prompted anyone to go and check the physical state of the vessel, whether or not there was indeed a watertight door, bearing in mind that this is actually a paper exercise?
A. There does seem to be a disjoint between the people in the office doing the calculations and the people on the ground looking at the vessel. So I suspect there would be little communication between the two.
Q. Because the impression that we've got, the effect of the evidence so far is that there was a disconnect starting from 1995, failing to appreciate the absence of a door, plus failing to appreciate the 0.1L requirement, so that the calculations had all along been done on the basis of steering gear compartment, tank room, engine room, and that simply carried through.
A. Yes.

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Q. Can we now turn to 2005. 2005, it's the raising of the ballast. I think this point is similar, because if tank room only flooded, margin line test would pass. But applying the 0.1L requirement, we take tank room and steering compartment together.
A. Tank room only would pass, but steering gear only would fail, because the steering gear would have to include the tank room as well.
Q. Yes, because -- put it this way: you can't just have steering gear only.
A. Correct.
Q. If you measure steering gear, you have to bring in tank room as well --
A. (Witness nods).
Q. -- and it would fail, as in the last row of the table?
A. Correct.
Q. So the scenario as similar to the scenario in 1998, if the proposal was sent back and said, "Calculations failed", those at Hongkong Electric or Cheoy Lee go back to the drawing board, they may think of ways of addressing the floodable length problem, but could they then have been alerted in some way to the absence of a door, physically?
A. Well, if the damage stability book had been done correctly, without the door, they would have seen that

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there was a floodable length issue and then they would have had to decide what to do about it. And I'm sure they would realise that putting a door on would not work.
Q. Because even the door is there, floodable length, 0.1L requirement, requires them to disregard that bulkhead --
A. Exactly, yes.
Q. -- for the purpose of ascertaining floodable length.
A. Yes.
Q. Or the length of the hypothetical compartment that they need to flood.
A. Yes.
Q. Thank you.
A. We've heard that they were aware of the 10 per cent L requirement, so I'm sure they would pick that up.
Q. Could I ask you then to look at your second supplemental report, under the section "Regulatory Standards and watertight doors". We are moving away from intricate matters about calculation, submersion of margin line. We are talking about general concepts of standards and the need for doors to be watertight, because this seems to be what this section addresses.
A. Yes.
Q. It in a way links up with the aft peak bulkhead, whether

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it should be watertight, and we read on, paragraph 19:
"The safety standards represented by regulations and the Instructions for the Survey of launches and vessels for guidance represent a minimum acceptable safety standard. There can be no leeway or flexibility in minimum standards. Consequently most prudent engineers would carefully consider the risk associated with designing to the minimum standard, especially when it was intended to carry a large number of passengers.
In particular I note that many craft have been lost owing to aft watertight doors being left open or omitted, and this fact is widely known in the industry. Several examples known to me and covering the past 100 years are the loss of Lusitania ..."
And then a number of vessels which have been lost over the years because of the absence of an aft watertight door, as recent as Costa Concordia in 2012, which we can see at the end of paragraph 20.
"It is because of the risk associated with watertight doors that the international regulatory body, the International Maritime Organization IMO, specifies strict requirements for watertight doors for seagoing ships, including that they have remote indication and alarms in the wheelhouse, remote operation from the wheelhouse, and be of sliding construction that they can

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be closed against the force of incoming water. Hinged doors are not permitted.
I am surprised and disappointed that a vessel designed for and operating with over 200 passengers can be accepted with a watertight door removed when it appears that it was originally designed to have one, whether or not it was required under the regulations when it was built."
I have in mind a particular line of thinking which I want to put to you, on which I wish to invite your comment in light of what you have said here. It may be said by way of ex post facto justification -- indeed it has been so attempted -- margin line calculations passed in 1996, even if you merge steering and tank. There may be a departure from the plans because of the absence of a door, but if we fall back on margin line calculations, all passed. So this idea of a watertight door: not so important, or really redundant, or can be departed from. Even though Blue Book says so, we can do away with it. Even though the rules say so.
So what do you say to that sort of mentality, in the light of what you have said here about standards being only of minimum standard and in light of the fact that history tells us that so many vessels have been lost because of the absence of a watertight bulkhead at the

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aft?
A. Certainly when I started work as a young naval architect, as a consultant, I was aware straightaway of issues with watertight doors and vessels being lost. One of those vessels, as I mentioned there, was a vessel that had been designed by the company I was working for.
Q. Which one is that?
A. Called Sedco Helen, mentioned in the --
Q. Which is the fourth line. Sedco Helen in 1970.
A. I don't need to go into the accident, but the fact is the vessel had been undergoing maintenance in Singapore and, to assist with that maintenance, they had removed a watertight door so they could readily move through the compartment whilst they did their work.
Q. People can move in and out just by walking through the access door, rather than go up to the deck and down again?
A. And they had cables running through the opening. When they had finished their renovation work, they decided they wouldn't put the door back. Unfortunately the vessel only a few days later I think wrapped a cable around the propeller -- it was manoeuvring alongside an oil rig -- and put a hole in the tank room. The vessel subsequently flooded, and because there was no door on the opening, which it was required to have, the

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vessel sank.
So I was intimately aware that these problems do happen and that a watertight door is extremely important.
Since that time, I have been involved --
Q. Can you pause here. Would incidents of this nature be widely known to people monitoring harbour safety or ship safety?
A. Widely known, and indeed you can read about the Sedco Helen on the internet today, because incidents like this are seen as being --
Q. Alarm bells?
A. Yes, indeed. Important to bring to people's attention. I think that -- if I remember rightly, there are newspaper cuttings for Sedco Helen available on the internet.
Q. Sorry, going back to your being intimately aware of the need for -- of this incident, and what -- following on?
A. Yes, there was a recent incident in which I was involved where we had designed a vessel to operate strictly within the state of Western Australia, and the owner decided that he wanted it to go to Papua New Guinea, which becomes an international voyage. Our local regulations allow hinged doors, but seeing as it had to go to Papua New Guinea, it was required to have

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a sliding watertight door, because of the risk of the pressure of water, meaning you couldn't open -- or close, I should say -- couldn't close a hinged door, but you can close a sliding door.
That requires, as I've said in my text, that it be capable of being operated from the wheelhouse and it has alarms to tell the master that it's open or closed, and alarms at the side so people don't get crushed. The regulations are really very strict for sliding watertight doors on ocean-going vessels, for reasons that they need to be closed at all times.
I should say, although it's not written here, that IMO has a requirement that the door has a label on it saying, "To be kept closed at sea at all times". Indeed that's the case with hinged doors in Australia and in the UK that such a notice is displayed. I'm not sure that a notice has a lot of practical effect, but at least it is brought to people's attention.
So from my perspective, if you are in this industry, you know that an opening should have a watertight door on it, particularly at the after end of the vessel, which is why I wrote paragraph 22, because I felt that that was just generally accepted as part of naval architecture.
The arguments as to whether it was needed under

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floodable length -- that's why I wrote the very last part of that section 22.
Q. This is the part "whether or not it was required ..."?
A. "... under the regulations when it was built", yes.
Q. What do you say about this mindset, "As long as I do the regulations, I'm fine"? What do you think about this sort of mentality?
A. I spoke to a colleague before I came up to Hong Kong who has been involved in ship safety on both a local Australian scene and internationally, and he knew nothing about this particular incident other than he had read something about it in the newspaper. He said to me, "My advice is check the watertight door." And I said, "Yes, I'm aware of that issue." So that was his first reaction: "Check there's a watertight door." Not "Check floodable length", you understand; "Check there is a watertight door".
Q. Thank you, Dr Armstrong, for that.
A. You asked me what would I say about people who -- I understand you asked me about people who would design a vessel without the watertight door. Having thought about that, I would respond that the vessel was designed with a watertight door, and indeed the original plans for the sister ship, which I understand was built previously, did have a watertight door, according to the

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plans that were submitted.
Q. I know. Looking at the plans, on one view they were designed to have a watertight door. But on another view, it was actually not intended to have a watertight door and it was a mistake.
You know there is an issue as to whether or not it was truly intended to have a watertight door. Because the sister ship may be designed to have one, but there is a suggestion that Lamma IV was actually intended as --
A. Oh, yes, I understand that. But my point is, Mr Shieh, that the original ship from the original designer, the Chinese-built ship -- I've forgotten the name -- appears to have been designed to have a watertight door. So the designer's intention was it had a watertight door. And I believe the first ship was built with a watertight door.
THE CHAIRMAN: That being Eastern District, I think.
A. Thank you, that's correct.
MR SHIEH: Which was the sister ship the plans of which were subsequently shown to Mardep when they tried to expedite the process, which we saw yesterday?
A. Indeed. I do not know for certain that vessel was built with a watertight door, but the plans certainly show it with a watertight door. So the designer's intention

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I think was quite clear.
Q. Let's test that further. Let's say on the scenario, let's say if it is found that as far as the Lamma IV is concerned, the intention was actually to have no watertight door, so when Mardep spots the absence of a watertight door as built, it raised the problem with the builder and they say, "Oh, the plans were a mistake. We actually want a vessel with a bulkhead there, but with a hole. It passed all the calculations criteria, except that there is now a bulkhead with a hole. So please pass this vessel, because it has passed all the numerical tests. It passed all the minimum standards." Let's say they argue the toss with Mardep. What would you say should be the proper response, bearing in mind what you've said just now about people trying just to design to minimum standard?
A. I would expect to do a floodable length calculation, which would indicate, if it was done correctly, that a watertight door made no difference, as we have heard.
Q. But should Mardep have then said, "Look, irrespective of floodable length calculation, there's a bulkhead there, and if there's a bulkhead there, I would expect that to be watertight"?
A. Thank you. I was about to say that very same thing: there's a requirement for a bulkhead to be there, so it

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should be there. One has to ask, why build the vessel with the bulkhead? It serves no structural purpose. It serves no real purpose that I can think of.
Q. If it has a hole in there?
A. If there's a hole in it.
Q. Thank you. I have been kindly reminded by Mr Beresford -- because yesterday we discussed the question of whether or not there may be some requirements to submit as-built drawings after the vessel had been built. My attention was drawn to a requirement in the specification. Can we have a look at marine bundle 10, page 3307. This is the tender specification. If you look at page 3304 first, the cover sheet:
"Tender Specification for One 28M Aluminium/GRP Passenger Launch for The Hongkong Electric Co Ltd. Cheoy Lee Shipyards ... 1994."
That's the tender that was put in. It's really clause 9 at page 3307:
"All important working drawings together with stability and floodable length calculations, et cetera to be submitted to Mardep ...
Upon completion of the vessel, two copies each of necessary 'As Fitted' drawings to be provided as follows ..."

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General arrangement, hydrostatic curves, docking plan, et cetera.
I've been reminded by Mr McGowan to read 9-2 as well:
"All departures from the specifications or drawings, together with modifications in costs, if any, to be mutually agreed to, before the work is commenced."
Do you see that?
A. I see that, yes.
Q. Would you read that to mean that even though you can agree to depart from the originally submitted or approved plans, after the ship was built, you still need to submit as-built plans, perhaps reflecting what had been agreed by the parties to deviate from the original plans?
A. Yes, I can see that, Mr Shieh. However, if I remember rightly, we were talking about thickness of material at the time, and I don't see here the drawings, Profile and Deck, saying that it should be 5 mm thick.
Q. I'm talking about the door.
A. You're talking about the door? I thought when we were talking about "as fitted" we were talking about thicknesses.
Q. Yes, but "to be provided as follows". Would the General Arrangement plan show the presence or absence of a door?

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Let's say if the ship as built has no door, it would have been revealed in the General Arrangement?
A. The General Arrangement does show the door opening. However, it would be only evident to those skilled in the art, if I might put it that way, because it is just two small lines on the plan view.
THE CHAIRMAN: The two triangles pointing at each other --
A. The two triangles, correct.
THE CHAIRMAN: -- that's a door.
A. Correct.
THE CHAIRMAN: In what's described as a watertight bulkhead.
A. In what's described as a watertight bulkhead, but that is a symbol for an opening.
THE CHAIRMAN: Yes.
MR SHIEH: But if the ship as built had no watertight door, then the depiction, the symbols would have been different?
A. I think there will be no symbol at all, in that case.
Q. Yes. So there will be a difference between a plan showing a door and a plan showing no door?
A. There's not really any convention, Mr Shieh, so it's hard to be sure on that.
THE CHAIRMAN: But if you'd built it without a door in this hitherto-described watertight bulkhead, wouldn't you change the description of "watertight bulkhead"?

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A. Almost certainly you should do, yes.
THE CHAIRMAN: That's what would be in the as-fitted or as-built drawing?
A. But there are no as-fitted drawings there that I can see that would indicate that it was watertight or non-watertight. There are no structural drawings required in the as-fitteds. So nowhere on those drawings listed (a) to (k) and the calculations (a) to (k) would there necessarily be appearance of the word "watertight". Unless they're on the General Arrangement, and I'm sorry, I can't recall.
MR SHIEH: Sorry?
A. Unless they are on the General Arrangement, and I'm sorry, I can't recall that.
THE CHAIRMAN: But are there any as-fitted or as-built drawings, as opposed to the drawings that were created prior to the physical construction of the vessel?
A. Not that I'm aware of, Mr Chairman.
THE CHAIRMAN: The drawings we have been looking at are stamped "approved" by the Marine Department in May 2005.
A. (Witness nods).
THE CHAIRMAN: The keel was laid in June 2005.
A. Yes, sir.
THE CHAIRMAN: And the vessel built, the steel hull built after that. I think the China Classification survey is

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dated 6 September.
A. I'm not aware of any drawings later than the approved drawings.
THE CHAIRMAN: No. That would mean, then, that there are no as-fitted or as-built drawings?
A. I have not seen any, so I believe you're right, sir.
MR SHIEH: Could I bring your attention to what might appear to be an as-fitted drawing. In expert bundle 2, this is in Mr Wallaston's report which Hongkong Electric have submitted, Mr Chairman, at page 983. This I think is taken from Lamma Power Station Library, because you can see it at the top corner on the right-hand side.
THE CHAIRMAN: Just give us a moment, please.
A. It also has the words "As Fitted" on it.
MR SHIEH: "As Fitted", yes.
MR GROSSMAN: Mr Chairman, I don't know if it's of relevance, but I did indicate we may very well not seek leave to call this witness.
THE CHAIRMAN: No. You made that clear.
MR GROSSMAN: I just mention that in case it thought --
THE CHAIRMAN: Thank you very much. You made it very clear. In fact I think you said it was unlikely.
MR GROSSMAN: And that still remains the position.
MR SHIEH: I think I can indicate that there are very few areas of disagreement (if any).

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THE CHAIRMAN: Which page are you looking at?
MR SHIEH: Page 983 of expert bundle 2.
Mr Chairman, you can see, bottom right-hand corner, it's "General Arrangement (As Fitted)", and in the underdeck plan -- how would you interpret the underdeck plan, Dr Armstrong --
A. Well, it is difficult to --
Q. -- and the profile?
A. In profile, it looks like a watertight bulkhead, in profile. In plan view, on the lower underdeck plan, as it's called, you can see, not very clear, but there are two triangles there which would indicate to me an opening in the bulkhead.
Q. Which was the same as in the original General Arrangement plan, as we can see in marine bundle 2?
A. Yes, it's the same.
Q. You remember that? We can compare that, marine bundle 2 at page 172. You can see that?
A. Yes.
Q. So, same shape?
A. Same thing.
Q. Which, as you say, used a symbol which conventionally denotes a watertight door?
A. That symbol would indicate to me an opening.
Q. An opening, sorry, an opening. But with no indication

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whether or not it is watertight? It's an opening, yes, but it's neutral as to whether or not it's watertight?
A. I have seen the same symbol used with the words "WT door" against it, but when I see it like that, it tells me there is an opening.
THE CHAIRMAN: So what it tells you is that there's an opening in what is described as a watertight bulkhead?
A. That is a contradiction that means it's not a watertight bulkhead anymore, Mr Chairman.
THE CHAIRMAN: It doesn't remain a watertight bulkhead unless there is a watertight door fitted to the hole?
A. Yes. It's built as if it were a watertight bulkhead and then they've put an opening in it, yes.
THE CHAIRMAN: That's how you read the as-fitted plan?
A. That's how I read the as-fitted plan.
THE CHAIRMAN: That it has been built with a watertight bulkhead because the door is a watertight door?
A. I cannot tell from this plan for certain that it is intended to be a watertight bulkhead. I can only say the line indicates to me there is a bulkhead there. There is a difference, Mr Chairman, between a watertight bulkhead and a non-watertight bulkhead. The non-watertight bulkhead may have -- where the stiffeners pass through, for example, they will not have what are

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called collars welded on. There's a lot of extra work needed to make it watertight around the stiffeners that run along the deck plating and the side plating. So a line does not necessarily, when drawn like this, indicate that it is watertight.
THE CHAIRMAN: Do any of the lines on these drawings indicate that the other bulkheads are watertight?
A. No, sir. You'd have to look at the structure drawing. A reasonably competent naval architect, however, would assume that they were watertight.
MR SHIEH: Of course we know in the approved plans, in the other part of the approved plans, Profile and Deck and the other plans that we have looked at in marine bundle 2, there are numerous other notations indicating "WT"?
A. Yes, indeed. Everywhere where you would expect to see an indication, if it was intended to build them as watertight, they are nominated as watertight.
Q. So would it be the case that in a General Arrangement drawing like this, the focus is not going to be on the details of whether or not something is watertight?
A. A drawing like this is really to get the intention of what the owner wants across to everybody in the builder's organisation. It's a way of showing that this is the vessel that is required. It doesn't usually

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fulfil much of a legislative purpose, other than to describe the vessel: it has one hull, not two hulls; it has a superstructure; the people are above the decks. A sort of general overall impression. It shows you where the engine room is relative to everything else. It would usually be rather foolish to take dimensions off a General Arrangement, for example, and then assume you could construct the vessel from it.
I think one of the few useful purposes of a General Arrangement concerns life-saving. Quite often the General Arrangement may be used to indicate correct positions of life rafts and lifebuoys and the like, and used for production of something called a safety plan, which looks very like a General Arrangement.
Q. Because we have looked at the other plans. If you want me to turn it up, I can. We've looked at the Profile and Deck plans and we've looked at the Sections and Bulkheads plans. They had all clear notations "WT", and significance is placed on the fact of solid lines or differently appeared dotted lines. Do you remember the discussion?
A. Yes, I remember the discussion. As I said a short while ago, everywhere where you would expect to see that a bulkhead was required to be watertight, it does say on the plans "watertight bulkhead", or indicates that it is

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watertight.
Q. Whereas in the General Arrangement plan, we don't have notations of "WT"; all we have are various solid lines. I'm just interested in the significance to be attached to depictions of lines in a General Arrangement plan, as opposed to Profile and Deck and Sections and Bulkheads plans, in the sense that in General Arrangement plans, would you expect to find detailed requirements of watertight doors and things in the General Arrangement plan, or would those sort of things be expected to be found in the more detailed plans such as Profile and Deck and Sections and Bulkheads?
A. There is some information on the General Arrangement when it comes to watertight integrity, but they're usually to do with weather-tight -- without going into the definition of weather-tight, it's a lesser standard than watertight. It basically means keep the rain out, or water from someone using a hosepipe or something like that. And the hatches you can see on this particular General Arrangement drawing are marked as "weather-tight".
But as for watertight, I would assume that all of the lines shown on the underdeck plan running athwartships were watertight bulkheads but I would note the opening in the steering gear/tank room bulkhead and

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say that one isn't, and then I would find out by other means which of the other bulkheads were watertight by going to the structural plan.

Q. Profile and Deck or the other one, Sections and Bulkheads?

A. Yes, Profile and Deck.

Q. Thank you. Dr Armstrong, could I now leave the rather heavy topic of bulkheads and calculations and return to your first report, that part horn and whistle at page 428 of expert bundle 1.

Paragraph 68. You discussed what you saw in the wheelhouse on Lamma IV and where various horn or siren buttons can be found:

"On inspecting the vessel I also examined the wheelhouse and control console. I noted a push-button clearly marked 'Horn' on the right-hand side of the console immediately in front of the helmsman. On investigation I noted that the connections of the electrical cables to the push-button were corroded, as were many of the other connections to other equipment on the console. With a 24-volt connection it is generally important to keep the connections clean to ensure satisfactory operation. The connections to the horn push-button are shown in appendix IV, item 13."

Which is page 468 at the bottom. So we can see the

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corrosion here, can we?

A. Yes, I believe that's quite clear.

Q. Under the horn button?

A. Under the horn button you can see some blue powders which are typical of copper deposits because of corrosion of the copper contacts.

Q. Yes.

"It was noted that there is a second button marked 'Horn' and a third button marked 'Siren'. These additional buttons are part of the control panel for the loud hailer. The loud hailer control panel is on the port side of the helmsman ... It is not known which button is claimed to have been pressed by the coxswain immediately prior to the incident. It might reasonably be assumed that the 'Horn' and 'Siren' buttons on the loud hailer panel would not operate if the loud hailer was switched off, and there is no requirement that I am aware of for it to be switched on during normal operation."

Could we turn to page 469. When you say the control panel for the loud hailer being on the port side of the helmsman, that is the panel marked "Also marked Horn Button?"

A. That's the one, yes, on the right-hand picture, on the left-hand side of that, marked "Also marked Horn

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Button?"

Q. The left-hand picture is a close-up of the loud hailer panel?

A. It is a close-up, yes. And I've marked on there in the middle at the bottom, there's a button marked "Horn", with the words "Also marked Horn Button?", and the button above that is marked --

Q. We need a close-up to see "Siren". I can see it on paper, but --

A. Yes. The button above that is marked "Siren". I do not know the difference between horn and siren but I might guess that the siren might be some automated function like a fog horn that goes off every so many seconds, or it may be a police-type siren. I have no information.

Q. But the point you're trying to make is that you have read that the coxswain of Lamma IV alleged or asserted that he had pressed a button to sound a horn prior to the incident. But of these buttons, you could not figure out which might have been a button that he had pressed. Is that the point?

A. The point I was trying to make, sir, is yes, I read the coxswain had claimed to have pressed the horn button, and I was unable to find anybody who had heard a horn button. I was in the wheelhouse and I wondered whether there was any reason why, if he had pressed it, it

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hadn't sounded. So this was my conclusion. If he had pressed the horn button on the right-hand side of the panel, maybe it didn't sound because of the corrosion.

I also inspected the connections, as far as I was able to, to the speaker above the wheelhouse. I noted that it was an IMO-approved one and therefore should have been suitable. But I came to no conclusions about whether it was working or not.

Q. It was no longer possible to switch the power on to test whether they were working?

A. Getting a bit outside my expertise, Mr Shieh.

THE CHAIRMAN: If the coxswain had pressed the button in the wheelhouse, you'd expect him to be able to hear his own siren, would you not, or his own horn?

A. He would have been able to, and there was a witness that I referred to earlier who was looking down at the wake, you might recall, Mr Chairman, and noticing it was a white colour, and he was stood on the after deck and the horn was right in front of him, and it's a large horn, and he would have been well aware whether the horn went off or not, as would anyone else on the open deck. Mr Tang --

THE CHAIRMAN: We're yet to hear from him.

MR SHIEH: That is Mr Tang, I believe, who observed the wake, Mr Chairman, who will be here on Friday.

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THE CHAIRMAN: Yes. But in your opinion, anyone on the open deck would be able to hear this?
A. It would have been astonishingly loud up there, sir. I think the horn is 131 decibels, it's required to be. I cannot be sure of the number, but I seem to recall that. For a vessel of this size. That would have been very loud for someone a mere 5 metres away, perhaps.
MR SHIEH: Thank you, Dr Armstrong.
THE CHAIRMAN: We have some information, do we not, about the various horns, or at least this box on the left --
MR SHIEH: The manuals?
THE CHAIRMAN: -- on the screen that we're looking at, by virtue of the manuals. Have you seen the manuals for the device on the left? I think it's called a Horizon.
A. I have not, sir, no.
THE CHAIRMAN: Was that not provided by Mr Grossman? I see Mr McGowan nodding. Can you give me the page reference?
MR McGOWAN: I can't immediately, sir, but we'll dig it out.
MR SHIEH: Perhaps I can carry on with other parts of Dr Armstrong's report, and once the reference is available I can show that to Dr Armstrong.
THE CHAIRMAN: Yes, certainly.
MR SHIEH: Dr Armstrong, I move on to the subject of life jackets, which is in your first report, paragraph 69, page 429. You say:

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"I was invited to comment on the ease of donning life jackets as fitted to Lamma IV ... It was obvious to me that a life jacket was under the seat, because it was clearly visible in a yellow carrier marked 'life jacket' in English together with some Chinese characters. I was conscious that it was daylight, whereas the accident happened at night-time. Removing the life jacket from its carrier was a simple process and putting it on was also obvious to me. I knew that it was important to restrain the life jackets from riding up and choking the wearer when in the water, and that it needed restraining in some way, but the method of tying the relatively long tapes which were attached to the life jacket was not obvious. Eventually I worked out that they needed passing around the body and tying together. I have donned similar life jackets on several occasions in the past during evacuation trials, and accept that it would not be obvious to someone who was not familiar with the various life jackets. It is standard practice in many other countries to have a demonstration at the start of any voyage on how to don a life jacket. I was subsequently invited to comment on the effects of the long tapes of the life jackets, and I am of the opinion that the length of the tapes would have represented a significant safety hazard to anyone donning a life

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jacket in a hurry, because of the large number of open seat legs which would have entangled the tapes. A demonstration of how to put on the life jackets would not have solved this problem."
Dr Armstrong, could I perhaps ask you a few questions out of this. You say:
"It is standard practice in many other countries to have a demonstration at the start of any voyage on how to don a life jacket."
Practically speaking, you would not expect all vessels carrying passengers to have such a demonstration? And if so, where would you draw the line? Let's say the Star Ferry. You wouldn't see demonstrations on the Star Ferry. It may be a rather silly question, but how would you draw the line, where would you draw the line?
A. It's a rather interesting question. My experience has been that you always get a demonstration before setting out on a voyage, on a vessel carrying passengers. I'm mindful of a relative of mine who lives on an island which is 100 metres away from the mainland, and the little 20-foot launch that runs across there does give a demonstration every time, every 10 minutes that it sets off.
THE CHAIRMAN: In which jurisdiction is that?

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A. That's in Australia. It's actually the New South Wales jurisdiction. However, quite impractical for the Star Ferry, I agree. I don't know where to draw the line, sir.
MR SHIEH: Or the ferries to Staten Island in New York State; you wouldn't see a demonstration.
A. No.
THE CHAIRMAN: What about the ferry to Fremantle, where you live?
A. There is a ferry runs from Fremantle to Perth, and no, there is no demonstration on that vessel.
MR SHIEH: But that's why I wish to test that a bit, because the --
A. Then maybe the -- and this is hypothetical. Maybe the delineation can be on the area of operation and whether it's protected smooth waters, and the number of other craft in the vicinity.
Q. Because the Commission will be tasked with making recommendations, and I simply wish to assist the Commission in seeing where any lines can be drawn. Because we can draw on our daily experience. Hong Kong-Macau ferry, you do see --
A. That's an international voyage, of course.
THE CHAIRMAN: And that's by way of a short video?
MR SHIEH: Yes. Yes.

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A. It's required on an international voyage by IMO.
Q. It's because you said "of any voyage" that I raised that point, so the line is hard to draw.
A. Yes. Maybe I should withdraw the word "any" in that case, because I've just been reminded by Mr Chairman that I know of an example where it's not done.
Q. Perhaps I can test you a bit in seeing where the line can be drawn, because for a vessel like the Lamma IV, where day-in, day-out, it takes people from, let's say, Central to where they work, which is the Lamma Island Power Station, users would be regular users and they would be well familiar, and they are adults not travelling with family. Whereas on a special-purpose leisure trip like this, we are talking about a different category of passengers altogether. Would that be a relevant criteria?
A. Yes. The difference between those had crossed my mind. I'm not sure about the regulations for launches in Hong Kong, and how they might differ from ferries in regard to life jackets and so on. A vessel that was used like a launch to regularly take the same people on a trip one could assume would not need a continuous demonstration of life jackets on a daily basis. But the vessel wasn't being used in that way at the time of the accident.

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THE CHAIRMAN: So one issue that then is relevant is if the normal use is changed for a special event, it might be safe, safer, to require a demonstration in those new circumstances?
A. I think you're correct, Mr Chairman, yes. I also note some of the statements I have read, translations of statements, whereby people who regularly travelled on the Lamma IV in the course of their normal business assisted other people to put on their life jackets. So the people who were regular travellers knew how to do it.
MR SHIEH: At the bottom of this paragraph, you said:
"A demonstration of how to put on the life jackets would not have solved this problem."
"This problem" being the tapes being too long?
A. The tapes being too long, and the seats on board had thin open legs, and there were a lot of them. And there were rails, and the tapes could easily entangle around them.
So I did not like the mix of the life jacket tapes and the seats. That could be solved by changing the seats, of course, but the mix of the two is not at all suitable.
Q. And the reason why demonstration would not have solved the problem is that, even though you have done a pristine job in putting on the life jacket, it's beyond your control, beyond any demonstration to prevent your tapes from being caught.

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A. Yes, and are the people sitting down or standing up when they put on their life jackets? Some of them would have been sitting down, because they had to sit down to get the life jackets from underneath. If they stayed sitting down, then the tapes were hanging down amongst the seat legs.
Q. Thank you.
A. Although I don't make a comment in this paragraph about the plastic bag, I did note that the one that I undid was indeed in a grey plastic bag, and I just ripped it apart without any problems. It was so trivial I didn't mention it.
Q. Dr Armstrong, I now move on to the next --
COMMISSIONER TANG: Sorry, before we move on, can I ask Dr Armstrong a question about life jackets.
Dr Armstrong, I'd be interested to seek your advice about the functions of life jackets, lifebuoys and life rafts. Basically, the provision of such safety equipment on the vessel, how would it be calculated in terms of the number of passengers? Do they perform the same functions?
A. No, sir, they don't provide the same functions. In my

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experience, lifebuoys are traditionally used for throwing towards people in the water, and they are designed to be thrown, not necessarily people from your vessel. You may come across some other vessel, for example it's on fire so people have jumped into the water, so you would throw lifebuoys at them and I believe that happened from Lamma II, that they threw lifebuoys at Lamma IV.
I have never come across another jurisdiction where lifebuoys were also included amongst the life-saving appliances on board your own boat. Under legislation here -- I'm sorry, not legislation. Under the Instructions here I see that there was an allowance that two passengers per lifebuoy were assumed. I've not come across that sort of regulation before.
THE CHAIRMAN: And that counted towards the total of in effect life jackets required?
A. Exactly, yes.
THE CHAIRMAN: So if you had 220-odd capacity, you could have 100 lifebuoys, and that counted for 200 life jackets?
A. Correct, sir, yes. I've not come across that before. In the Australian jurisdiction, with which I'm familiar, and the UK jurisdiction, you have to have 100 per cent life jackets. In fact you have to have more, because

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you need children's life jackets as well.
With regard to the life raft, the life raft -- it's a bit of a strange one because the life raft is required on ocean-going vessels, for example, such that it automatically releases, and I believe it did automatically release on Lamma IV.
THE CHAIRMAN: This is hydrostatic release?
A. Hydrostatic release, so that as soon as it goes underwater, it releases, which is good to know that it did do that. But I can't see it being of a lot of value when you have a six-man, or whatever number it was -- it was quite small -- inflatable life raft, when you have 200 people on board. It seems to be of very limited value.
COMMISSIONER TANG: Thank you.
THE CHAIRMAN: Before we move on, I'd like you to have a look at one of the life jackets that's been given to us. Apparently the employees of Hongkong Electric expressed concern about the life jackets, they being the people on board the Lamma IV, together with their friends and family, and the result was that they were permitted to choose, apparently, a life jacket which will be used on a vessel which is yet to be commissioned for use. I'd like you to have a look at the life jacket they've chosen.

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The jacket you will see, as it reaches you, is of a solid foam buoyancy and has a front buckle across the waist and another fastening device higher up on the chest. (Handed). You'll see that they are in effect like Neptune's harpoon -- that they click in, the male fitting fits into the female receptacle.
A. Yes, sir.
THE CHAIRMAN: Therefore, quite obviously, they're easily fitted within seconds.
A. And I see has a wheel certificate, so is approved certainly for use in Europe.
Mr Chairman, I was involved in the investigation in an unofficial capacity on the loss of another vessel called Sleipner. I was involved because I was working for the company that was building this vessel. Three weeks after delivery into Norway, Sleipner ran onto a rock at night-time in very heavy weather, with a result of six fatalities.
The Court of Inquiry report I'd like to refer you to, because one of the criticisms was of life jackets with buckles on. For the reason that people were jumping off the vessel into the water, and because the buckle on that particular design, which is not necessarily the same as this one, but the buckle did not allow the jacket to be pulled tight, as a result of

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which when people jumped into the water, the jacket came up over their heads and unfortunately that was the result of at least two known fatalities.
These are meant to be tested and they are tested in the laboratory, and they are correctly tightened. And that's not necessarily what the public will do when they put them on. So this jacket to me looks quite good, but I do wonder about the thickness of this top tape and whether it's going to secure the top part adequately.
THE CHAIRMAN: There is a device -- you're demonstrating it right now -- to tighten it yourself, is there not?
A. There is a device which easily allows you to tighten it, but I think it's also reasonably flimsy and easily brought apart (demonstrates), which just made me think about -- it's probably worthwhile getting an expert in in this area of life jackets, and there are some that I can refer you to.
THE CHAIRMAN: Thank you for that. Perhaps you can provide us with the part of the report you say is relevant to this issue.
A. I no longer have a copy of the Court of Inquiry, because I left that with my previous employer. But it may be possible to get one off the internet for you.
THE CHAIRMAN: Was this a Court of Inquiry in Australia or in Norway?

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A. It was in Norway, sir.
THE CHAIRMAN: Thank you.
A. There were also some other findings which you may find useful.
THE CHAIRMAN: Thank you very much.
MR SHIEH: So perhaps the link, or if it doesn't cause you too much inconvenience, printing it out or giving the Commission the link so that we can make arrangements for that to be produced.
A. This looks like it's easy to put on, I must say. Easy to fit.
THE CHAIRMAN: Thank you.
MR SHIEH: Dr Armstrong, could I now move on to hopefully the penultimate subject, which is "Stability and Ballast", paragraph 70 of your first report, page 429:
"The stability of a ship is generally understood by those skilled in the art of ship design to mean the ability of the craft to return to the upright position when disturbed in a transverse direction (ie rolling or heeling). Stability does not generally involve the trimming effects evident in the sinking of Lamma IV. I have examined the stability details of Lamma IV and I am of the opinion that the transverse stability was adequate ..."
Then paragraph 71 of your first report, I think you

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have actually replaced that by a new paragraph which we can find in your second supplemental report at page 924; correct?
A. Correct.
Q. Could I turn that up. The second supplemental report, page 924. In paragraph 2 of this, you said:
"In paragraph 71 ... I identified the role of ballast in changing the trim of the vessel ... It has come to my notice that it is not clear that my intention was to refer only to intact stability, and that the effect on the damage stability is not adequately addressed in my report. I therefore withdraw paragraph 71 of my report, and replace it with the following paragraphs:
...
Solid ballast is sometimes added ..."
So you replace paragraph 3 of this report, and also paragraph 4?
A. I'm sorry, paragraph 3 and paragraph 4 of which report?
Q. The second supplemental.
A. Paragraph 3 --
Q. Because you used the plural "the following paragraphs", and that prompted my question as to whether you intended to replace paragraph 3 with paragraph 71 only, or paragraphs 3 and 4 to replace paragraph 71?

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A. 3 and 4, sir.
Q. 3 and 4 together?
A. Yes.
Q. So paragraphs 3 and 4 are to be read together and they together replace paragraph 71 of your first report; correct?
A. Correct.
Q. Thank you.
"Solid ballast is sometimes added to a craft to improve the intact transverse stability by lowering the centre of gravity. If ballast is added for this reason, then it can have serious outcomes if it is removed or relocated. On Lamma IV, 8.25 tonnes of solid lead ballast was added to the craft in October 1998 (and subsequently repositioned on 21 September 1995). According to the submission letter from Cheoy Lee Shipyards, the ballast was added to improve the running trim of the vessel. Because the stability book indicates that Lamma IV had adequate stability characteristics before the ballast was added, and because it was added as far aft as possible, I am of the opinion that the solid ballast was added to improve the trim and not added to improve the intact transverse stability."
So it's not added to deal with sideways movements?

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A. Correct. I was merely confirming what Cheoy Lee had claimed in their submission letter.
THE CHAIRMAN: May we see that letter of 10 March 1998?
MR SHIEH: It's footnote 1, and that is marine bundle 3, page 428. That's the letter informing Mardep about the intention to add 8.25 tonnes.
Dr Armstrong, you've seen that and you referred to it in footnote 1?
A. Yes, sir. The reason I highlighted that was because ballast is treated, in my opinion, it appeared, by the Marine Department in a very serious fashion. It's even mentioned in the licence how much ballast is on board and is it in the right place, and it's even mentioned in the annual survey. So obviously Mardep was in the habit of treating ballast in a rather serious fashion, as they should. But usually ballast is added for stability reasons. In this case I was highlighting that it was added for trimming reasons. Of course, it also improved the stability.
THE CHAIRMAN: And you take it that it's for trimming reasons because that's the description of ballast: it's "trimming ballast". Is that how you reached that conclusion?
A. That's how I came to the conclusion. Also because it had been added about as far aft as physically possible,

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which wasn't as low as physically possible, and if you wanted to improve the stability, you would add it low down.
THE CHAIRMAN: Yes. Thank you.
MR SHIEH: This letter enclosed an earlier form of what may be called the damage stability calculation, whereas the final version we can see is at page 472 of the same bundle. This is not to ask you any question but simply to inform you that this letter enclosed a set of damage stability calculations, but the final form is the one at page 472, which I believe you have seen, Dr Armstrong.
A. Yes. In fact I think there's a previous letter, Mr Shieh, which informs the Marine Department they are going to do this.
Q. Informs the Marine Department they are going to do what, sorry?
A. Put some trimming ballast in.
Q. You mean before the 10 March letter?
A. Could we see the 10 March letter again, please?
Q. Page 428.
A. Yes, okay. That seems to be the advisory letter.
THE CHAIRMAN: Although it does say "We wish to keep you informed". Well, perhaps that could be investigated over the mid-morning adjournment. If that's --
MR SHIEH: I can see the query. "Keep you informed"

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presupposes that they had been informed previously. On the other hand, it may well be that if there was previous informing there would be a reference to a previous letter. But we'll follow that up.
THE CHAIRMAN: Yes. If that's not inconvenient, we'll take the morning break now.
Dr Armstrong, we'll take a break now for 20 minutes.
MR McGOWAN: Sir, I do have the details of the loud hailer system here.
THE CHAIRMAN: Yes. Perhaps you'd give that to counsel and we can deal with that when we come back.
MR SHIEH: Yes. I have the reference and I'll let Dr Armstrong know.
THE CHAIRMAN: Thank you.
(11.32 am)
(A short break)
(11.51 am)
MR SHIEH: Mr Chairman, just to report, in relation to deriving the point about the coverage or the applicability of the legislation or the inapplicability of the legislation to local vessels, I tried to read out a particular section in the current Ordinance to Mr Chairman but then I have been told that -- these are the sort of things that everyone takes for granted, it doesn't apply. But when it comes to actually deriving

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it chapter and verse, it may actually take a bit of time tracing through various old ordinances. So perhaps we can shelve that without taking up time during Dr Armstrong's evidence, because that's a matter we can deal with --
THE CHAIRMAN: Yes, that's a matter simply ---
MR SHIEH: That's a matter we can deal with by tracing through various legislation.
THE CHAIRMAN: That's simply a matter of law.
MR SHIEH: Yes. Thank you.
Dr Armstrong, over the mid-morning break you might have been swamped with documents that various people wanted you to look at, one being the horn or the loud hailer manual in police bundle O, and the other are some calculations lately done by Dr Peter Cheng concerning aluminium plate thickness.
A. Yes, sir.
Q. Let's put them to one side, because I want to go through what you have written by way of your written reports to the Commission, and then we can pick up those loose ends.
Before the mid-morning break, we were dealing with the question of ballast, in particular the purpose of adding the ballast in 1998. The track down the paper trail to see whether there had been any prior

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notification will continue but at least for the letter we have looked at it says "trim ballast", and from the location of the ballast added, you took the view that it has to do with trim and not transverse stability?
A. Correct. I did spend a bit of time during the break looking for what I thought was a previous letter, but I now believe there was no previous letter. There was a letter returning the Stability Book approved, which referred to the trimming ballast, which is what I was thinking of.
Q. Returning from Mardep?
A. From Mardep, the approved stability.
Q. Could we look at page 924 of expert bundle 2, at the bottom:
"As was required by Mardep, a new stability book and a new damage stability book were recalculated and submitted for approval when the ballast was added in 1998 and again in 2005 when it was shifted. A visual check of the solid ballast in Lamma IV indicated to me that all of the nominated ballast was in its designated position at the time of the collision."
THE CHAIRMAN: Before you move on, do we have a photograph that shows us where the ballast was when raised?
MR SHIEH: Perhaps that can be checked. Mr Beresford is trying to locate that.

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A. There are some photographs in the police album, in the damage --
MR SHIEH: I was told the omnipotent marine bundle 1 has the answer at page 160 and page 164. Perhaps we will look at page 160 first, the bottom.
Dr Armstrong, those are the ballast forward in the tank room?
A. In fact they're in the aft part of the tank room, but forward of the freshwater tank.
Q. Yes, forward of the freshwater tank in the tank room.
A. And aft of the fuel tank.
Q. Aft of the tank room but forward of the freshwater tank; correct?
A. In the after part of the tank room, immediately aft of the fuel tank and forward of the freshwater tank.
THE CHAIRMAN: So that's consistent with your earlier observation as to the purpose being trim, not stability? They were putting this ballast as far back as it could be put?
A. Indeed, and there is some more ballast in the steering gear compartment.
MR SHIEH: At page 164, steering gear compartment.
A. Although this of course has moved, as might be expected, when the vessel was in a more vertical position.
Q. Yes.

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A. There was also a fair amount more ballast underneath the mud that you can't see.
Q. Under the?
A. Under the mud.
Q. Right. Which we can't see.
THE CHAIRMAN: So there was no top casing on top of the ballast boxes?
A. Not that I was aware of, no, sir.
THE CHAIRMAN: Which is perhaps why we have -- that photograph at page 164, the ballast is scattered around, is it not?
A. To some extent, yes.
MR SHIEH: Dr Armstrong, reading on, paragraph 4 of your second supplemental:
"Effects of Weight increase
According to the revised stability book, issued after the ballast was added, the lightship weight increased substantially from 48.7 tonnes to 63.6 tonnes, representing more than a 30% increase. I consider this to be a substantial increase. Although the ballast weighed 8.25 tonnes, there must have been additional changes made to the vessel to account for the remaining 6.7 tonnes, which are of unknown origin, although it is believed that additional fendering was added to the ship side. The effect of this large increase in lightship

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weight was for the vessel draft to increase, with a consequent decrease in the vessel freeboard. The vessel waterline length also changed, but this does not appear to be reflected in any of the documentation nor in the certification. Although the effect of the additional weight on intact stability was to lower the centre of gravity and hence increase the intact stability characteristics, the effect on damaged stability and on the watertight subdivision was that the floodable length reduced, and the margin line immersed at a much lower angle of heel or trim, subsequent to damage. This fact does not appear to have been fully appreciated by those carrying out the work, nor by Mardep in approving it."
As the calculations show, after adding the ballast, if we treat tank and compartment together, margin line test failed?
A. Correct.
Q. Could I take you to paragraph --
THE CHAIRMAN: Before you do that, could we have a look at the Revised Stability Book that indicates, provides the basis for the observation that the lightship weight had increased from 48.7 to 63.6 tonnes?
MR SHIEH: Yes. Could we have marine bundle 3, page 428. That's the March letter. The weight of the ballast that was added is page 430. You can see lightship weight

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being 48.74. The ballast added is 8.25 tonnes. But the ultimate, the resulting lightship weight of 63.6 -- I'm trying to locate the 63.6.
THE CHAIRMAN: Dealing with page 430, Dr Armstrong, the bottom of that page, lightship is there described as 58.44, is it not?
A. Yes, it is, Mr Chairman, and that's rather interesting. I'm actually quoting from a different stability booklet.
THE CHAIRMAN: Well, this was the one enclosed with the letter of 10 March.
A. The one I was referring to has the trimming lead ballast, but I don't believe on the front cover mentions vertical fenders.
MR SHIEH: My attention has been drawn to -- there are a number of different references to the figure of 63.6. Mr Lui has given me one, and Mr Beresford has given me the other.
Could you look at page 466. Dr Armstrong, you see that?
A. Which is the original Stability Book; is that correct?
Q. This is one sent by Cheoy Lee to Mardep on 20 October, "copies of Inclining Experiment and Stability Calculation".
A. Thank you, yes.
THE CHAIRMAN: Perhaps we could pick that up so we can

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follow this step by step. Page 455 is the letter. Now we're in October, not March.
A. I believe I can resolve the riddle. If I remember rightly, Cheoy Lee submitted a new estimated stability book in March where they said they were going to move the ballast and this is what would happen, and Mardep responded with a letter saying, "You're going to have to do the inclining again", and therefore we see at page 466 the stability book that was finally submitted.
MR SHIEH: The letter from Mardep is at page 450. Mardep referred to the March letter concerning 8.25 tonnes of ballast, asking for inclining experiment. So your recollection is correct, Dr Armstrong. Mardep asked for inclining experiment "in the presence of Mardep ship surveyor/inspector", and returning one copy of each of the following items, and included within that is Revised Stability Booklet and Estimated Damage Stability Calculation. That's the one you have in mind, Dr Armstrong?
A. Yes, correct. I believe the one at page 466 is the --
Q. Stability calculation with --
A. Page 463 is the better one. It's the lightship calculation of the vessel with the lead ballast added, showing lightship of 63.618.
THE CHAIRMAN: Is there any explanation in the material here

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for the other 6-odd tonnes of extra weight?
A. Not that I'm aware of, Mr Chairman, except that there is some mention in the file about adding the fendering. But I have not seen an estimate of the weight of the fendering.
THE CHAIRMAN: Thank you.
MR SHIEH: I believe it's a question that had been asked of Mr Lo during Mr Lo's testimony. I think Mr Lo agreed to actually go back and check and provide an answer, and couldn't find an answer.
Be that as it may, Dr Armstrong, so that is the material based on which you came to identify the problem, adding 8.25 tonnes of ballast but resulting in an increase to 63.6 tonnes.
Could I also ask you to look at page --
THE CHAIRMAN: Before we move on, could we have page 450 on the screen. This is the Mardep reply to the first indication from Cheoy Lee that they are going to add 8.25 tonnes of ballast, providing the estimated figures, and then Mardep is replying. Can I ask you for your reaction to this, in the second paragraph:
"Please be advised that the lightship particulars will be changed dramatically when such quantity of ballast is installed on board. In this regard, an inclining experiment is required to be conducted,

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under the ballasted condition, in the presence of Marine Department ship surveyor/inspector."
What do you read into that middle paragraph as to the Marine Department reaction?
A. Quite a responsible reaction, and they were requiring the inclining in order to come up with a new intact stability book. I don't read into that that they would then assume that there was a need for a damage stability book, sir.
THE CHAIRMAN: But alert to the fact that this was --
A. A major change.
THE CHAIRMAN: -- a major change in the vessel?
A. Yes, thank you, you're right. I've also noted on page 430 -- 430 represents the booklet that was sent in advance of the lead being added, which was rejected by Mardep. And there is a note in there "added [something] side fendering", showing 1.3 tonnes. But of course this was only an estimate and was never used for anything.
THE CHAIRMAN: The first item?
A. The first item.
THE CHAIRMAN: "Added aim side fenders", 1.3?
A. Perhaps "aluminium", sir.
THE CHAIRMAN: "Aluminium", thank you. "Added [aluminium] side fenders". Can you make out the last reference, "wi" or --

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A. Unfortunately not.
THE CHAIRMAN: 1.344 tonnes. Yes, thank you.
MR SHIEH: Yes, Dr Armstrong. Having dealt with the weight increase which took place in 1998, your report then deals with a weight decrease in 2005. Could I now go to that. It is in the same report, paragraph 14, at page 930. You say:
"It is noted that the third inclining experiment was conducted on Lamma IV in 2005 because of modifications to the vessel, namely that the ballast was raised by 10 inches. I note that the vessel weight as measured during this experiment had reduced by 3 tonnes from the 1998 experiment."
I think some arithmetic will show that in 1998, the lightship weight, as we have seen, was 63.6 tonnes; correct?
A. Correct.
Q. The inclining experiment documentation is in marine bundle 4. It starts at page 667, where Cheoy Lee sent the Stability Booklet to Mardep consequential upon the inclining experiment. You can see the covering letter at page 667. The measurement, the relevant one, is at page 673. You can see "Loading Summary", "Fixed Weight Status". They both refer to lightship weight of 60.36. Is that the lightship weight you refer to as indicating

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a decrease by 3 tonnes?
A. Yes, it is.
Q. Thank you. I'm reading from your paragraph 14 at page 930:
"Probably this was associated with the difficulty of reading the draft marks accurately, owing to the weather or waves on the surface of the water, which is not unusual. I find it more problematical that raising the ballast resulted in a lowering of the centre of gravity ... by 157 mm (over 6 inches). This problem is suggestive of some substantial error at some unknown time, either during the 1998 inclining experiment or during the 2005 inclining experiment. It could also be an error in the software used for one or other calculation, as the software was changed between the two dates."
This is the point I think you mentioned, that if you raise the ballast, the centre of gravity should be higher.
A. Yes.
Q. Whereas in this case it was actually lower, as it turned out.
A. Yes.
THE CHAIRMAN: Where do we see that in the figures themselves?

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A. On page 673, which is previously mentioned.
THE CHAIRMAN: Yes.
A. You will see the item "Lightship" about halfway down, under "Loading Summary".
THE CHAIRMAN: Yes.
A. Weight is given as 60.36 and then the vertical centre of gravity, VCG, on the end, 2.273.
MR SHIEH: Whereas for the 1998 equivalent, if we look back at the 1998 documentation, at marine bundle 3, the page that we looked at, at 466.
A. At the bottom of the page?
Q. The bottom of the page.
A. You can see it says "Lightship", 63.18, I think it is.
Q. Yes.
A. You then can't read the next column, and then it says 154.56. The 154.56 is the product of the weight times the vertical centre of gravity. So dividing 154.56 by 63.618, it gave me a value.

You can then look at other pages such as the next page, which -- next page again. Just keep going down if you would, please.

Could I refer you to page 464. At the bottom there, you can see some lightship figures which are rather hard to read on the screen. But again you can read the moment as 154.584. Not the bottom line. That's it,

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yes. That cursor. And then on page 465, lightship weight, again we've got 154.564, and 63.618.

I must say on my copy it's a little bit clearer.

But dividing the third column by the first column should give you the vertical centre of gravity.
THE CHAIRMAN: And that figure will be 157 mm higher than 2.73 metres, which is the 2005 figure?
A. Thank you, Mr Chairman. I think you're right. I don't have the calculator in front of me, unfortunately.
THE CHAIRMAN: Thank you.
MR SHIEH: Thank you.
A. There may be a third reason why there is a discrepancy, in that the vertical centre of gravity has to be measured from somewhere and in all cases, there's reference to the design baseline, and that is what naval architects would usually use. But it may well be in 2005, when they used new software, that they moved the baseline. But I have no knowledge of that and it's not presented anywhere.
Q. You were just pointing out this odd feature, but in terms of let's say the vessel sinking, what impact or bearing would this odd feature or discrepancy have? The fact is, if you take the 2005 calculations, the ship as it was, and you performed the calculations and you came to the conclusion as to why the vessel sank and you have

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managed to plot the chart over time -- so this was simply an observation?
A. It's an observation, but I believe it's a relevant observation, for this reason. The surveyor in fact questioned -- I've seen somewhere in the paperwork, and I'm sorry I can't show you where without going back and doing some research. But there are some references somewhere by one of the witnesses that they queried why the 3 tonnes had increased. The response from his senior person was that this was probably because of difficulties in reading the draft marks, or something along those lines. So there is a reference somewhere that the 3 tonnes discrepancy was of a little bit of concern.

However, not only -- the inclining experiment is not only done to get the weight correct, but also the centre of gravity, which has a direct bearing on the intact stability of the vessel. When I see that I lift a weight but the centre of gravity goes down, it's indicative that there is something fundamentally wrong with the whole calculation. So it has an impact right throughout anything that relies on the characteristics that are derived from the inclining experiment.

Now, the watertight subdivision makes an assumption as to what the lightship is, and that comes from the

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inclining experiment. So if I find something fundamentally wrong, I've got to assume there's something wrong with the floodable length calculation as well.

In fact, my comment is referring to vertical centre of gravity, and that is not used in the watertight subdivision calculation. It's just expressive of something fundamentally wrong with the calculation.
THE CHAIRMAN: And it's simply this, is it not: you've raised 8.5 tonnes of lead by 10 inches, yet the centre of gravity has gone down?
A. Appears to have gone down, but I don't believe it did so.
THE CHAIRMAN: Yes. So that rings alarm bells: "There's something wrong here"?
A. Very much so.
MR SHIEH: But if we then test the matter in the same way, a hypothetical Mardep inspector, somebody comparing the figures of 2005 and looking back at the 1998 calculations, and then spotted this oddity and then raised questions, we were then into some rather unknown territory, right? Because the point having been raised, it is not actually quite clear as to how the point would or could have been explained, because you have suggested several possibilities.

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A. Yes. If it had been noticed at the time, the normal course of action will be to do the experiment again.
I must say, I just noticed that both books refer to the drafts being measured from the moulded baseline, and I believe the moulded baseline is the same in all cases. It's shown on the lines plan from the drawing. So my comment earlier about whether they were measured from the same reference point, the indications in the book are that they were indeed measured from the reference point.
Q. When you say "both books" you mean the 1998 book and the 2005 book?
A. The 1998 book and the 2005 book.
Q. And therefore the third possible reason that you offered just now --
A. May not be the case.
Q. -- is possibly not a valid reason. Thank you.
Dr Armstrong, I know it has been a very long time in the witness box. I think I have covered in clusters of paragraphs the various big topics that you covered in your three reports.
Could I take you to your "Conclusion" section in your first report, just to tidy the matter up, before taking you to the new documents that you looked at over the mid-morning break.

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We now come to the "Summary" section at page 430.
"A brief summary of the salient points is given in the following paragraphs. More detailed technical information is contained in appendix IV.
Lamma IV sank quickly because of the extent of damage to the hull caused by the collision with Sea Smooth."
You then set out the calculations, including the time factor. But the timeline has I think been modified since in your subsequent report, so we read it subject to the caveat that the timeline has been subsequently modified. But the point remains the same, that Lamma IV sank quickly because of the extent of damage to the hull caused by the collision; correct?
A. Correct.
Q. Paragraph 73:
"Lamma IV was well-constructed and in good structural condition at the time of the accident. There is some question as to whether the hull plating was built with adequate thickness in accordance with the Regulations, and whether this may have contributed in some way to the extent of damage ..."
Dr Armstrong, I will revisit this question with you, because some new calculations have come in.
Leaving paragraph 73.

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Paragraph 74:
"Lamma IV was designed in accordance with stability regulations in force at that time to meet a capability to float in a stable condition with any one watertight compartment flooded below decks. There were five such watertight compartments, and calculations confirming compliance ... were submitted to Mardep. My calculations show that in reality Lamma IV was capable of survival with two compartments flooded, and therefore it was theoretically capable of meeting a higher standard than was required.
The watertight bulkhead indicated on the design drawings at frame 1/2 and forming a boundary between aft peak space and the tank compartment was not constructed as watertight, as it contained a large access opening. The regulations required a watertight door to be fitted, but I am of the opinion that it never was fitted, and the omission was not noticed during survey. The effect of this missing door would not have been catastrophic if only one compartment on Lamma IV had been damaged as postulated by the regulations.
The collision with Sea Smooth resulted in two compartments being flooded very rapidly, and because there was no watertight door at frame 1/2 the water also rapidly filled the aft peak space resulting in three

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compartments flooded, which was beyond the capability of the design.
The length of time during which the structure of Sea Smooth penetrated into the hull of Lamma IV was very short, less than 1 second, and Sea Smooth clearly exited the hull ... through natural forces when its collision bulkhead contacted the hull of Lamma IV. The upper part of the bow of Sea Smooth penetrated the cabin of Lamma IV above the main deck, creating a trail of damage until Sea Smooth stopped with its bow located at the aft toilet block of Lamma IV. Whether Sea Smooth was deliberately operated astern at this point is not known, but I believe that the two craft would have separated on their own almost immediately without mechanical reversing, and in any case the hull of Sea Smooth was no longer penetrating the hull of Lamma IV as the damage had already been done and it would have made no difference to the rapid flooding time."
This has been obviously subsequently updated, and you have supplemented your view as to the length of time, I believe, the two vessels were "together"?
A. Yes.
Q. "The passenger seats on Lamma IV collapsed because they were insufficiently attached to the plastic deck to withstand the abnormal load, being only screwed to the

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deck structure without apparent consideration of the make-up of the internal structure of the deck.

The vessels met at a relative heading of close to 40 degrees, clearly measurable in the damage trail on Lamma IV. This is a greater angle than indicated by the radar history, and suggests that one or other ... of the two vessels could have been turning with the rudder hard over at the time of the impact. The radar echoes are incapable of providing exact headings at a given time, especially when the speed is rapidly changing."

Of course, since you have looked at the AIS data for Sea Smooth and you have actually provided the animation showing the manner the vessels collided, and also the manner they separated?

A. Correct, yes.

Q. Is there anything you wish to further add or comment on to this series of conclusions or summary that I've just read out?

A. Thank you, Mr Shieh. I think not.

Q. Could I now come back to two topics. One is the manual in police bundle O at page 4391.

THE CHAIRMAN: This is dealing with the horn?

MR SHIEH: The horn.

THE CHAIRMAN: Yes.

MR SHIEH: Dr Armstrong, you have looked at this manual.

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Perhaps we'll turn to page 469 of expert bundle 1. Have you had a chance of looking at this manual in a sufficient degree of detail to form a view as to its correlation with the horn buttons that we see, and also its functionalities?

A. I've not have had sufficient time to read the whole manual, Mr Shieh, but I am of the opinion it is the same unit.

Q. The same unit as the --

A. Depicted in the photograph, yes.

Q. Depicted in the left-hand photograph?

A. Correct.

Q. Yes. Which is the one with buttons separately marked "Horn" and "Siren"?

A. Correct.

THE CHAIRMAN: Thank you. Well, that's made apparent if one looks at the legend in the diagram attached to the photographs in marine bundle 1 at page 139.

Do you see item 10? This is the wheelhouse of Lamma IV. That's described as "The Standard Horizon Loud Hailer VLH3000", is it not?

A. Yes.

THE CHAIRMAN: That's in the position on the photographs.

A. Yes.

THE CHAIRMAN: That marries up with the manual, does it not?

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Photograph 144 shows us that unit.

A. It does.

THE CHAIRMAN: So we've got the manual for the right piece of equipment.

A. I believe so.

MR SHIEH: Now, that deals with the manual.

The next question concerns the calculations that you kindly did yesterday.

Mr Chairman --

THE CHAIRMAN: Before we leave this subject, the manual makes it clear, does it not, that it can be used as a whistle, ship's whistle, or horn? It can also be set to send out automatic fog signals, but you can use it as a ship's whistle?

A. According to page 4402, Mr Chairman, the siren can send out a yelping pitch, a varying pitch tone, whilst pressing the microphone button, but I'm not clear to what loudspeaker that would have been connected, whether it was internal or external.

Similarly the "Horn" button would send out what's described as a passing signal whilst pressing the microphone button. One might assume that that would have been connected to the exterior horn, because it makes little sense to have a passing signal inside the ship.

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THE CHAIRMAN: "Passing signal" refers to vessels passing each other?

A. I understand that from the note underneath:

"The horn function is useful while underway to alert another vessel of your intention."

THE CHAIRMAN: And one short blast means "I am altering my course to starboard", as is set out in that note?

A. Yes, in accordance with the International Regulations for Preventing Collisions at Sea.

Q. So had one intended to send a signal, one short blast, "I am altering my course to starboard", the correct button to operate would be the horn?

A. Which button? There are two marked "Horn", one on this unit and one marked on the starboard side of the main console.

Q. The horn on this unit.

A. I think the correct one -- I'm not a seafaring person, but I think the correct one would have been the one on the right-hand corner of the main console.

THE CHAIRMAN: There appears to have been a facility, whether or not it was connected, in this other machine to do the same thing.

A. It's unknown to me, but I just mention there are two buttons, and which one did the coxswain press in the emergency.

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THE CHAIRMAN: Thank you.
MR SHIEH: Now, on the subject of thickness -- Mr Chairman, I'm not sure whether the Commission is aware. Dr Peter Cheng has overnight done a second supplemental expert report.
THE CHAIRMAN: No, nor have I read the first supplemental one either.
MR SHIEH: I think it was done in response to the handwritten calculations Dr Armstrong produced yesterday.
THE CHAIRMAN: Yes.
MR SHIEH: Dr Cheng has done his own calculation using a different value for one of the variables.
THE CHAIRMAN: Yes.
MR SHIEH: You would remember the exercise Dr Armstrong had carried out, because he was converting the steel standard to aluminium standard, and by converting it by way of his formula.
THE CHAIRMAN: I do.
MR SHIEH: Dr Peter Cheng said that a different grade of aluminium should be chosen. Basically he did some other calculations.
THE CHAIRMAN: When did this document reach you?
MR SHIEH: Halfway through my standing up this very morning.
THE CHAIRMAN: And when did it reach Dr Armstrong?

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MR SHIEH: Over the mid-morning break. I was about to ask him whether he felt sufficiently comfortable to deal with it.
THE CHAIRMAN: That seems like the right question.
A. I am very comfortable, thank you.
MR SHIEH: Could we actually read what Dr Peter Cheng has said, because obviously if you are in any way not sufficiently comfortable and you need to do some more research, I suppose Mr Chairman would consider giving some more time, but if you feel sufficiently comfortable, then we'll continue to look at it.
A. I'm well aware of the matter he raised. It was --
Q. Yes. Could we first of all look at what he has said, because I think it is the first time Mr Chairman and the Commissioner have looked at it?
THE CHAIRMAN: It is. But you for your part are comfortable in dealing with it immediately, are you, Dr Armstrong?
A. I am very comfortable. It's a matter I considered myself when I was doing the calculation.
THE CHAIRMAN: Thank you.
MR SHIEH: So we are skipping over the original report and we are skipping over the first one. We are now dealing with the short point raised by this second supplemental report.
Paragraph 2:

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"Dr Armstrong has taken the values of steel yield strength and aluminium 0.2% proof stress from Lloyd's Rules ..."
First of all, I think his starting point is your handwritten calculation. Can we look at page 956-12 of expert bundle 2. He commented, paragraph 2:
"Dr Armstrong has taken the values of steel yield strength and aluminium 0.2% proof stress from Lloyd's Rules and Regulations from the Classification of Yachts and Small Crafts ... I have located a copy of this Section, which is produced here."
I think we can find it starting page 922-26 onwards. Then:
"From this Section, Dr Armstrong has selected the figure 125N/mm squared ... as the 0.2% proof stress for aluminium alloy: see line 2 ..."
We can see the circled entry "2".
You have picked 125 N/mm squared; correct?
A. Correct.
Q. He then said, paragraph 4:
"However, it is necessary to recognise that there are different grades of marine aluminium alloy available in the market with different yield strength and ultimate strength for shipbuilding purposes. In the present case, the type adopted by Cheoy Lee for the side shell

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plating is aluminium 'alloy 5083-H116'."
We can see that from various documentation, such as the order form from the Florida manufacturer.
THE CHAIRMAN: 5083 refers to the alloy component and H116 to tempering; is my memory correct?
A. Correct.
MR SHIEH: He goes on to say:
"The yield strength of aluminium alloy 5083-H116 is 215 N/mm squared, as shown in table A5 of the Det Norske Veritas Rules for Ships ... a copy of which is produced here."
And he refers to appendix 8, which starts at page 922-8. It refers to 5083-H116.
You can see -- I think the relevant page is -29, right, the top part? Could you assist us in identifying that? Because if we look at --
A. The sixth line down, "NV-5083".
Q. Yes.
A. In the next column it lists four tempers, which are the letters beginning with "H".
Q. Yes.
A. You'll see against "H111" less than 6 mm. Yield strength is 125. Mr Cheng's comment really refers to the fact they're using H116 temper, which has a value of 215.

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Q. H111? I thought we are talking about H116.
A. That is Mr Cheng's point.
THE CHAIRMAN: H116, if one follows it through to the "Yield Strength" column, has the figure 215; is that the point?
A. Yes.
MR SHIEH: Yes.
A. I seem to be giving evidence on behalf of Dr Cheng here.
THE CHAIRMAN: At least you're helping us follow what's just come in.
MR SHIEH: So, based on that entry, Dr Cheng -- well, he refers to table A5, which is the one we have seen.
Over the page at paragraph 6, he says:
"In Dr Armstrong's calculation it is noted that he has chosen a marine aluminium alloy material with a yield strength of 125 N/mm squared which in accordance with table A5 is a lower grade material as compared with the 5083-H116 actually used for the side shell plating ...
In the light of the above, I am prepared to adopt 215 ... as being more appropriate to Lamma IV (as opposed to 220 ... which was used in paragraph (e) of my supplemental report ...
I have worked through Dr Armstrong's calculation and totally agree with his theoretical base except that, in my opinion, the yield strength of 125 ... shall be

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substituted by 215 ..."
So he agrees with the methodology; he simply wishes to replace the value of one variable by another?
A. (Witness nods).
Q. "My final value for the thickness of side shell plating with 5083-H116 marine grade aluminium alloys calculated by using the same equations ... is 3.987 ... My detailed workings are produced here.
However, as I have stated in paragraph 2(e) of my supplemental report, this is subject to a minimum shell plate thickness requirement of 4 mm."
Dr Armstrong, as I understand it, I'm not sure whether you have had a chance of checking the actual calculations in appendix 9 in terms of the arithmetic --
A. No, I have not done that but I would have assumed Dr Cheng could do that because it was quite a simple calculation.
Q. Right. It's simply an arithmetical exercise.
So the issue he raises, subject to any arithmetical mistakes of calculations, seems to be the choice of a particular input; is that a fair understanding --
A. Correct. Correct, yes.
Q. -- of the difference or the apparent difference between the two of you?
A. That's how I understand it, yes.

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Q. What would be your response to Dr Cheng's point? Because Dr Cheng's point, apparently, is the aluminium alloy used for building the ship is actually stronger.
A. Indeed it is. I would respond by starting with the instructions relevant -- the 1995 Instructions, the one after the Blue Book, which you will recall makes a comment about "You can use classification society rules, but if you do so, the vessel must remain in class". There is a reason for that. The reason is that each classification society has its own rules and regulations, and you cannot take one rule out of context. You've got to read the whole rules in their entirety. You cannot take a formula from one set of rules, say, DNV, and another paragraph from, say, Lloyd's. You have to read the rules in their entirety because they together work to provide a cohesive solution.
You will find that if you calculate the side thickness requirements for an aluminium vessel of this size, you will get different answers from each class society.
Could I ask you to put up page 922-27, please. These are from the rules of Lloyd's, Rules and Regulations for the Classification of Yachts and Small Craft.

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Q. Page 922-27, which is headed "Steel and Aluminium Alloys"?
A. Correct. On the top right-hand side, you'll see there at paragraph 4.2, "Material properties".
Q. Yes.
A. It tells you when you are calculating the scantlings according to Lloyd's that you should use a yield strength for steel of 235. Both Dr Cheng and I agree on that.
Under item 4.2.2, it says:
"The basic mechanical properties of marine grade aluminium alloy AL1 referred to in 1.3.1 ..."
0.2 per cent proof stress is 125. I therefore chose to use 125 in accordance with Lloyd's.
There are some other factors that we should be aware of, that aluminium is tempered by putting it through a heating process, usually in a furnace, in order to improve the strength characteristics, and this refers to relieving stress in the grains formed when the plating is rolled, a mechanical process.
When an aluminium alloy is welded, the heat destroys that tempering and therefore when you weld aluminium, you actually reduce its strength capability substantially. When designing stiffeners in aluminium, one has to allow for that, and in fact you use a value

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of less than 90 for that reason, in the same units as shown on this page.

It's usual when designing to Lloyd's not to account for that welding process, just to use the 125.

Dr Cheng has chosen to use a different set of rules, different classification society rules, which allow you to use 215 for temper 116. I do not know under these Rules -- which I would say are not rules for lightweight craft but are rules for ocean-going vessels with presumably aluminium superstructures, and I believe this refers to aluminium superstructures because I know of no large SOLAS-classed ocean-going vessels with aluminium hulls. I do not know without reading the Rules carefully whether you can use this value of 235 for a higher grade of aluminium without allowing for the decrease when you weld it.

THE CHAIRMAN: 215, is that not the figure?

A. Sorry, 235. No, 215. You're quite correct, Mr Chairman. I'm sorry.

THE CHAIRMAN: So your point is, under Lloyd's, having taken 125, you don't subtract anything to deal with the reduced strength from welding?

A. Correct.

THE CHAIRMAN: But you don't know whether if you take 215, you might then have to do a subtraction from that figure

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because of welding?

A. That's the point I'm trying to make, Mr Chairman. So I chose to use the values I had in front of me. I did not have the DNV ocean-going rules, but I did have the Lloyd's Rules and the two values there are quite clear.

Can I also then add that under 4.2.2, where it refers to "AL1" in paragraph 1.3.1 -- it's worthwhile going to paragraph 1.3.1, which is on the left of the page, I think.

MR SHIEH: Page 922-26.

A. And that's basically telling you that it has to comply with the various rules stating what properties the high-tensile steel and other materials have to have.

"1.3.1. Aluminium alloy plates, bars and sections, are to be manufactured in accordance with ..."

And then there's a specification.

"For applications where the material is subjected to high local stresses, it is recommended that [you get a higher strength material] ..."

It doesn't apply in this case.

"1.3.2. ... materials which have been manufactured and tested in accordance with the requirements of a national or proprietary specification may be accepted ..."

What that means is if you use a higher temper

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material, such as H116 -- "may be accepted provided the specifications give reasonable equivalence to the requirements of this Section."

And you need manufacturer's test certificates.

That's telling me if you can prove to Lloyd's that this higher-strength material is better, then you may be able to use a higher value of yield strength. My difficulty with that is that this is all relying on the class society. But under 1995 Regulations, you're meant to have the vessel in class. And this gets back to a vessel in class has to comply with the Rules in their entirety.

THE CHAIRMAN: You can't pick and choose one rule from one class and then another rule from another class?

A. Correct, you can't do that. You have to comply in its entirety. So I think you'd need to do an awful lot more work to justify using 215 in this particular case. It may well be right. Mr Cheng may be valid in what he is saying. I'm just saying that under Instructions 1995, I can't see how you can do that. And I would want to read these Rules very carefully to be sure whether that's correct or not.

MR SHIEH: Earlier on, Dr Armstrong, when you talked about the tempering process and what happens after you weld aluminium, you said you actually reduce the strength

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substantially. But you say:

"... when designing to Lloyd's not to account for that welding process, just to use the 125."

Could I just make sure I understand that. You mean when you design to the Rules of Lloyd's, people don't normally discount further and simply use 125?

A. Correct.

Q. So in a sense, in theory, you should -- if you actually take into account the weakening of the strength of aluminium as a result of the welding process, the yield strength could well be less than 125, if you designed to Lloyd's? Is that the point?

A. No. Normally the 125 I think is adequate for 116 material, and I wouldn't reduce that any further.

THE CHAIRMAN: Because built into it is as allowance for the fact you're not going to subtract?

A. I'm trying to avoid using that term "built in", because I do not know -- these are Lloyd's Rules and I'm not sure of their background. But certainly if I were designing a craft to Lloyd's, I know from experience they will accept 125 for plating.

I don't know if DNV Rules -- Dr Cheng is known to me as a designer of quite large vessels. I don't know if he has experience of small craft or not. But on small craft, the welding seams tend to be much closer together

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because of the small shape. The small craft has a lot more shape in it. There are no large flat panels. So you have to use smaller-sized plates. So the welding seams are closer together on a small boat compared to a large vessel, where the welding seams may be many metres apart. Because there's more welding, there is more reduction in strength.
THE CHAIRMAN: Is there welding at each of the frames on the vessel?
A. Generally not. There is welding at each of the frames where the frames are attached to the plating.
THE CHAIRMAN: And this is a vessel with 350 mm frames?
A. Well, the frame spacing is 1,250, but there are then stiffeners welded horizontally at 350.
THE CHAIRMAN: Stiffeners. So your caveat is that with a smaller vessel with that kind of configuration, frames and stiffeners, there is more welding closer together; is that the point?
A. Yes, sir.
THE CHAIRMAN: And that has an effect on reducing the strength of the alloy?
A. That is my assertion, yes. I did consider the higher strength, but for those reasons I chose to use 125.
MR SHIEH: Now, to a layperson -- I mean, there is a beauty in scientific precision and one might think alloys are

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alloys and there is a scientific value to be attached to a particular alloy. So it's alloy grade X, and science tells us the breaking strength of this alloy is X. But how come the figures we have seen, if you go by one set of rules, let's say the Lloyd's Rules, it stipulates it in a rather general fashion, 4.4.2, and there's only one value, 125 N/mm squared. When you look at the DNV Rules it actually splits into numerous detailed grades and with each grade having very differently valued yield strength, as if each classification society somehow decides yield strength differently. I mean, either it yields at this strength or it doesn't. Can you assist me with that?
A. I'll attempt to assist you but I cannot be totally authoritative because I didn't, of course, write the rules. But my experience, based on using them, is with the Lloyd's Rules, you're dealing with small craft. It's headed "Rules and Regulations for the Classification of Yachts and Small Craft."
Q. Which would have fitted Lamma IV?
A. Which would have very much applied to Lamma IV, yes. They would be the appropriate rules for Lamma IV.
Whereas the DNV Regulations Dr Cheng has currently provided are for ocean-going vessels, I believe, without seeing the introductory parts, and therefore --

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THE CHAIRMAN: Do we not have introductory parts so that this can be resolved?
A. Mine starts at section 9, and the book itself --
MR SHIEH: Page 922-28.
THE CHAIRMAN: Mr Mok, could we be supplied with the introductory parts so that Dr Armstrong can address that?
MR MOK: We will ask for them.
THE CHAIRMAN: Thank you.
A. It is a substantial book.
MR SHIEH: Would you find it helpful if over lunch, perhaps with the help of DoJ, you were supplied with more background about the DNV Rules for you to be able to assist on the question that I have put forward?
A. Of course I'm willing to assist in any way I can, yes.
MR SHIEH: Mr Chairman, perhaps --
THE CHAIRMAN: Given that you've been confronted with this at short notice, don't feel that you have to forgo your lunch. If you need time, you'll have time, and time will be granted so that you can, if necessary, come back.
A. Okay.
THE CHAIRMAN: Just say if you need time.
A. May I have a look first and then make a decision?
THE CHAIRMAN: Yes, that sounds sensible.

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MR SHIEH: Because, Mr Chairman, from the indications I have been given from my learned friends, the questions that they will be applying for leave to ask, if leave is granted, could well take up the whole afternoon and straddle into tomorrow. In which case, if Dr Armstrong really needs some more time to study the rules in greater detail, it may well be I won't ask him further now, subject to him providing his response when I come to "re-examine".
THE CHAIRMAN: Let's see where we are at 2.30, but that may well be a sensible way of dealing with it.
MR SHIEH: Yes.
THE CHAIRMAN: Dr Armstrong, we'll take our lunch break now and we'll resume this afternoon at 2.30.
A. Thank you.
(12.55 pm)
(The luncheon adjournment)
(2.30 pm)
MR SHIEH: Mr Chairman, I was in the course of trying to find out whether or not over the lunch adjournment the relevant DNV Rules forming part of that set of small clip produced by Dr Peter Cheng had been located, produced and shown to Dr Armstrong. I have yet to get an answer, but since I think Mr Mok is here and Dr Armstrong has just gone into the box, perhaps I can

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just ask that.
Dr Armstrong, welcome back.
A. Thank you.
Q. Over the lunch adjournment, have you been shown the relevant part of the relevant DNV Rules which you indicated you might need time to study before you could assist us further?
A. No, I have not been shown any of the relevant DNV Rules, but I have taken the liberty of downloading the DNV Lightcraft Rules for Small Ships, and I have worked on those over the lunchtime.
Q. In terms of logistics, have you got physical hard copies?
A. Yes, I believe there are a number of physical hard copies, although I don't have one at the moment.
MR SHIEH: Mr Chairman, I'm in your hands whether or not in this state -- whether or not we'll deal with the copying now immediately and ask Dr Armstrong cold, or --
THE CHAIRMAN: Let's find out, first of all, having worked industriously over lunch, are you in a position to address this material, or do you need further time to think and consider it?
A. I will be happy to attempt to address the issue now, Mr Chairman.
THE CHAIRMAN: Very well.

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MR SHIEH: Mr Chairman, I have just been given -- a number of these documents are being handed out. (Handed). They may come from various sources.
Mr Chairman, the three-page document that has just been distributed says "Rules for Classification of Ships/High Speed, Light Craft and Naval Surface Craft: Part 2 Chapter 2", which is a July 2011 document.
THE CHAIRMAN: Yes. DNV.
MR SHIEH: Dr Armstrong, is that a product of your research after lunch?
A. Correct, yes.
Q. Because just as the documents were coming in my learned junior Mr Lui handed me another document which has a sticker saying "From DoJ, only one copy". That is also a DNV document which is a 1996 document, which says "Rules for Classification for High Speed, Light Craft ... Materials and Welding: Part 2 Chapter 1".
So the objective state of affairs is that Dr Armstrong apparently located the three-page document, but DoJ supplied another set of documents which possibly DoJ regards as relevant.
THE CHAIRMAN: Well, that's the one that we should be having regard to, is it not, 1996?
A. It seems to make more sense to me. I used the 2011, Mr Chairman.

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THE CHAIRMAN: Yes, I follow that. Perhaps that was all you were able to download in the time.
A. Correct, yes.
THE CHAIRMAN: As I understand it, we have simply one copy of that?
MR SHIEH: Only one copy, yes.
THE CHAIRMAN: Very well. That can be copied now, scanned, paginated, and then we can come back to it.
Is there anything else we can deal with in the meantime?
MR SHIEH: I do not believe I have anything further for Dr Armstrong, subject to revisiting the question about the DNV Rules and the aluminium yield strength issue.
THE CHAIRMAN: Yes. Well, thank you for that. As we came in or as I came in to the hearing room, shortly before I came in, I was handed some material that had come from Wilkinson & Grist which is a response to the enquiry for information that the Commission made of Cheoy Lee to Mr Pao relating to the construction of the superstructure, the design and the construction of the superstructure. And this is the material in response to that request?
MR PAO: Yes, Mr Chairman. You will find that it concerns preliminary negotiations between Cheoy Lee and High Modulus, and you will find that Cheoy Lee initially was

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thinking of a single-skin structure for the deck which was about 9 mm thick, I was given to understand, but High Modulus suggested the sandwich construction for weight-saving reasons, and Cheoy Lee adopted that. But so far as the construction of the superstructure is concerned, no material has survived, because the handwritten work order handed down to the shipyard workers no longer exists.
THE CHAIRMAN: Right. Thank you for that.
Mr Shieh, has this material reached Dr Armstrong?
MR SHIEH: Not yet.
THE CHAIRMAN: I think, therefore, there are two matters he might be able to help us with, and I think it makes sense, rather than becoming disjointed, if we were to rise for a short time whilst this material is made available to Dr Armstrong. The priority, obviously, would be the DNV material.
MR SHIEH: The DNV Rules.
THE CHAIRMAN: And then it may be that you can help us with such material as now being provided about the construction of the upper deck floor, if I can call it that, into which the seats were attached, and whatever it is that you can find in that material that throws light onto the circumstances in which it came to be constructed in that style. And matters that are related

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to providing for the proper securing of seating to whatever the material was, whether it was this sandwich or whatever else it was, whether there was anything about the structure that for example would have permitted attachment of wood. We've heard evidence of that as being one way in which you could add extra security. So wood underneath the deck, and the screw coming through the deck and into the wood.

Perhaps we could invite you to look at that to see if you can help us at all in that area.

A. I understand your instructions, Mr Chairman.

THE CHAIRMAN: What we'll do is take an adjournment for, say, 15 minutes at the moment. We'll get the material to you, the up-to-date DNV material first, Dr Armstrong. Let's see where we are in 15 minutes.

MR GROSSMAN: Mr Chairman, just before you adjourn, since we've got a few minutes, I wonder if I might ask a housekeeping question. That is this: you've indicated, of course, that you'll be asking us for submissions. May I take it that you want the submissions in writing? That's the first point.

The second point is, insofar as the terms of reference of the Commission are concerned, the second part of it, looking at it compendiously, relates to recommendations that the Commission will make about

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future safety, et cetera. I put that generally.

Now, at the end of the day, I suppose, speaking from my clients' point of view, it may be regarded as not appropriate for us to make suggestions to the Commission. But if the Commission feels that any suggestion from us, which it may or may not accept, would be appropriate, then it would be of interest if you could give us an indication.

THE CHAIRMAN: Yes. We'll revert to you on those two subjects later.

MR GROSSMAN: Thank you.

(2.40 pm)

(A short break)

(3.00 pm)

MR PAO: Mr Chairman, I do apologise for giving the Commission the wrong information.

THE CHAIRMAN: We've seen the mistake.

MR PAO: Yes.

THE CHAIRMAN: We assumed you had made an error, because it's the opposite, isn't it?

MR PAO: It is. It stemmed from my misunderstanding.

THE CHAIRMAN: It was Cheoy Lee that was asking the designer to consider the less expensive, less heavy model.

MR PAO: Indeed. The designer was in fact given the single-skin construction superstructure design for the

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Lamma II that was previously built by Cheoy Lee.

THE CHAIRMAN: It's the other way round from what you told us.

MR PAO: Yes, it's completely opposite, because --

THE CHAIRMAN: Thank you for correcting that.

MR SHIEH: Mr Chairman, in relation to the two DNV documents, my understanding is this. The 1996 document provided by the Department of Justice in fact duplicates some pages of the appendix to Dr Peter Cheng's latest report.

THE CHAIRMAN: Yes.

MR SHIEH: In particular, Dr Peter Cheng's latest report, appendix 8, is actually section 9 of the DNV document. If Mr Chairman were to look at the DoJ document, the second-last sheet is section 9.

THE CHAIRMAN: Yes, I see that. Yes.

MR SHIEH: So what goes before that is basically to put that particular section in context, I gather.

THE CHAIRMAN: Yes.

MR SHIEH: But what Dr Armstrong had located through the internet, the 2011 version, as I understand it there should be a 1996 equivalent of that 2011 document which would have formed part of the 1996 document produced by the DoJ.

THE CHAIRMAN: Yes. Specifically which pages in the

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2011 version?

MR SHIEH: The 2011 version -- at the moment, the 1996 equivalent is not in front of us. So I understand that Dr Armstrong has caused enquiries to be made of the DoJ for production of the 1996 equivalent of the 2011 document.

THE CHAIRMAN: That is to say, part 3 chapter 3, looking at the top right-hand corner?

A. (Witness nods).

MR SHIEH: Dr Armstrong, perhaps you can indicate which equivalent you have asked for. Is it part 2 chapter 3, or part 3 chapter 3?

A. Part 3 chapter 3, Mr Chairman.

THE CHAIRMAN: Yes.

MR SHIEH: But I understand that it might take some time for the DoJ to locate it and produce it, but perhaps Mr Mok can indicate.

THE CHAIRMAN: Yes. Mr Mok, can you help?

MR MOK: Yes. I think they have to go back and look for it.

THE CHAIRMAN: Is this being done in some electronic archive, or how is it being done?

MR MOK: I haven't enquired. I was just given these pages, just like the Commission was, and I don't know where they came from. I'm sure enquiries are now being made to see how to track down that part.

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THE CHAIRMAN: Very well. Thank you for that.
MR SHIEH: My understanding is that Dr Armstrong is prepared to give an explanation based on the 2011 document, but that of course is subject to assuming that the 1996 equivalent is more or less the same, or not dissimilar.
THE CHAIRMAN: I don't think we need to assume. We'll wait until we get the 1996 document.
MR SHIEH: Yes. In which case, Dr Armstrong will not be in a position to immediately address that issue.
THE CHAIRMAN: I follow that.
MR SHIEH: In relation to the Cheoy Lee documents from Wilkinson & Grist, which I think Dr Armstrong has also been asked to look at, I wonder whether it is the Commission's intention to really ask Dr Armstrong now to express his views?
THE CHAIRMAN: Let's ask Dr Armstrong.
Do you need more time to digest this material, or are you able to help us now?
A. Mr Chairman, I would seek some further advice on the mistake from Mr Pao. I'm not sure I fully understand it. I see a letter here which is a proposal, I think from High Modulus, suggesting a single-skin construction dated 1994.
THE CHAIRMAN: Yes.
A. That is for Lamma II, did I understand?

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MR PAO: For Lamma II. The design was given to High Modulus for reference. That was single-skinned construction on a steel hull.
A. Yes.
MR PAO: Because Lamma IV needs to be lighter and faster and more economical on fuel.
A. I understand.
MR PAO: That's the preference of Cheoy Lee, to ask High Modulus to investigate the possibility of a sandwich construction where they did all the calculations and did the final design.
A. Okay. I think I'm in a position to answer your questions, Mr Chairman.
THE CHAIRMAN: Very well.
A. As stated, a number of different alternative arrangements were examined by High Modulus, specifically four different arrangements of sandwich construction using PVC foam, and the aim, as I read the various correspondence between them --
THE CHAIRMAN: Before you go any further.
Mr Shieh, I think it would assist if you were to lead the witness through the document so that those in the public can follow what's now been received.
MR SHIEH: Yes. I was about to ask Dr Armstrong to really talk us through individual pages, because he should

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have --
THE CHAIRMAN: Yes. But I think it's important that we see the chronology of the correspondence that we've been provided with.
MR SHIEH: Yes.
Dr Armstrong, the screen is now showing the covering letter by Messrs Wilkinson & Grist at page 61, but the meat of the document starts -- actually it's the reverse order. We shall start at the very end of the bundle. Because if you start immediately after the covering letter, we are way into February 1995. We should start at the very bottom.
THE CHAIRMAN: That's the Hong Kong way of constructing a file, is it not?
MR SHIEH: We should go straight to page 94, the bottom of the bundle, which is actually chronologically the first one. It's 14 November 1994, which enclosed certain drawings. It's from Cheoy Lee to High Modulus.
As I understand it, it informs High Modulus that they had received an order for a 28.5 m passenger ferry, "which is almost a repeat order of a vessel we delivered to the same owner". So the repeat order, the previous order was Lamma II, as you understand it; correct?
A. As I understand it, yes.
Q. Instead of reading out this letter, is there any part of

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this letter that you feel pertinent --
THE CHAIRMAN: This has only recently arrived in front of us. It might take a little longer, but I think it would help. I appreciate you're coming to this without your usual preparation, so we'll just have to take it step by step.
MR SHIEH: Yes.
"Both vessels for operational reasons have metal hulls and main decks. Both however have FRP superstructures (FRP upper deck and house top)."
THE CHAIRMAN: Can we just identify the numbers. 4625, is that Lamma IV? Second line of the letter.
"We have recently received an order for a 28.5 m passenger ferry, our Yard No. 4625 ..."
MR SHIEH: We'll check the relevant references. Yes, it is. It's in the relevant Cheoy Lee plans. "Yard 4625" refers to Lamma IV.
THE CHAIRMAN: Thank you.
MR SHIEH: Second paragraph:
"Both however have FRP superstructures (FRP upper deck and house top).
Yard No. 4555 [that is Lamma II] utilised a conventional single-skin method of alternate layers of mat and woven roving, without cores."
Just pausing here. Can you explain to us the

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meaning of "conventional single skin method of alternate layers of mat and woven roving, without cores"?
A. Yes, I can attempt to do so.
Woven rovings are long strands of glass which run perpendicular to each other and are woven together into some loose mat-like material. It is a woven material. They come in different weights and sizes. As we have previously discussed, they don't have a lot of strength in the perpendicular direction. So to assist with that adherence of one layer of woven roving against another layer of woven roving, it is usual to put some chopped strand mat material between them.
Chopped strand mat are the same material; it's just chopped up into 2- or 3-inch lengths and then pressed into a sheet type of form, a flexible sheet type of form.
This allows, when put into a resin, some continuity of strength in the perpendicular direction. If the chopped strand mat wasn't there, it would have far less strength in the perpendicular direction. So it is quite good practice when making a single skin out of more than one piece of woven roving to include some chopped strand mat between.
"Without cores" means that there was no foam material, no PVC foam.

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THE CHAIRMAN: So "core" means "foam" in this context?
A. I believe so, yes, sir.
THE CHAIRMAN: Yes.
MR SHIEH: "We wish to see whether you are interested in the re-engineering of the superstructure for this new project for us, with a view of obtaining savings in weight, labour and materials. Our preference is to use foam cores in conjunction with pillars to reduce significantly the number of stringers."
What do you understand to be the proposal put forward by Cheoy Lee to High Modulus?
A. My understanding is their proposal was, instead of having a single skin, which is the alternate layers of woven roving and chopped strand mat, to start out with a very lightweight PVC foam core and then skin that on top and bottom with woven rovings, and there would also be some chopped strand mat involved in that process, which allows you to have a thicker material and therefore a stronger material.
"In conjunction with pillars" means that the span of the material would have been smaller, so there would be less bending associated with the skin, which would again allow you to make it lighter. So this is telling me that the aim is to try and make a lighter structure.
"Stringers" is a name given to the stiffeners that

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are associated with the panel on which they sit.
THE CHAIRMAN: I'm sorry, can you explain pillars to me, at least for my benefit?
A. A vertical post underneath the deck running down to the deck below, exactly.
THE CHAIRMAN: As in a Roman pillar, as it were?
A. Yes, although not quite so fancy usually.
THE CHAIRMAN: No. I follow. And stiffeners or stringers?
A. Stiffeners are added to the panel in order to give it additional strength, particularly if they are located in association with the pillars, so that the stiffeners land on a pillar and span between pillars.
THE CHAIRMAN: So the pillar would be vertical and the stiffener horizontal?
A. Exactly, sir, yes.
MR SHIEH: You referred to the concept of span, "the span of the material would have been smaller". What do you mean by "the span of the material would have been smaller"?
A. The distance between supports or, if you like, the distance between the pillars. However, I should say naval architecture can be complicated sometimes. There are probably in a single skin stiffeners running in two directors, and the stringers are usually -- it's usually the name given to some quite small stiffeners running in one direction, and then there would be thicker

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stiffeners, which we might call girders, running perpendicular, although horizontal, which would lie between pillars.
So stringers are usually the lighter, smaller -- for convenience sake, let's say the girders run forward and aft, and the stringers run athwartships, but they could be the other way round.
Q. First of all, this letter puts forward the Lamma II design of single-skin method of alternate layers of mat and woven roving, whereas the suggested alternative is to use foam cores in conjunction with pillars. So the suggested alternative is to have a layer on top, a layer at the bottom, and in the middle you have the foam which you say would increase the thickness?
A. Correct.
Q. Whereas in the original design, when it says "single-skin method", there's no foam?
A. Correct.
Q. But there will be loads of the same kind of layers that we see in the alternative design?
A. Correct, although there may be different strengths of glass. Glass comes in a variety of properties. So you cannot assume they are exactly the same material.
Q. So in the wafer-type design, there's one sheet on top, one sheet at the bottom, foam in the middle. In the

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single-skin method, how many layers normally would there be?
A. I cannot say normally, but in this particular case I think there were two or something approaching that. Four layers of chopped strand mat, I think, and two alternate layers of woven rovings.
Q. Thank you.
A. But I think you'll find that in the detail later on in the letters.
Q. Right. Okay. Thank you.
The letter goes on:
"We have attached herewith three excerpts to allow you to make an initial observation whether sufficient gains could be obtained in weight, labour and materials to warrant this exercise, and if so, allow you to quote for the cost of doing so. The guideline is DNV. We are not building this to DNV Class, but rather to Hong Kong Mardep standards."
THE CHAIRMAN: Before you move on, do we know what these three excerpts are? There is described at the end of the letter "Attachment: 1. Profile of" --
MR SHIEH: "Yard No. 4625", which is Lamma IV.
THE CHAIRMAN: Yes. Wheelhouse deck arrangement of Lamma IV. Construction of Lamma II.
Do we have those?

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MR SHIEH: The only thing that we have -- perhaps this can be directed at Mr Pao, because 1996 is something different.
MR PAO: It might be around somewhere.
THE CHAIRMAN: Thank you very much.
MR SHIEH: The paragraph says:
"The guideline is DNV. We are not building this to DNV class, but rather to Hong Kong Mardep standards. They accept scantlings based on DNV requirements.
One version has a 21-knot top speed, fully loaded. The other has a 30-knot top speed, again, fully loaded. Please advise whether two sets of scantlings are required. Weight allowance is 68 kg per person. Weight of seat is 10 kg each, average per passenger.
We can use either male or female male mould, depending on your recommendations. We have used one-off female moulds for Yard No. 4555 [that's Lamma II]. We moulded the lower cabin-sides and the upper deck in one piece, and the upper cabin-sides and the house top in another, and then joined the two together by taping.
If you require additional information would you kindly let us know?
When picking materials ..."
Numerous brands are mentioned. I won't read the very last --

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"We can then compare the savings in weight, labour and materials to determine whether this is a viable exercise. You may prefer breaking your proposal into two, one that deals with initial study, and the other the final design. This is acceptable to us."
We are waiting to see the attachments, but what comment would you have on the paragraphs we have looked at, starting from "We have attached herewith" up to the end? Or would you prefer to actually see the attachments first?
A. I'd have two comments first, if I may, just for explanation. The materials Divinycell and Hexcel are the foam materials.
Q. These are foam materials?
A. Yes. The fifth paragraph I thought was interesting.
Q. Which is the paragraph starting "One version"?
A. Yes. The last line comments on the weight of seats, which I draw to your attention. Even at an early stage, there was thought given to seating.
Q. Yes. So early thought has been given to weight of the seats that are going to be mounted.
THE CHAIRMAN: And the weight of the passenger sitting on the seat.
A. Which is an essential, so that we know the overall load on the structure.

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MR SHIEH: Thank you. And the bit about the mould, probably not material for present purposes?
A. No, I don't think it's relevant. It's an internal manufacturing process.
Q. You've mentioned Divinycell and Hexcel being brands for foam. You've drawn our attention to thought having been given to the question of seats.
Somehow at the back of this bundle, page 96, there's a High Modulus drawing. It may be a separate document from this --
THE CHAIRMAN: It seems to be out of date in sequence.
MR SHIEH: It's 1995, yes.
THE CHAIRMAN: It's drawn 29th, I think the 3rd.
MR SHIEH: March 1995.
THE CHAIRMAN: 1995, and it's approved by the Marine Department on 17 May 1995.
MR SHIEH: Yes.
THE CHAIRMAN: It has a comment on it under the name of the Marine Department:
"Construction material properties should be DNV Class or equivalent and comply with the scantling calculations."
Do we have the Marine Department version of this document?
MR SHIEH: I think we should ask Mr Mok.

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THE CHAIRMAN: Mr Mok?
MR MOK: We'll look for it, sir.
THE CHAIRMAN: Yes.
MR SHIEH: This in a way is out of order. This would not have been the attachment to the Cheoy Lee Shipyards document.
THE CHAIRMAN: Clearly not. The attachments are listed at the end of the letter.
MR SHIEH: Yes. Which is not this one. This one is out of turn in terms of sequence. We'll park that for the time being.
THE CHAIRMAN: Just give me a moment, if you would.
Well, I don't see it in the few documents I've looked at from the Marine Department.
MR MOK: Mr Chairman, there is "Framing Details (a)" which I have found. It is in marine bundle 2, tab 7, page 210-2. In the index, it says that "Framing details (b), drawing 3 could not be located". That's in the index, page 2.
THE CHAIRMAN: Could you zoom out, please. Thank you.
Thank you, Mr Mok.
MR SHIEH: The one at page 210-3 is drawing 2, but the index actually says "drawing 3 could not be located", but drawing 3 has now been produced by Cheoy Lee.
Dr Armstrong, could we then look at the next

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document, which is at pages 92 and 93. 28 November 1994. That is again from Cheoy Lee, Mr Martin Lo, to High Modulus.
"Sorry for the delay on replying your fax."
So there had been a fax in the meantime from High Modulus back to Cheoy Lee, but that doesn't appear to have been included in this clip. I take it that it can't be located?
MR PAO: That's correct.
MR SHIEH: Yes, it's been confirmed it can't be located. So presumably High Modulus raised some enquiries, questions 1, 2 and 3, and Cheoy Lee responded.
"House side laminate is 3x600 g CSM and 2x800 g WR with alternate layer."
I take it "WR" is woven rovings?
A. Correct, and "CSM" is chopped strand mat.
Q. Chopped strand mat?
A. And the 600 g and the 800 g refers to the weight of the material being used per square foot. It actually gives you some indication of the thickness of the material.
THE CHAIRMAN: Is that in grams?
A. It's in grams, yes.
MR SHIEH: "This is also the basic laminate for bridge deck house end bulkhead and main deck house and bulkhead.
Bridge deck laminate is 4x600 ..."

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There are numerous dimensions given.
"Additional house side stiffening is by glassing in 2x1.5 -- I think it's feet, right? -- "hard wood with one layer of 600 g chopped strand mat."
Pausing here, any particular comment on these, the dimensions and the measurements?
A. I'm not sure I fully understand the hard wood reference, or how it was utilised. I'm just looking at the drawings to see if I can understand that. But I cannot see on the drawings any reference to hard wood in the sides. So personally I don't quite understand how that was done.
Q. If we could move on:
"Two types of fibreglass top hat stiffener are used. These stiffeners are 8 feet in length and preformed with one layer of 600 g CSM. Additional lamination, after placement on deck laminate, will be added in situ. The stiffeners are trapezoidal in shape. The dimensions for the stiffeners are: 1) 3-inch top width x 3.5-inch bottom width x 1.825-inch height and 2) 4-inch top width x 5.5-inch bottom width x 5-inch height.
Lamination schedules ..."
And then various measurements are given, terminating with that bracket, "(for bridge deck girder and transverse beam)".

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Looking at all these measurements and terminology, anything that is material for our purposes?
A. I think if you refer to the drawing shown on page 96, the last page in the bundle, you can see examples of these trapezoidal stiffeners.
Q. Which of these diagrams would best illustrate the point?
A. Possibly --
Q. We have G, H, J and K.
A. Possibly none of them. I was only using them for illustrative purposes. I would need to go through the dimensions on the drawing to be sure. I don't see any that are 75, a 3-inch top width, for example. They were all larger.
THE CHAIRMAN: What is a mullion?
A. In this context ...
THE CHAIRMAN: We've got major and minor.
A. May I ask -- oh, I see. On the drawings. It's not a terminology I am aware of, other than when applied to a window. So maybe these are sections in way of the tops of the windows. But I'm guessing.
THE CHAIRMAN: Yes.
For our purposes, since what we're actually interested in is the deck of the upper cabin, that is to say its floor, is that the part that we see depicted laterally across what might look like a girder?

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A. Correct, yes.
THE CHAIRMAN: So in this plan, perhaps you can interpret it for us. I think they're all -- well, there are slightly different dimensions. Take the one on the left, G:
"Pad laminate: 4xEU860 E-Glass UDR."
What's that?
A. Well, UDRs are uni-directional rovings. Instead of having woven rovings running perpendicular to one another in a horizontal direction, to give this girder added strength, added moment of inertia, you can fit uni-direction rovings, glass running in just the fore and aft direction, in this case, which are the strongest orientation of glass fibres. They're only a local feature being part of the mullion. They're not really part of the deck structure per se.
THE CHAIRMAN: Thank you.
MR SHIEH: The online dictionary definition of a mullion, thanks to Mr Beresford, is:
"A vertical member, as of stone or wood, dividing a window or other opening."
There could be other variations.
THE CHAIRMAN: Thank you.
A. My colleague has just shown me a plan which has the page number 210-1, from High Modulus. I'm not sure --
THE CHAIRMAN: That's the one Mr Mok drew our attention to.

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MR MOK: The one before.
THE CHAIRMAN: The one before.
A. -- which does have the designations G and H and J and K, suggesting where these various mullions are, as I read it quickly.
Perhaps, Mr Shieh, if I can just answer your question by looking at that particular drawing.
MR SHIEH: You mean the one at page 210-1?
A. Yes.
Q. Yes.
A. You can see in the centre sketch, the plan view on the upper deck underside, there are a number of vertical posts which are noted as "post", although they're only shown as a dot. There are then two longitudinal girders, as I would call them, running throughout the length of the deck, supported by the posts.
Q. Yes.
A. Then in association with those longitudinal girders, there are also transverse girders on each frame, and these transverse girders are also supported on the outboard by vertical -- I would call them posts, but they are actually stiffeners, on the side of the deckhouse. So we have like a --
Q. But these posts are not designated on this upper deck, like the side plan?

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A. On the upper plan? You can see on the upper plan the vertical posts --
Q. Yes, sorry.
A. -- which also support the transverse frames. Then sitting on top of, skeleton work of stiffeners is the deck itself, which is proposed to be -- I'll call it one layer, but it's more than one layer, of woven rovings with foam on it, and then woven roving on top.
Q. Thank you. If we look at the top drawing, we see J, H, J, H, J. Would they correspond to the J and H that we can see at the Wilkinson & Grist bundle, page 96?
A. I believe so, yes.
THE CHAIRMAN: Of what material were the longitudinal and transverse girders that you've described made?
A. I'm just reading the letter of 28 November, Mr Chairman.
THE CHAIRMAN: Yes.
A. This refers to chopped strand mat. But I don't believe that was the complete specification.
MR SHIEH: Are you referring to the reference to "awning deck girder and transverse beam", and then "for bridge deck girder and transverse beam"?
A. As I read these two plans, Mr Chairman, ignoring the word "mullion", it seems to me that these are the transverse and longitudinal beams. But I stand to be corrected. So for example, on frame 6 it seems to me

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that the deck beam running across is an H-type deck beam.
Q. Yes.
A. And they are essentially major and minor, alternating, depending on whereabouts they are, one deeper than the other one.
Q. In the upper deck underside plan see A, C, A, C, A, C. But we don't have the drawings for what A and C look like.
A. No. I believe, Mr Shieh, if you look at page 210-2 --
Q. Ah, yes.
A. -- that solves the problem, because they are listed as longitudinals and transverses.
Q. Yes. These taken together with page 96 would be the full set, because Mardep doesn't actually have drawing 3 and the gap is now plugged by the plan at page 96?
A. Yes.
Q. But, Dr Armstrong, returning to the letter at page 92, at the bottom, Cheoy Lee set out the various dimensions and measurements and materials. Are there any other matters you wish to draw our attention to? If not, we'll move over to page 93. Or do you want to pause for a while and reflect on the matter?
A. No, I have no further comments on page 92.
Q. The next page is about headroom. I don't suppose there

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will be anything of interest in relation to this consideration of headroom or "clean look inside the cabin, no protruding beams or girders" --
THE CHAIRMAN: Are we to understand that headroom would be the space between the lower side of the deck on the upper cabin and where a false ceiling would be inserted?
A. No, Mr Chairman, I believe "headroom" refers to the clear height between the deck you're standing on and anything above you. So it's the clear height you can walk around in without banging your head. Headroom of 1.9 metres. So, quite generous.
THE CHAIRMAN: So if one was approaching this from the main deck, the upper deck would be your ceiling and you would have 1.9 metres of what I call false ceiling?
A. No, Mr Chairman. From one deck to the other will be 2.4.
THE CHAIRMAN: Yes.
A. Below that deck above you would be a 500 mm gap in order to contain air-conditioning and electrical conduits and the like, and then there would be a false ceiling. The distance from the false ceiling down to the deck would be 1.9.
THE CHAIRMAN: Yes.
MR SHIEH: 1.9 plus 0.5 would be 2.4?
A. Correct.

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Q. The 0.5 would be the false ceiling, which contains all sorts of things inside?
A. Yes, in round terms. Because the false ceiling has a thickness, of 3 mm, I believe.
THE CHAIRMAN: What I'm examining is how one would appropriately fasten seats to the upper deck when the vessel is clean, as it were, and you can work at it from both sides, from the top where you're perhaps putting the bolts through, and on the bottom.
A. Yes, the false ceiling is put in very late in the stage because one needs to install perhaps electrical cables and air-conditioning ducts and the like.
THE CHAIRMAN: So from that point of view, there would be nothing preventing through-bolting through the top layer of the sandwich, if I can call it that, the 2- or 3-mm fibreglass, through the foam, through the other fibreglass in the second part of the sandwich, where it would be visibly bolted with a nut and a washer?
A. The obvious difficulty, Mr Chairman, is where there are stiffeners in the way of where you want to put the bolt.
THE CHAIRMAN: Yes.
A. That would be difficult to get around, with a bolt.
MR SHIEH: But if there are stiffeners, how do you actually drive the screw in? Forgive my inability to --
A. Drive the screws?

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Q. If there are stiffeners which prevent you from actually putting a bolt in, so if there are stiffeners which prevent you from putting a bolt in on one end, would the stiffeners likewise prevent you from putting a screw on the other?
A. No, I can't see anything would restrict you from putting a screw in. But if you want to put a bolt in, if it's through the deck, it's only 30 mm deep, approximately. But if there's a stiffener there, it may be 150 deep, so you'd need a very deep bolt indeed. So one would have to think about, in that case, some sort of pad, a wooden pad if you knew where the seats were to go, or alternatively think about some local epoxy filling.
Q. Any other points you want to draw attention to in paragraph 2?
A. No, sir.
Q. And then there is typical price for fibreglass materials, resin, chopped strand mat, and woven rovings. Would you be in a position to comment on pricing? We know that it's way, way back in 1994.
A. I have no comment on that, except to say the price looks like it was polyester. I think we probably know that from other places.
Q. Over the page at page 91, 9 December, High Modulus to Cheoy Lee:

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"We have performed an assessment of the bridge deck panels and stiffeners to evaluate whether savings in cost, weight and labour were possible. The results are subject to approval by a senior engineer ... and should be faxed to you ...
We are confident that significant weight and labour savings will be possible ..."
So I think this is basically what you may call a holding letter. Nothing in particular you wish to comment on?
A. I'm happy with page 91.
Q. Yes. We'll move over to page 90. High Modulus to Cheoy Lee, 21 December --
THE CHAIRMAN: I don't think that particularly concerns us.
MR SHIEH: No.
Page 88, High Modulus getting back to Cheoy Lee, 23 December:
"Dear Martin,
I trust you received our preliminary analysis of the use of foam sandwich construction as an alternative to your current single skin specification for superstructure for the 28-metre ferry. Although this was not fully comprehensive, I believe it illustrates the potential weight saving possible, which can be evaluated in light of an increase in materials and

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a decrease in labour costs. If you would like us to pursue this matter further we would be happy to put a proposal for a formal engagement to carry out a complete design."

It refers to a preliminary analysis done by High Modulus. Again, I'm unable to find it in this chronologically arranged clip. I take it that it couldn't be located.

"Unfortunately the vacation break is now upon us and during the Christmas/New Year period we are moving offices ..."

And then some information for contact being given. So that's that.

If we can't find the preliminary analysis, I suppose you can't comment on it, Dr Armstrong.

We move forward to page 87.

A. Please.

Q. Cheoy Lee to High Modulus.

"Thank you for your preliminary analysis."

THE CHAIRMAN: We see that the Christmas vacation has not interrupted Cheoy Lee's work. 27 December.

MR SHIEH: Yes.

"Thank you for the preliminary analysis. We have studied the analysis, and we have the following comments:

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1. Weight saving on 35 per cent is significant, however the production cost for materials is almost doubled. Reduced number of layers is noted but the labour savings can be offset by work involved in foam bonding."

What do you understand by that, Dr Armstrong?

A. That Cheoy Lee were looking for weight savings, but as they say here, they were worried about the cost increasing as well. They're commenting -- "Reduced number of layers" means that there's less work involved.

But in saving on labour with a reduced number of layers, there's more work involved in presumably the chopped strand mat needed to bond the woven rovings to the foam.

So they are I think possibly negotiating a bit more work by saying, "Yes, there may be some savings but there's also some additional costs. Can you do better, please?"

Q. Yes.

"Labour cost is still relatively low here. With no minor stiffeners, turnaround time indeed is faster by about 4 to 5 days. However, saving on labour takes up a small fraction of total costs.

We are concerned about the costs of all materials involved. Would you please provide a rough price

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indication on various materials for our further consideration?"

Well, basically trying to bargain?

A. I believe so.

Q. Yes. Then over the next few pages, 86 all the way down to 77, 10 January 1995. This refers to Cheoy Lee's fax of 27 December, which should be the one we looked at at page 87.

"Please accept my apologies ... closed over the Christmas/New Year vacation ... shifted our offices."

Second paragraph:

"Andre is not back in the office until next week, but I have reviewed his preliminary analysis in the light of your comments. Rather than simply look at a 'per square metre' analysis I have extended the brief to evaluate both the plating and stiffening for a given area. (The next step would be to go even further and consider the effect of weight and cost on the whole structure, but this would be too large a task for a 'preliminary' analysis). In this particular case I have look at the bridge deck plating and stiffeners in the enclosed area forward, considering an area 9.03 metres long by 5.3 metres wide (see attached sketch). Note that I have neglected to consider in detail the stairwell opening and surrounding stiffening,

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preferring to treat the whole area as a uniform specification for simplicity."

It refers to the "attached sketch". Could you make out, Dr Armstrong, whether or not this is actually any of the sketches that we see from page 82 onwards, down to page 86?

A. Yes, Mr Shieh, I believe the drawing at page 83 shows some stiffeners highlighted. They're a darker colour. I believe that's approximately 9 metres long by 5.3 metres wide. That same area is reproduced in drawings 84, 85 and 86. All of those sketches are six frames long, which is approximately 9 metres long.

Q. So the dark lines are the stiffeners, at page 83?

A. That is how I understand it, yes.

Q. And the area is 9.03 times 5.3 metres?

A. Correct.

Q. Is that right?

A. Correct.

Q. Yes. That corresponds with the description in the text of the second paragraph.

"This has been a worthwhile exercise as the total weight saving achievable has been defined, and it is significantly higher than had been previously estimated by Andre. In addition a number of options have been explored which allow you to select the right balance

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between the number of stiffeners and the core thickness. The differences in weight and cost can be assessed along with any savings in labour.

The DNV Rules have been used as a guide. Interestingly the design pressure for an accommodation area such as considered here, is greater than for an exposed weather deck, especially forward. The design pressure of around 6.0-6.5 kPa in this region, coupled with an assumption of simply supported panel edges, produces a plating which, in our opinion, is very stiff. This high degree of 'rigidity' is desirable in a passenger vessel such as this where the public expect a 'solid' feeling underfoot. Given this, it is strange that the DNV Rules do not specify a stiffness criteria for framing, and therefore we have applied our own in-house approach. In addition to meeting the strength requirements of the DNV Rules we impose an L/150 criteria under the DNV design load, and a maximum beam deflection of 2 mm irrespective of span under the weight of a single 90 kg person mid-span. As both these checks are made using the conservative approach of assuming simply supported ends the result is a comparable degree of stiffness in the support for the plating."

What do you have to say about this paragraph, referring to the DNV Rules and also design pressure and

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the like?

A. Thank you. There are two features here in this paragraph. The first one illustrates the rather quirky nature of the classification society rules sometimes in that usually the greatest loads are those seen from the sea. So what they're saying at the top of page 78 is that the rules require you to use a design pressure on the weather deck, which is the open area forward, subject to sea loads of some value. But inside the deckhouse, which is protected, the rules require you to use an even higher value, which is somewhat unusual. I'm not sure why that should be.

Nevertheless, they have used those values, the way I read it, and then they have used their professional judgment to state that even if they used the DNV Rules, there would be some give in the panels. And if you're walking along a deck and you feel the deck giving beneath you, it is most disconcerting. So they have increased the thickness, based on their experience, in order to prevent the flooring, for want of a better description, giving as you walk along.

I think that's all I have to say about that paragraph.

Q. "In the first instance the 'as specified' construction was analysed with respect to the DNV rules. I am not

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sure whether or not these rules were used in the original design, but I must say I was impressed to see how close the current specification is to the minimum requirements in many areas, indicating some effort and detailing had gone into the project. In summary the following comments could be made ...

1) The shell laminate itself is possibly 'over designed' as there is more than adequate stiffness and strength given the close spacing of frames. However it is likely that a thinner laminate would be impractical in other respects, as one needs to consider more than just the DNV criteria.

2) The minor longitudinal stiffeners are some 15 per cent stronger than required by DNV, but significantly less stiff than required by our in-house criteria (L/80 under design pressure and approximately 10 mm under 90 kg centre span load). However it is unlikely that one person would load a single beam, but rather the load would be spread over several adjacent beams. Nevertheless we feel increased rigidity between the transverse beams would be preferable.

3) The major longitudinal girders are around 15 per cent below the DNV requirement, based on a span of 2.9 m between posts. Again they are possibly less stiff than is desirable with regard to the uniform pressure

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loading, although under a 90 kg centre span load the deflection of 1.5 mm is acceptable.

4) The transverse stiffeners are a mere 5 per cent over the DNV strength requirements, and spot-on with respect to HM's stiffness requirement."

That's High Modulus's stiffness requirement.

Looking at these four comments, what do you have to say which is material for our purposes?

A. Essentially these four subparagraphs and the previous paragraph appear to be telling me that the original design they analysed and found it to be well-thought-out and well-designed.

Q. Can you pause here. When you say "the original design", do you mean the original design of Lamma II or the original design of the deck?

A. As I read it, the original proposal of the single-skin layer, because it says "As specified".

Q. Yes.

A. Sorry for my choice of words.

Q. Yes. So they were commenting on the merits of the original single-skin proposal?

A. That is how I read it. They then made some detailed comments in the subparagraphs quoting where they would have made some slight adjustment for one reason or another. It is interesting because they highlight that

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the DNV criteria, the class society requirements are not the be-all and end-all. There are some other things that need considering, like the ability to walk on a panel without it flexing under your feet. And they have compared it also against their own in-house formulations, based on their experience.

Q. Over the page at 79:

"The total weight and material cost for the area considered (excluding any localised reinforcement or bonding angles, has been assessed and is presented in the attached table. The weight is based on a 33 per cent fibre content for CSM, and a 45 per cent fibre content for woven rovings, with an allowance of 5 per cent for overlaps on the shell plating. Material costing includes resin and fibre reinforcements, and the overlap allowance, but excludes any wastage factors. Prices are as advised ..."

And then quotes are given.

"The 'area of reinforcement' is included as a guide to the labour content, and has been broken down into shell and framing."

Any comment on this?

A. I'm not sure we have a breakdown of weight -- oh, yes, maybe in table 81. Basically this section is talking about a weight estimate, because what they're trying to

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do, of course, is to compare costs and weights and the two are related. They've also added in some areas for where there's doubling-up of materials, area of reinforcement, as they call it.

Q. Because if we look at page 81, "As specified", we see core is not applicable, because as specified, it doesn't involve the core?

A. Correct.

Q. Whereas all the other options, A, B, C and D, are different ways of constructing the wafer, or sandwich or whatever you call it.

A. Correct. Then at the end they've commented that they've not included any wastage factors, which Cheoy Lee would probably know more about.

Q. Thank you. So the breakdown you take it to be the breakdown at page 81.

"The alternatives considered are also detailed in the attached sketches and table. The amount of framing was progressively reduced ..."

I suppose that refers to the various options, A, B, C and D?

A. (Witness nods).

Q. Because it refers to the alternatives considered. So it would be --

A. Yes.

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Q. -- the various options.

"The amount of framing was progressively reduced, and the larger spans catered for with increased core thickness."

Let's see if it's actually reflected numerically in the options. The core would be of increasing thickness. So we can see option A, the core being 15 mm thick, the next ones are 30, 50 and 60, so they increase from option A down to option D. That's the way you would understand this?

A. Correct, yes.

Q. How about "the amount of framing was progressively reduced", where do we see that? It's at the bottom, right, "Framing", and then we see 105, 95, 85 and 55?

A. Well, if you compare, for example, page 83 with page 84, simply put you can see there are less black lines so there is less framing. Then if you compage page 84 with page 85, there is yet again less black line.

Q. Page 85 has less black than page 84?

A. Correct. And then page 86 has even less again. So that is what they mean with less framing. There's less support for the sandwich structure above.

Q. Yes. "And the larger spans catered for with increased core thickness", so the less framings you have, the larger the area, the thicker the core you need; is that

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a simplistic way of looking at it?

A. Simplistically, yes. You might recall you put up a formula in my handwritten calculation which was BM/stress equals I/Y. What they're trying to compare here is the bending moment and the "I" value, "I" being the moment of inertia of the section. If you go for a longer span, the bending moment increases. If the bending moment increases, you need to increase the I/Y value.

So for a bigger bending moment, you need a bigger "I". "I" is a moment of inertia and is a function of the cube root of the depth of the material. So you need to go thicker for a greater bending moment capability.

Q. Which would mean greater thickness?

A. Greater thickness.

Q. Because if I remember, it relates to -- "t" cubed, right?

A. "t" cubed, yes.

Q. There's an element of "t" cubed inside?

A. "t" cubed, yes.

Q. Because "I" involves "t" cubed?

A. "I" involves "t" to the power 4, but it's the depth of the section so it becomes "t" cubed.

Q. Yes. Reading from page 79, in the middle:

"In all options the skin laminates remained the

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same, being the minimum considered acceptable from an impact/durability consideration (in line with the DNV requirements), and based on highly efficient 0/90 biaxial with a CSM backing for practical application. The code number we use for this particular reinforcement is EBM895/260 ... The Knytex/Hexcel code is CDM2408."

I won't try to read that. It's English but sounds like Greek to me.

Is there any comment on this?

A. I've tried to make things simple by talking about chopped strand mat and woven rovings at 90 degrees to each other, but one can buy some very sophisticated products these days where the glass is already laid out in different orientations. So these are different orientations of glass mat which may include -- for example, 0/90 biaxial is material that's got a lot more strength in one direction than the other, with a chopped strand mat backing, all in the one piece of cloth. So these are various types of cloth with various capabilities in different directions.

Q. Then there is a paragraph dealing with price.

"The core thickness ranges from 15 mm through 60 mm, depending upon the amount of framing."

Estimated prices were given. Then the prices.

Over the page, page 80:

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"The stiffeners have been redesigned to meet the DNV requirements, and to accommodate the different spans and spacings presented with the revised arrangements. The construction is similar to that employed presently, namely a hollow former of a single layer of 600 g CSM, with uni-directional capping. Instead of covering the former as is the present practice, we recommend a simple tape on each side of 150-200 mm wide strips of CSM. This process be much easier and quicker than complete encapsulation, and is possible if one incorporates uni-directional into the capping."

Is that relevant?

A. I don't believe so, sir. It's talking about the method by which they make the frames and stiffeners.

Q. Yes. We move on:

"As you can see from the table the lowest cost (in materials), and the lightest option is the 15 mm cored specification with a still significant amount of framing. The total area of reinforcement in the framing is one-third of that in the current specification, and this, coupled with the reduced number of layers in the shell, should offset the material cost increase of around 25 per cent or US$450 for the area being considered. The benefit is a saving in weight in the order of 50 per cent. Roughly extrapolated over the

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whole superstructure this could mean a reduction of as much as 5 tonnes."

So they are looking at reduction in weight, also taking together cost considerations. So basically they're going to get to an optimum option.

A. Yes. And on page 81, you can see there is a line "Weight", and as "As specified" was 1,120, that is the single-skin construction, and then there are four options with various thicknesses of core.

Q. Yes.

A. The lowest one of those is option A with a weight of 570, which is a substantial reduction, of the order of 50 per cent.

Q. Yes.

A. They've also shown that the cost increases by 25 per cent for option A over "As specified", which matches the words used.

Q. Cost increased by about 25 per cent, which is shown by the "+25%" under "Option A"?

A. Correct.

Q. So basically they are talking about option A there?

A. Yes.

Q. "The thicker cored options do not, surprisingly, offer any further reduction in weight and are associated with material cost increases due to the core component.

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These are offset by labour savings as the framing is reduced, but such a trade-off may not be significant in your environment where the cost of labour relative to materials differs from our situation. Therefore the 'ideal' specification (cost versus weight) may be different in your yard, to that one might select here in NZ. Sometimes an assumption as to the labour costs leads to a tendency to specify thicker core/fewer frames in areas where it is not the 'optimum' solution.

I suspect the Mulder 40 m MY you are currently working on is such an example of this as the deck is relatively thickly cored with minimal framing. In other situations such a specification is preferred if the added headroom is considered a benefit, or if the profile can be lowered and hence reduce the weight aloft and improve the aesthetic appearance. At the end of the day we can present the options and let you evaluate which best suits your requirements."

So from the face of it, basically it's just looking at the pros and cons but nothing terribly material for our purposes, would you say?

A. I think not. And "MY", for reference, is a motor yacht. A Mulder 40 m motor yacht is a particular design.

Q. Yes. But apart from that, is there anything material in this paragraph that you need to draw our attention to?

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A. No, I don't think so. They are basically saying that Cheoy Lee has to make its own decisions based on the information that has been given to them, and apply their own labour knowledge, the labour cost knowledge.
Q. Thank you. Now, the rest we can go through reasonably quickly because we have more or less gone through the more technical stuff where we are now into quotation and that sort of material.
Page 74, we see a quotation for supply of services dated 12 January. In fact there should be a covering document at page 73. From High Modulus, 12 January, to Cheoy Lee:
"Dear Martin,
Further to my fax earlier this week please find enclosed a formal quotation for our design services with respect to the superstructure of the 28.5 m passenger ferry. As I understand it, you are looking at two vessels with different speed capacity, but I expect that the one specification would be appropriate for both as the design is based on a limiting acceleration rather than related to the maximum speed.
We would anticipate that in addition to a brief report detailing the calculations for the relevant approval authority we would also produce two or three A1 size construction drawings ... This would detail the

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laminates for the bridge deck, awning deck, superstructure sides and ends, and GRP bulkheads, as well as all stiffeners. While we would endeavour to cover all structural details minor items such as moulded furniture, window attachment etc would not be considered.
If this is acceptable and we are engaged in the near future I anticipate we could produce the drawings within a three to four-week period ..."
Then over the page, we see the quotation. But the quotation, the text itself doesn't actually tell you the precise option they had gone for. It is more a commercial document here, a quotation.
A. Yes.
Q. You don't get anything out of it?
A. No, correct.
Q. Page 72 --
A. Mr Shieh, may I just comment on the letter at page 73 just by way of clarification?
Q. Yes, yes.
A. The end of the first paragraph, "both as the design is based on a limiting acceleration", it may be not well understood. One vessel goes faster than the other but the way DNV designs structures is to design to a vertical acceleration. The acceleration on a vessel

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is principally a function of the speed of the vessel and the wave height it is operating in. So if you're designing to a limiting operation with two vessels that can go at very different speeds, it means one of them can operate in certain wave height but the other one can only operate in a different wave height.
Q. The "two vessels" here basically refers to Lamma II and Lamma IV?
A. That is my estimate, yes. So if they're designed to the same acceleration but have different speeds, it reads a little awkwardly, but that is in fact the case. It's just that one can go out in bigger seas than the other.
Q. Because I'm not sure about -- yes. You are looking at two vessels of different speed capacity. One way of looking at it is they are looking at Lamma II and Lamma IV, but of course Lamma II has been built already. Or are they saying they have two alternative designs in mind?
A. Okay. I was not aware of when Lamma II was built.
Q. No, but what I mean is, Cheoy Lee is trying to obtain services for High Modulus for building the deck or the superstructure for Lamma IV. Lamma II doesn't involve High Modulus. This series of correspondence is not to enlist High Modulus's services for Lamma II.
A. Well, the second sentence of the first paragraph says:

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"As I understand it you are looking at two vessels with different speed capacity ..."
I do not know what the two vessels were.
Q. Well, anyway, "28.5 m passenger ferry" would fit Lamma IV very well. But apart from that gloss over what is the meaning of "two vessels with different speed capacity" --
A. It does not matter at the end of the day.
Q. Yes. Anything else you wish to comment on this letter?
A. No, thank you.
Q. Over to page 72. Cheoy Lee to High Modulus.
"Thank you for revised analysis and quotation."
It's 25 January. It says "revised analysis and quotation". It doesn't refer to the date. It may well be the quotation and the analysis simply refers to the document at page 73, being the quotation, and page 77, being the analysis.
The second paragraph:
"We are more inclined towards option A."
Which really is the option which High Modulus was gently pushing Cheoy Lee towards, if I may put it that way.
A. Yes.
Q. "This option offers the best compromise" -- or, as I said, optimum solution -- "and we would like to pursue

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this venue further. However, before we enter into an agreement, would you please clarify the followings:
1. NZ$3,000 is the ceiling cost for the project.
2. The drawings are to be in A1 size transparencies.
3. Construction is designed according to DNV Rules.
4. Once entered into agreement, is downpayment ..."
Nothing really to comment on?
A. No, sir.
Q. Except that they go for option 1.
Over the page, 71:
"Dear Andre,
Thank you for your reply. We wish to proceed and please treat this fax ..."
So something must have come over from Andre in New Zealand, but we don't have that.
"... please treat this fax as formal acceptance. We shall forward updated profile ..."
Nothing of any moment in this document, Dr Armstrong?
A. No, sir.
Q. And then conditions of sale, quotation and all that. It's really a commercial document, page 67.
But we can be reasonably clear now that basically the upshot is they have gone for option A; correct,

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Dr Armstrong?
A. Correct.
Q. Option A as in page 81?
A. And in the letter between pages 67 and 71, I see no reference to seating or anything relevant to seats at all.
Q. Yes. When you say that, you mean the quotation doesn't relate to anything concerning design or mounting or the layout or the mechanism whereby seats are mounted, that sort of thing?
A. I can see no consideration was given to seating at this stage, which I would expect because this is an initial construction stage and seating is thought of usually as an outfit item which comes later.
Q. Page 66:
"Dear Andre/Richard,
Enclosed please find the revised drawings for above vessel. Please proceed with option A at your earliest. Meanwhile we await your material quotation."
Then there is an enclosure which we don't have.
"Please consider using ..."
That's probably not relevant to us.
A. No. It's a type of glass.
Q. Sorry?
A. It is a type of glass.

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Q. Right. Yes.
Then over the page, 65, "Dear Martin". This is from High Modulus.
"Thank you for your fax with regard to the forwarding of the revised drawings. We shall await the couriered hard copy and should be in a position to start immediately once they arrive ...
I note from our fax records that a quote dated 9 February 1995 ... was sent and confirmed ... to the above number."
Nothing of any moment, this fax?
A. No, sir.
Q. No. Page 64:
"Dear Andre,
Thank you for your prompt reply. The drawings should have arrived at your office.
We purchased one shipment of ... for our 43 m project. This material was never used ... We would consider using this material for this 28 m ferry project ... Please advise."
Nothing of particular moment here?
A. No, sir. It's a good standard of glass, sir.
Q. Over the page, 63:
"We will shortly be at the stage where we will be beginning drawings of the ferry superstructure. I note

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that the drawings that you have sent are drawn using some form of computer drawing package. It would save us quite some time if the necessary outline drawings were forwarded to us by either couriered floppy disc or via modem."
I don't think they had started using the language of "email" at that time.
"We have a Compuserve address which we can forward if necessary or you can directly modem us using our normal telephone number ..."
Then there is a paragraph talking about the glass. But again, nothing of particular moment?
A. No, nothing of particular moment. They just comment that it may be heavier.
Q. It may be heavier?
A. The proposal to use EWR1200 is probably heavier than what they were proposing, although they say -- not wishing to jump the gun, but in the next, page 62, they comment that it has a lightweight chopped strand mat incorporated, so maybe it wasn't heavier.
Q. Okay. So, page 62, apart from that, nothing of particular moment.
Then page 61 is the covering letter.
Having been through this, we know they have gone for option 1. But looking at option 1, would it correspond

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to or coincide with what you have actually observed on deck?
A. Yes, it would be very close to it, without actually going and taking close measurements.
Q. Being the diagram that we see in the expert evidence bundle --
A. Interestingly enough, no, not according to the final drawings I received, which were 25 mm core.
Q. I was about to show you expert bundle page 467, which depicts the sandwich, and ask you to compare option 1, option A.
THE CHAIRMAN: Where is the text reference that marries up with page 467 from the report, which gives the dimension?
MR SHIEH: You mean the text of the report?
THE CHAIRMAN: Yes.
MR SHIEH: Let me just try to locate it. It's where he talks about the seats. It's page 418.
THE CHAIRMAN: Yes, that's it. Paragraph 45.
MR SHIEH: Yes. No, paragraph 44.
THE CHAIRMAN: Paragraph 44. Yes.
MR SHIEH: Paragraph 44 refers to item 11, which is at page 467.
If we were to compare that with option A, the core, 15 mm, but here I think it is 20-odd, is it --

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THE CHAIRMAN: That's the figure I was looking for. What is Dr Armstrong's measurement of the foam?
MR SHIEH: Yes.
A. Perhaps I could refer you to a drawing in marine bundle 2, page 210-1.
Q. Yes.
A. On the left-hand side, there is a table.
THE CHAIRMAN: Yes.
A. It says that the upper deck had a thickness of 25 mm. It's the fourth one down. "2c. 25 mm contoured 60 kg/cubic metre foam", 25 mm thick.
THE CHAIRMAN: And those figures marry up with option A, do they not? 15 mm, 60 kg?
A. I have difficulty with the 15 marrying up with 25, sir.
THE CHAIRMAN: I beg your pardon. Yes, thank you.
The 60 kg matches, but not the 25?
MR SHIEH: Yes.
A. Yes. It's somewhere between option A and option B. If you could perhaps go back to the table at page 210-1, the way this should be interpreted is that there is an outside layer, number 1, of the EWRM1200 woven roving, which is 2.1 mm thick; that's like the top layer. Then there is item 2, and there are three item 2s here because it's referring to three locations, but we only need consider 2c, which is the upper deck:

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25 thick. Below that, there is another layer of EWRM1200 woven roving and cropped strand mat, 2.1 thick. So overall, 29.2 thick.
THE CHAIRMAN: Yes.
MR SHIEH: So it seems that for cabin top, they did go for option A, but then for 2c, the upper deck, the thickness of the core was increased because 2a cabin top, it matches with option A: 15 mm, 60 kg?
A. It makes considerable sense, because a cabin top has a far smaller load than the upper deck would. There are no passengers on the cabin top.
THE CHAIRMAN: Cabin top being the ceiling of the upper deck?
A. That's my interpretation of it, yes, sir.
THE CHAIRMAN: Yes.
MR SHIEH: So it could afford to be thinner?
A. So it would be thinner. There are no passengers up there.
THE CHAIRMAN: Have you measured the foam dimensions in the upper deck, in the floor of the upper deck? It's vinyl, fibreglass, foam, fibreglass.
A. Yes.
THE CHAIRMAN: Have you measured the foam?
A. I need to go back to my notes to be certain, Mr Chairman. I think not.

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THE CHAIRMAN: Because that's what I've been looking for in your reports.
MR MOK: It's paragraph 43, page 417.
THE CHAIRMAN: Thank you. Yes, that's the one. Thank you. Do you have that?
"The upper deck was manufactured as a glass fibre composite structure, which was made up of three components ...
2.1 mm thickness of woven rovings and chopped strand mat.
25 mm thickness of foam.
2.1 mm thickness of woven rovings ..."
MR SHIEH: Mr Chairman, it was footnoted by reference to "Laminate structural design of deckhouse and submission letter from Cheoy Lee to Mardep". So that may be a reference to the drawing rather than as-measured dimensions.
A. It is.
THE CHAIRMAN: So you need to check your notes to see if you've actually measured it, or what the answer is?
A. Yes, I would have to do that.
THE CHAIRMAN: Yes.
MR SHIEH: But in a way it won't be --
THE CHAIRMAN: Just pausing there. This 25 mm that you refer to here would come from page 210-1, or something

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like that?
A. Page 210-1.
THE CHAIRMAN: Yes.
MR SHIEH: Because the footnote says "Laminate structural design of deckhouse and submission letter from Cheoy Lee to Mardep", which would match the description of page 210.
If I can just check the index to see whether or not -- if I could have a moment. It's footnote 47, which is indeed page 210-1, which is that very page.
THE CHAIRMAN: Yes. Thank you.
MR SHIEH: So we are at the stage where the text of your report referred to a dimension which was actually taken from the drawing, but we would like you to check your notes to see whether or not the as-measured thickness coincided.
A. Yes, sir.
Q. Thank you. The paper trail did not reflect any express stipulation for the spread of the various decks in that manner, but I suppose you wouldn't say that's unusual because they went for option A as a matter of principle. But, as you say, depending on whether you're talking about, colloquially, the roof or the floor, there may be variations in the thickness of the core?
A. I think that's the case, yes. And maybe also what

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material was available to them at the time.
Q. "What material was available to them at the time"? You mean maybe thicker material was available, then they went for the thicker one?
A. Perhaps.
Q. Anyway, the end result is that a thicker material as was stipulated by option A ended up being at least shown on the drawing, subject to your checking the actual thickness?
A. The table is for the bridge deck, and I'm not exactly sure what is meant by the bridge deck in their terminology.
THE CHAIRMAN: Yes. I noticed the terminology and I took it to mean the deck on which the bridge is located.
A. Yes, which would be the upper deck, according to the GA. And that is what I was assuming, sir.
THE CHAIRMAN: Yes.
A. It's curious they talk about the bridge deck, but their drawing just talks about main deck, upper deck and cabin top. I think we can safely assume it is the upper deck. Particularly because the drawings show the upper deck.
MR SHIEH: Yes.
So with that note, seeing that it's 4.30, could I ask Dr Armstrong perhaps to come back on that point about the measurement.

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A. It's going to be difficult, because my notebook, unfortunately, is in Australia.
THE CHAIRMAN: Well, we're on the same time zone as Western Australia, are we not?
A. We are.
THE CHAIRMAN: Are there not people who can assist you by locating it in Australia?
A. I will attempt to do so.
THE CHAIRMAN: Yes. And if possible, scan it so that it could be sent up here as is, as it were.
A. Yes. Scanning it is easy if we can find it, yes.
THE CHAIRMAN: Very well.
MR SHIEH: Or perhaps last resort, immediate measurement taken on Lamma IV?
THE CHAIRMAN: Yes. Of course, we have the vessel available so it can be measured again if necessary.
A. There is in fact a photograph in the file with a tape measure hanging through the hole, so somebody has measured it. I can identify that photograph somewhere.
THE CHAIRMAN: Let's leave it there, and we'll hopefully address this matter successfully tomorrow, together with the issue of the plating, the aluminium plating, the technical aspect.
MR SHIEH: Subject to identifying the missing 1996 equivalent, which the DoJ is looking at.

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MR MOK: I understand an email has gone to Lo & Lo by now.
THE CHAIRMAN: Right. We're all in the same room, but we still do things by email. Very well.
In that case, we'll adjourn until tomorrow at 10 o'clock, Dr Armstrong.
A. Thank you.
THE CHAIRMAN: Thank you.
(4.32 pm)
(The hearing adjourned until 10 am on the following day)

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