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<p>1 Monday, 28 January 2013 2 (10.00 am) 3 THE CHAIRMAN: Mr Grossman. 4 MR GROSSMAN: Good morning, Mr Chairman, Mr Commissioner 5 I have an application to make. 6 THE CHAIRMAN: Yes? 7 MR GROSSMAN: We're in the throes of filing an expert report 8 from a Mr Wallaston concerning the matters that are 9 dealt with by Dr Armstrong. Now, at the end of the day 10 I'm fairly confident we won't be calling him, but in 11 case we do -- 12 THE CHAIRMAN: Seeking to call him. 13 MR GROSSMAN: Seeking to call him, yes. But in case we do, 14 I make the application now. 15 THE CHAIRMAN: When is the material to be provided to the 16 Commission? 17 MR GROSSMAN: This morning. 18 THE CHAIRMAN: Thank you. So this is really a matter of 19 information? 20 MR GROSSMAN: Correct. 21 THE CHAIRMAN: Thank you. 22 MR GROSSMAN: My recollection is it's necessary to make 23 an application seven days in advance. 24 THE CHAIRMAN: Yes. 25 MR GROSSMAN: So this is what I do. But let me say</p>	<p>1 A. Yes, sir. 2 Q. Let me just explain to you the manner in which I propose 3 to take you through your reports. The reports, some of 4 them contain rather technical language and they have 5 been written out rather fully. I do not propose to read 6 them out verbatim because they will be projected onto 7 the screen and the Commission would have had a chance of 8 pre-reading the materials. But for the purpose of easy 9 elucidation and explanation, especially to the public 10 and to the press, what I would propose to do is to take 11 you to and identify relevant paragraphs in your reports 12 concerning a subject matter. 13 Sometimes in your first report you deal with 14 a particular subject matter and in your subsequent 15 reports, you go back to the same subject matter and 16 supplement that or elaborate on that. So I will 17 actually take all these topics in clusters; do you see 18 what I mean? 19 A. Yes. 20 Q. For example, aluminium corrosion, there is a bit of that 21 in your first report; there is a bit of that in your 22 second supplemental report. So I will take these topics 23 in a cluster. 24 A. Understood. 25 Q. That will, I think, facilitate easier understanding of</p>
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<p>1 immediately, I think it unlikely we'll be seeking to 2 call him. 3 THE CHAIRMAN: Very well. Thank you for that. 4 MR GROSSMAN: Just one other point. We have brought today 5 a light bulb which is used in the fog light, so it's 6 available. 7 THE CHAIRMAN: Yes, I've seen a letter from your instructing 8 solicitors. This is a 1,000-watt bulb? 9 MR GROSSMAN: Yes. We have it here. 10 THE CHAIRMAN: Thank you. In which case, if you would 11 provide it to the secretary during the course of the 12 morning, we can have a look at it. 13 MR GROSSMAN: We shall do that. 14 THE CHAIRMAN: Thank you for that. 15 Yes, Mr Shieh? 16 MR SHIEH: Mr Chairman, this morning we are going to call 17 Dr Neville Anthony Armstrong, the expert, naval 18 architect. 19 Could I have Dr Armstrong in the witness box. 20 DR NEVILLE ANTHONY ARMSTRONG (sworn) 21 Examination by MR SHIEH 22 MR SHIEH: Good morning, Dr Armstrong. 23 A. Good morning. 24 Q. For the purpose of this Inquiry, you have made three 25 expert reports; correct?</p>	<p>1 the subject matter. 2 Once I have taken you to and identified the relevant 3 parts, I will identify any relevant underlying documents 4 and photographs that you have referred to. But then, 5 instead of reading out chunks of your report, I may 6 identify the subject matter and perhaps invite you to 7 explain to the Commission, in your own words, live, so 8 to speak, the points that you are seeking to make in 9 those relevant paragraphs. 10 Do you follow the mode in which I propose to take 11 you through it, rather than to read it out and ask you 12 whether you confirm it? 13 A. I understand that. 14 Q. I understand that you have also prepared, kindly, some 15 video animation. 16 A. Correct. 17 Q. First of all, based on the Mardep radar and AIS records 18 of the two vessels, showing the tracks of how the 19 vessels collided, and more importantly their movements 20 after the collision; correct? 21 A. Correct. 22 Q. There is also a video, which I hope has been completed, 23 of a view taken from inside, I believe, the engine room, 24 looking out and seeing the approach of Sea Smooth and 25 how the gash and also the holes were created.</p>

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<p>1 A. That is correct, although I haven't seen the video 2 myself yet. I'm hoping it will be completed, sir, by 3 lunchtime today.</p> <p>4 Q. Right. Because you have obviously staff and personnel 5 assisting you in compiling that?</p> <p>6 A. Correct.</p> <p>7 Q. In the course of your evidence, we will be seeking to 8 play that for the purpose of easy illustration. You 9 don't need to actually control that yourself, because 10 I think the secretariat can do the pause and play 11 buttons.</p> <p>12 Without further ado, can I ask you to identify your 13 report, your first report in the expert bundle. The 14 cover sheet is at page 399. It goes from page 399 up to 15 page 435, being the signature page. That is your 16 signature; correct?</p> <p>17 A. Correct.</p> <p>18 Q. Your second report is in the same bundle, page 470.</p> <p>19 THE CHAIRMAN: But there is also an appendix to --</p> <p>20 MR SHIEH: Yes.</p> <p>21 THE CHAIRMAN: -- or appendices to the first report.</p> <p>22 MR SHIEH: Yes, I will deal with that.</p> <p>23 You also included appendices to your first report.</p> <p>24 Appendix I is your curriculum vitae?</p> <p>25 A. Correct.</p>	<p>1 Marine Department in Hong Kong, and applied for that 2 position and was granted a 2.5-year contract, I believe, 3 as a ship surveyor, in which position I was working with 4 the Government New Building Section, although I was also 5 involved in doing some overseas work, which I mention 6 here, due to circumstances. For example, I went to East 7 Germany because I could speak German, and also got 8 involved with registering some ships which were building 9 here for the UK registration.</p> <p>10 So the purpose was to learn something about 11 regulation, and it was very successful, and I have the 12 greatest of respect for what I learnt with the Marine 13 Department.</p> <p>14 Q. Thank you. Now, we could see various positions and 15 areas of experience that you have listed out in your 16 curriculum vitae. Could you briefly explain to us, by 17 reference to individual items of your experience and 18 also employment, which are the particular aspects of 19 your professional history that you regard to be 20 particularly relevant to the subject matter of our 21 Inquiry here?</p> <p>22 A. It's been a long life, and I have been involved in very 23 many ships. I have been involved in shipbuilding 24 since -- I started in 1965, originally working with 25 a company manufacturing warships, for some 10 years. In</p>
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<p>1 Q. Page 436.</p> <p>2 You have a PhD from the University of New South 3 Wales on the topic of hydrodynamics of high-speed craft, 4 and a Bachelor of Science in Naval Architecture from the 5 University of Newcastle-upon-Tyne, UK, in 1970. It sets 6 out various awards you have received.</p> <p>7 THE CHAIRMAN: Can you just help me with the acronym "FIE 8 Aust"?</p> <p>9 A. A fellow of the Institute of Engineers, Australia.</p> <p>10 THE CHAIRMAN: Thank you. The previous one is fellow of the 11 Royal Institute of Naval Architects; is that right?</p> <p>12 A. Technically it's the Royal Institution of Naval 13 Architects.</p> <p>14 THE CHAIRMAN: Thank you.</p> <p>15 Yes, Mr Shieh.</p> <p>16 MR SHIEH: Of your professional background, we can see from 17 page 437 onwards, down to page 440, that you have 18 actually spent time with the Hong Kong Marine 19 Department. We can see that at page 440. Could you 20 explain to us your involvement with the Hong Kong Marine 21 Department back in the late 1970s, up to 1980?</p> <p>22 A. Certainly, sir. I was interested in the regulations of 23 shipping, particularly with regard to safety. And I was 24 looking for an opportunity to learn more about safety 25 regulations. I saw an advertisement for working in the</p>	<p>1 that position, my responsibility was for the safety of 2 the vessels. In particular warships are used, are 3 trialled for extensive periods of time, going to sea for 4 six weeks or something like that. My responsibility was 5 to ensure that the vessels were safe. I was responsible 6 for fire-fighting, and also for damage integrity in case 7 of collision or colliding with rocks; it was my 8 responsibility to make sure that the vessel was kept 9 safe. There were indeed a couple of incidents where we 10 did have breaches of the hull watertight integrity.</p> <p>11 I came to Australia in 1974 and --</p> <p>12 THE CHAIRMAN: Before you get to that, was HMS Sheffield the 13 same vessel that was damaged in the Falklands?</p> <p>14 A. Sadly that is true, sir, yes.</p> <p>15 THE CHAIRMAN: With an intense fire in part caused by 16 aluminium, or with that as the combustible material?</p> <p>17 A. A very interesting myth, Mr Chairman. If you go to 18 the --</p> <p>19 THE CHAIRMAN: Thank you for correcting it.</p> <p>20 A. If you go to the internet and put in "Sheffield fire" 21 and "aluminium", you get 24,000,700 hits, and they're 22 all wrong. The fact is that HMS Sheffield had no 23 aluminium whatsoever on board. The fire was intense, as 24 you've suggested. It was caused by an Exocet missile 25 which entered just above the waterline and finished up</p>

<p style="text-align: right;">Page 9</p> <p>1 inside the fuel tank. The missile did not explode, but 2 the burning efflux from the missile set fire to the fuel 3 and caused an intense fire. It also, unfortunately, 4 with the shock decommissioned all of the fire pumps so 5 there was no water available to fight the fire. 6 THE CHAIRMAN: But for our purposes, aluminium is 7 irrelevant? 8 A. Aluminium was irrelevant on Sheffield. 9 THE CHAIRMAN: Thank you. 10 A. I subsequently worked in Australia as a naval architect 11 with a consultancy company, eventually working with 12 a shipbuilding company called Carrington Slipways for 13 one year. I then started my own company. At that 14 stage, I started working with the Australian Maritime 15 Safety Agency, advising them on technical issues with 16 regard to regulations, and have attended the 17 International Maritime Organization as part of the 18 Australian delegation on -- I'm not sure, but 19 approximately 20 occasions, particularly involved in 20 writing the high-speed craft code. 21 I joined International Catamarans in 1989, which was 22 the company that first designed the very large 23 high-speed catamarans, many of which were operated in 24 the English Channel and in other places. I had some 25 experience there with small vessels which came to</p>	<p style="text-align: right;">Page 11</p> <p>1 investigate that particular incident. The vessel ran 2 onto a rock in severe weather and as a result of that, 3 eventually came off the rock and sank, with sad loss of 4 life. There were some experiences from that that 5 I think will be worth passing on, particularly with 6 regard to life jackets and the use of radar. 7 That led to my interest in how aluminium behaves 8 under crash circumstances, and we did do some 9 investigations using rather clever what are called 10 finite element techniques -- that is, computerised 11 software -- to understand how aluminium deforms under 12 load. 13 This was used in association with classification 14 societies, in this particular case one called 15 Germanischer Lloyd, to understand crash behaviour and to 16 attempt to design for it. 17 I finished with Austal Ships in April of last year, 18 and started my own company. I think that summarises my 19 experience with aluminium in particular, and with 20 investigation of unfortunate accidents. 21 Q. Thank you, Dr Armstrong. Could I now move on to the 22 other appendices of your expert report. Appendix II at 23 page 441 of the bundle sets out a list of the documents 24 that have been supplied to you for the purpose of your 25 first report.</p>
<p style="text-align: right;">Page 10</p> <p>1 Hong Kong. But the interesting thing there, and I think 2 the relevant thing was that we were building in 3 aluminium at a time when there were no regulations 4 covering these types of craft. And we worked with the 5 authorities to develop the regulations for aluminium 6 craft. 7 You can see there were some interesting experiences 8 there at International Catamarans, designing vessels the 9 like of which had never been seen before. 10 I got the opportunity to go back to university, 11 owing to the work I was doing with aluminium, and that 12 is when I did my PhD. After I had completed that at 13 university, I was offered a job with Austal Ships, which 14 is the world's largest builder of aluminium catamarans, 15 as the chief scientist or the person responsible for all 16 research and development. 17 In that position, my first task was to investigate 18 a rather unfortunate incident with a vessel called 19 Sleipner, which was a vessel built by Austal and a few 20 weeks after the owners took delivery, it was operating 21 in Norway when, owing to an error of navigation, it ran 22 aground onto a rock with, I think, six fatalities. 23 I can't be sure of the number now. 24 There was a lot of criticism, that the vessel had 25 been built too light, so I was charged by the company to</p>	<p style="text-align: right;">Page 12</p> <p>1 Appendix III at page 442 sets out the bundle 2 references to the various footnotes that you have 3 included in your report, so that provides a handy guide 4 to where we can find them. I'm not going to take you 5 through each and every of those bundle references, 6 because in the course of the evidence so far, we have 7 been reasonably treated to a fair share of those 8 documents. But I would direct your attention and ask 9 for your comment on a few more pertinent documents in 10 due course. 11 Appendix IV at page 446 is, again, a list, this time 12 of photographs and sketches or diagrams that you were 13 the author of. Again, I will be taking you to some of 14 those, especially some sketches showing the positions of 15 the two vessels. 16 So that is your first report. 17 Your second report, supplemental report, can we 18 found in the same bundle at page 470. Your signature 19 and statement of truth appear at page 478. 20 Again, at page 479 you refer to the bundle 21 references of the various footnotes that you have 22 included, and at page 480 there's a list of various 23 diagrams and sketches that you have compiled. Again, 24 I will take you to those in due course. 25 Your third report, which is really your second</p>

<p style="text-align: right;">Page 13</p> <p>1 supplemental report, is in expert bundle 2, page 923. 2 Your signature is at page 938. Again, following 3 a similar pattern, page 939, you set out the bundle 4 references for your various footnotes. Appendix IV at 5 page 940 sets out various diagrams and sketches that you 6 have compiled. Again, I will be taking you to those in 7 due course. 8 So, Dr Armstrong, with that structure of your 9 various reports, I would now propose to go back to your 10 first report and invite you to comment on various topics 11 as we go along. 12 Page 401, you set out the terms of reference and the 13 instructions that you have received. 14 Page 402, you set out the background of the incident 15 with which we are now reasonably familiar and therefore 16 I'm not going to take you to that in any detail. 17 Page 403, you set out a description of the 18 vessels -- based on various primary source materials 19 that you have seen -- Sea Smooth and Lamma IV. 20 Paragraph 6, you set out the details of the 21 investigation that you have undertaken. You refer to 22 attending the offices of the Commission's solicitors, 23 a meeting with senior surveyor of ships of Mardep, and 24 also, over the page, you refer to inspection of the two 25 vessels that you undertook.</p>	<p style="text-align: right;">Page 15</p> <p>1 Q. Was the mud still there when you entered? 2 A. A considerable amount of mud in certain places, yes. 3 Q. If I can now move on to the first section or first 4 heading of your report immediately above paragraph 7, 5 "Explanation for the extent of structural damage on 6 Lamma IV". There you refer to: 7 "The manner in which the structure had deformed at 8 the point of impact was assessed, and measurements of 9 the damaged area were taken, as reproduced in 10 appendix IV, item 8." 11 For that, could I invite you to look at your report, 12 appendix IV, item 8, which is page 464 of this bundle. 13 That is a sketch that you compiled, depicting the 14 dimensions and measurements of what has been called the 15 gash and the holes; correct? 16 A. Correct. 17 Q. Could you talk us through the depiction in this diagram? 18 A. Describing the diagram or as a sequence of events? 19 Q. No, describing and explaining the various notations and 20 what they are trying to show. 21 A. Okay. The top left-hand corner of the diagram shows the 22 main deck of Lamma IV on the port side, and is where the 23 Sea Smooth port bow first touched Lamma IV, around about 24 frame 7, although that information is not on the 25 drawing. The stem bar of Sea Smooth then entered into</p>
<p style="text-align: right;">Page 14</p> <p>1 Is there anything about the inspection, briefly, 2 that you would particularly wish to inform us of, over 3 and above what you have written in your detailed report? 4 A. I would just like to comment that the Sea Smooth was in 5 the water, so I was not able to inspect Sea Smooth other 6 than have a visual walk-around and look at the condition 7 of the vessel. But I was more interested in Lamma IV, 8 and I spent a considerable amount of time looking over 9 Lamma IV. 10 Q. So you've had a better opportunity to inspect Lamma IV 11 in detail? 12 A. Correct. 13 Q. Thank you. 14 THE CHAIRMAN: Lamma IV being on the hard? 15 A. Lamma IV being on the hard, yes, sir. I was ably 16 assisted by Chief Inspector Tang, who -- I'm sorry, 17 Senior Inspector Tang, who was able to show me parts of 18 the vessel that had been laid out, parts of Sea Smooth 19 that had been laid out on the hard underneath Lamma IV. 20 THE CHAIRMAN: They being items found on Lamma IV? 21 A. They being items being found inside Lamma IV. 22 MR SHIEH: And in particular, you have had a chance of 23 actually entering the engine room, the tank room and the 24 steering compartment of Lamma IV? 25 A. Correct.</p>	<p style="text-align: right;">Page 16</p> <p>1 Lamma IV and started creating a diagonal line down 2 towards the right, with a width of approximately 350. 3 I would point out that this diagram is somewhat 4 simplistic; that there was a jagged edge along the top, 5 and along the bottom also, a jagged edge on that 6 diagonal hole. But the plating had been pushed in, so 7 it was generally of a rounded shape, which I noted 8 because I was interested in how I would model this 9 numerically. So this diagram was really done as an aide 10 memoire to myself when I was making the hydrodynamic 11 model to simulate the flow of water into the ship. 12 That diagonal line then passed down to a point where 13 it met frame 6, which is where the cursor is now, and 14 I noticed that the plating that was missing from the 15 gash, the diagonal gash, had been folded down and was 16 occurring just underneath the lower fender on Lamma IV, 17 and is marked with the words "Folded plates" and can we 18 see in photographs. 19 Q. I'm going to show you that photograph, because 20 unfortunately we can't have the photograph and the 21 sketch side by side. I have in mind page 447. Can we 22 have a brief snapshot of page 447. 23 That's the photo you have in mind? 24 A. Yes, indeed. There is a mention there of "Diagonal gash 25 from stem bar", and just to the right of that you can</p>

<p style="text-align: right;">Page 17</p> <p>1 see there is some -- a little to the right of where the 2 cursor is now. Further to the right and lower down. At 3 the end of the black line. Further down. Thank you. 4 Just there. There. 5 There is a certain amount of plate doubled over. In 6 fact it only looks like one piece of plate doubled over, 7 but it is two pieces of plate. That was torn down from 8 the gash, the diagonal gash above it to the left. 9 If we can go back to the other diagram. 10 Q. To the sketch? 11 A. To the sketch. 12 Q. Page 464. 13 A. At that point, the stem bar has become clear of the 14 fender, and the diagonal gash to the left, on top of it, 15 it says "sharp edge", and that was a sharp edge because 16 it was following the line of a diagonal fender on the 17 shell side of Lamma IV, and which is a very strong 18 point. 19 As soon as it cleared that diagonal fender, it 20 started then to destroy more shell plate, and that can 21 be seen along the line which says "600". It was 22 destroying a much wider swathe of plating, and did so 23 until it reached frame 5, which is marked here with 24 "sharp edge". That described what I call "Hole 6" for 25 convenience, because it is centred on frame 6, although</p>	<p style="text-align: right;">Page 19</p> <p>1 I separated them because there are different physics 2 involved in the water flowing in. Nevertheless, they 3 appear as one hole. 4 I would at this stage like to add that of course 5 there was a lot of material from Sea Smooth remaining 6 within this hole, which had been cleared out when 7 I investigated it. So -- 8 Q. Can we pause here and look at the photograph at 9 page 447. 10 So the vertical sharp edge would correspond to the 11 frame 5 that we see over there; right? 12 A. Correct. 13 Q. Now we're at a stage where it continued to move aft? 14 A. Correct. 15 Q. Where it actually stopped at frame 4, which was the 16 bulkhead? 17 A. Bulkhead was on frame 4. 18 Q. Yes. 19 A. And that lower hole is caused by the extension of the 20 stem bar, which I've called the keelson, and actually is 21 shown in the diagram above you what have on the screen. 22 You can see here the stem bar which becomes a keelson, 23 it's all one piece of material, but naval architects 24 choose to give them different names. 25 THE CHAIRMAN: What are the two components made of?</p>
<p style="text-align: right;">Page 18</p> <p>1 it extends from frame 7 on the left to frame 5 on the 2 right. 3 Q. In fact I was about to ask you about the significance of 4 the numbering of the holes. 5 A. It was just for my own convenience. Where it says 6 "sharp edge", there is a frame on Lamma IV which is like 7 a rib of the ship. It is a strong point. At that 8 stage, I believe the stem bar on Sea Smooth's port bow 9 broke off, which is why it ceased to create any damage. 10 Q. That's the vertical line saying "sharp edge"? 11 A. The vertical line through "sharp edge". And the 12 remnants of that stem bar were found within the engine 13 room at approximately that location. However, the lower 14 part of the stem bar was still within Lamma IV, which is 15 why I have left a gap at the bottom, and it then started 16 to move aft into what is now called "Hole 4.5". 17 Q. Can we pause there. The "sharp edge" where the stem bar 18 broke, that would correspond to frame 4? 19 A. I think frame 5, from memory, not bulkhead 4. Frame 5. 20 THE CHAIRMAN: You told us "sharp edge" was frame 5. 21 A. "Sharp edge" is at frame 5. And it is a sharp edge 22 because frame 5 defines it as a sharp edge. 23 MR SHIEH: Yes. It continues to move. Sorry, yes. 24 A. Although I have written "Hole 6" and "Hole 4.5", they 25 are of course all one hole, but for modelling purposes</p>	<p style="text-align: right;">Page 20</p> <p>1 A. The two components on Sea Smooth, according to the 2 drawings and also from my own notes of some of the 3 remnants, are made of a hard wood approximately 220 by 4 50 mm or 70 mm -- I can't remember -- in width, and they 5 are encased in fibreglass and are an integral part of 6 the structure of the vessel. They represent a very 7 strong point of the vessel. Even though they're made of 8 timber and fibreglass, I'm not surprised they were able 9 to penetrate aluminium because they are very strongly 10 manufactured. 11 So it was the keelson or the lower part of the stem 12 bar that continued to move aft. 13 MR SHIEH: Yes. We can now return to page 464, the diagram. 14 A. Thank you. Continued to move aft in what I've called 15 "Hole 4.5". The width of the hole, or the height of the 16 hole, shown here as 400, roughly corresponds with the 17 keelson dimensions that I mentioned to you of 220, plus 18 fibreglass on top and fibreglass below, plus the bending 19 of the plate. The hole itself was closer to -- on the 20 inboard side, because the edges were rounded, on the 21 inside of the rounded edges was closer to 300 than 400. 22 At that point, it met bulkhead 4 and I believe broke 23 off. 24 Q. That's the watertight bulkhead between the tank room and 25 the engine room?</p>

<p style="text-align: right;">Page 21</p> <p>1 A. That is the watertight bulkhead. The watertight 2 bulkhead itself showed quite a lot of collision damage, 3 scratches, bending, a few cracks. Nothing substantial. 4 The bulkhead was essentially still intact, but did show 5 signs of having been in a collision. 6 Q. That was as a result of your observation in the engine 7 room and the tank room? 8 A. Sorry, could you repeat that? 9 Q. That was as a result of your observation of the bulkhead 10 itself from within, from inside the tank room and the 11 engine room? 12 A. Correct. 13 Q. Thank you. 14 A. Not only from inside the engine room, but also, of 15 course, looking through the hole from outside the ship 16 as well. 17 Q. From outside, yes. 18 A. And then also inspected from inside the tank room on the 19 other side, and I have photographs of that. 20 Q. Yes. 21 A. At that point, there was no part of Sea Smooth within 22 the hull of Lamma IV, but it is very important to 23 recognise that above the main deck other things were 24 happening and parts of Sea Smooth were within the cabin 25 of Lamma IV.</p>	<p style="text-align: right;">Page 23</p> <p>1 A. This is on page 387, Mr Shieh. 2 Q. Page 387, yes. 3 A. The lower photograph. 4 Q. Yes. The bottom one. 5 A. The bottom one. This is taken between frames 6 and 5. 6 It's the upper fender and lower fender. You can see 7 there's extensive damage to the upper fender, and that 8 matches damage on the collision bulkhead at the side, 9 port side, of Sea Smooth. That to my eye signifies 10 a substantial amount of damage, quite a large force, and 11 I believe that is the force that stopped Sea Smooth from 12 moving any further into Lamma IV. 13 Q. Thank you. Could we go back to the diagram at page 464. 14 Is there anything else you want to supplement in 15 relation to the sketch? We have got to the stage where 16 it ceased to move any further aft after hole 3.25. 17 A. The only thing I would like to comment on is that there 18 was some other damage, which I've noted here, which was 19 caused by lifting the craft out of the water. 20 Q. Yes; that's because of the cable. If we can see 21 page 447 -- 22 A. Correct. 23 Q. Page 447, the photograph. The bottom one. On the far 24 right, there is damage caused by recovery? 25 A. There was in fact some further damage which you can</p>
<p style="text-align: right;">Page 22</p> <p>1 Q. The foredeck, going -- 2 A. Which is not shown in this diagram. 3 Q. -- near the centreline, yes, the -- 4 A. This diagram only shows damage to the hull. 5 As Sea Smooth continued to move aft, the keelson 6 made large scratches in the deck plating between what is 7 called hole 4.5 and hole 3.25, in the region where the 8 cursor is now, until it finally penetrated the shell 9 plating again, making another roughly rectangular hole. 10 It then met frame 3 and broke off the keelson, 11 I believe, and parts of the keelson were found in the 12 tank room. At that point, the keelson no longer 13 continued to enter into the hull, I believe because the 14 collision bulkhead of Sea Smooth at this point contacted 15 the side of Lamma IV, and there is a photograph which 16 I can refer you to which shows extensive damage to the 17 side of Lamma IV where the collision bulkhead hit it. 18 I think the best picture is contained in Dr Cheng's 19 photographic report; that is, the forensic scientist's 20 report. 21 Q. Yes, I'm trying to locate that. 22 Could we have Dr Cheng's photo album, which is in 23 the same bundle, starting at page 382. 24 You're looking for a photograph depicting what you 25 call hole 3.25?</p>	<p style="text-align: right;">Page 24</p> <p>1 possibly make out on this photograph, as well as the 2 cable cutting through, which of course can be ignored 3 for the purposes of the investigation. But where it 4 says "Bhd 4", just to the right of it was a strap which 5 was used to lift the boat out of the water at the 6 dockyard. The cable damage further out, which you've 7 referred to, I think, was used to pull the boat -- bring 8 the boat back upright and to bring it towards the shore. 9 So there were two different lifts. 10 So between the holes, at around about frame 4, there 11 is some damage to the plating just to the right of 12 bulkhead 4, which was caused by the lifting strap. 13 There are some photographs in one of the police bundles 14 which show this. 15 Q. Again, those can be ignored for the purpose of 16 investigating the effect of the impact? 17 A. Indeed. I was quite puzzled originally by what had 18 caused that damage, but the photographs clearly explain. 19 I think there's also a good photograph in marine 20 bundle 2, "Photographs". One of the items in marine 21 bundle 2 is called "Photographs". 22 Q. So that would be a close-up of the sort of damage that 23 you now say to be immaterial for the purpose of 24 investigating the effect of the impact? 25 A. Correct.</p>

<p style="text-align: right;">Page 25</p> <p>1 Q. Perhaps we can move over that for the time being, and if 2 we can locate that close-up, then perhaps we will ask 3 you to comment on it. 4 Could we now go back to the text of your report at 5 page 404. At paragraph 8, you mentioned the broken-off 6 remnants of the bow structure of Sea Smooth having been 7 removed from the hull of Lamma IV at the Government 8 Dockyard having been examined separately. And you refer 9 to the pieces corresponding to the stem bar which had 10 been removed from Lamma IV and had been aligned in their 11 correct relative positions. 12 At footnote 5 you refer to a photograph which we can 13 find in marine bundle 8, page 1981. 14 Is that the one, Dr Armstrong? 15 A. Yes, correct. 16 Q. "Photo showing the re-assembled port side keelson". 17 A. Correct. If I might explain the photograph? 18 Q. Yes, please. 19 A. On the right-hand side there is a blue portion. This is 20 substantially bigger than appears in the photograph. It 21 is the part which we call the forefoot of the vessel. 22 It's where the stem bar meets the keelson. It's lying 23 on its side. The right-hand side would be the bottom of 24 the ship, and the bottom of the photograph is the bow of 25 the ship, if I can make myself clear. So the parts that</p>	<p style="text-align: right;">Page 27</p> <p>1 A. Yes, that is the stem bar. The piece on the left 2 corresponds to the piece you saw in the previous 3 picture, and then there's another piece to the right. 4 You can probably make out there in the red part, in the 5 middle of the picture, the letters "1M", which means 6 "1 metre", and that's a draft mark. Just above that, 7 you might be able to make out "1.2" and then above that, 8 "1.4". 9 Q. Yes. Thank you, Dr Armstrong. 10 Could we now go back to your report. At 11 paragraph 9, you refer to the extensive series of 12 photographs taken by the police of the debris removal. 13 You have not actually referenced any particular 14 photograph, but basically that is the set of photographs 15 which gives one a broad idea as to the debris that's 16 left and the general appearance of -- 17 A. Correct, and I was interested in how much debris there 18 was in the hull, because of course I never saw it, for 19 the purposes of doing a numerical model to simulate the 20 flooding of the vessel. 21 Q. Thank you. Would it assist if you were -- 22 THE CHAIRMAN: What is the photograph reference of these 23 photographs? 24 MR SHIEH: Footnote 6. It is -- 25 THE CHAIRMAN: Yes, I see that.</p>
<p style="text-align: right;">Page 26</p> <p>1 you can see to the left of the large blue construction 2 are the stem bar, and the stem bar normally sits 3 approximately vertically. That is the part that cut 4 into Lamma IV and created the diagonal gash. 5 You can see it's broken into seven or eight parts, 6 which is consistent with striking the internal structure 7 of Lamma IV, in my opinion. 8 If the photograph could be rotated 90 degrees to the 9 right, clockwise, it maybe would be more clear. 10 Okay. So this shows the stem bar rising up the 11 page, and that is roughly, although it's lying down, the 12 stem bar running up the page, and along the bottom of 13 the page would be the keelson, with the forefoot the 14 blue part on the right. 15 Q. Which would have continued to the right? 16 A. Which would have continued to the right. 17 Q. Yes, which we don't see in the picture. 18 A. Correct. There are other pictures, I believe, in this 19 folder, which show more of that blue part. Because it 20 has the draft marks on it. In fact, on this picture 21 I can just see one of the draft marks, although it's 22 quite difficult to make out. 23 Q. Yes. There is a similar picture at page 1980, the top 24 of that page. 25 Could we rotate that 90 degrees anti-clockwise.</p>	<p style="text-align: right;">Page 28</p> <p>1 MR SHIEH: -- police album IX, page 427 onwards. I was 2 about to ask Dr Armstrong whether he wished to have 3 a brief look at those photos and see if there were any 4 particular ones that he wished to comment on in 5 particular. 6 Do you believe that may be helpful? 7 A. That may be helpful, because some of these photographs 8 demonstrate that it was extremely difficult to get some 9 of this debris out. 10 MR SHIEH: Could we have police album IX, page 427 onwards. 11 A. For example, page 441 shows gentlemen having difficulty 12 pulling out some pieces of fibreglass, and they've 13 attached clamps and then attached these clamps to 14 a crane to pull the parts out sideways. 15 Maybe page 444 is an illustration of how they were 16 trying to apply force to pull it out. 17 There's a series of photographs, then, all the way 18 to page 455 whilst they pulled that large piece out. 19 Q. Page 455. That's in the course of being pulled out, 20 yes. 21 A. There's a picture at page 461 of people using crowbars. 22 Page 464 shows a crane being used to remove parts. 23 Q. In fact the whole series of this set, running all the 24 way to page 475, illustrates the attempts to clear up 25 the debris?</p>

<p style="text-align: right;">Page 29</p> <p>1 A. Indeed, and page 477 shows some of the parts being 2 lifted vertically by the crane. 3 THE CHAIRMAN: Were they photographed laid out on the hard, 4 relative to the areas from which they'd been extracted? 5 A. They were laid directly underneath Lamma IV. 6 THE CHAIRMAN: Could we look at those photographs. 7 MR SHIEH: I'm sorry? 8 THE CHAIRMAN: Laid out on the hard, directly beneath where 9 they'd been extracted. 10 A. Correct. 11 MR SHIEH: If we can see page 502. In fact, page 491 12 onwards, because that is actually a consecutive series 13 of photographs. Page 486, for example, shows actually 14 the crane lifting it up. Do you see that, Dr Armstrong? 15 Then we move forward to page 491. That's where they 16 are laid out. 17 A. (Witness nods). 18 Q. Page 492 -- 19 A. Correct, although I did not see them laid out in this 20 fashion because they had been moved underneath Lamma IV, 21 presumably to take up less room. 22 MR SHIEH: And this series of pictures which show them being 23 laid out goes up to page 504, Mr Chairman. 24 There's one at page 511, but that doesn't actually 25 show the whole broken-off part.</p>	<p style="text-align: right;">Page 31</p> <p>1 the appearance of the radar tracks that had been 2 generated by the Mardep system. Could you briefly 3 explain to us how the large wake generated by the Sea 4 Smooth could well have impacted on the results of any 5 radar observation? 6 A. Yes. It is a fairly well understood phenomenon that 7 when a vessel travels at a certain speed in a certain 8 depth of water, it emphasises the pressure around the 9 vessel. This has parallels with aircraft when they're 10 trying to land and they generate pressure under the 11 wings, and it's called "ground effect" for an aircraft. 12 On a ship in shallow water, the pressure developed 13 around the hull moving through the water is exaggerated 14 by the depth of water, and there is a relationship 15 between speed and depth, as I said, which is called the 16 depth Froude number -- doesn't matter what it's 17 called -- but it just so happens that at a depth Froude 18 number of 1, there are some, in theory at least, very, 19 very large effects that happen which causes the vessel 20 to trim, that is to assume a large angle of deck, and 21 also to sink down in the water. There has been quite 22 a lot of investigative work done on this phenomena here 23 in Hong Kong, with large vessels coming into the 24 harbour, done by a university in Australia with whom 25 I have association, so I'm aware of that work.</p>
<p style="text-align: right;">Page 30</p> <p>1 A. You can see in that photograph, this is taken from the 2 side of Lamma IV and you can see the parts on the hard 3 alongside. 4 Q. Thank you, Dr Armstrong. 5 Could we now return to the text of your report. At 6 paragraph 10, you set out various plans for Lamma IV, 7 which you had seen and which had received Mardep 8 approval. We have actually seen a good deal of those 9 when the Mardep witnesses were testifying, and I don't 10 particularly propose to go through them at this 11 juncture, because in due course, when we discuss the 12 question of interpretation of these plans and also the 13 question of watertight bulkhead, we will be returning to 14 these plans, Dr Armstrong. 15 At paragraph 11 you discuss the calculation of the 16 draft of Sea Smooth. I don't particularly propose to 17 take you to any detailed part of that. 18 Over the page, you refer to "the speed-depth 19 relationship which is independent of vessel shape or 20 size shows a dramatic peak in trim and sinkage effects 21 at this depth and range of speeds, as well as producing 22 a very large wake." 23 Just to foreshadow a little bit in terms of the wake 24 that was created by the Sea Smooth travelling at that 25 speed, you will be commenting on the effects of this on</p>	<p style="text-align: right;">Page 32</p> <p>1 A lot of work done at the University of Liverpool in 2 the 1980s indicate that, in theory at least, at the 3 depth Froude number of 1, the effects of pressure are 4 such as to create all the waves that are generated by 5 the ship all become one wave, and that one wave 6 encompasses all of the energy generated by the ship. 7 On a catamaran, that has some strange effects, that 8 it creates a very large wave between the hulls 9 travelling at the same speed as the ship. It just so 10 happened, by coincidence, that Sea Smooth was operating 11 between 22 and 24 knots, and the critical depth for that 12 speed is 13.1 metres. That just happens to be the depth 13 of water, according to the Department of Justice's 14 information I have, at the site. So unfortunately, Sea 15 Smooth was -- 16 Q. Fortunately or unfortunately? 17 A. Unfortunately. Sea Smooth was travelling at exactly 18 a depth Froude number of 1 -- and it may have only been 19 temporarily. As soon as it went into deeper water or 20 slowed down, of course that would change. 21 It was relevant to this particular paragraph because 22 I was interested in what attitude Sea Smooth was at to 23 try and understand where the deck was relative to the 24 deck of Lamma IV when the two boats met. But I made 25 a comment here that it was also producing a very large</p>

<p style="text-align: right;">Page 33</p> <p>1 wake. It was only later on, when I read some evidence 2 which was presented when talking about radar, I believe, 3 that I realised the significance that this large wake 4 would have continued on past as Sea Smooth -- 5 Q. That is the evidence of the Dutch gentleman who was 6 responsible for designing the system? 7 A. I believe so. The wave behind Sea Smooth would have 8 carried on with the same speed as before, and I don't 9 know whether the radar can pick up a wave echo. My 10 experience is it can, but I don't know details about the 11 Hong Kong radar and I'm no expert in radar. But in my 12 experience of radar on ships, they can pick up waves and 13 it was travelling at the same speed as Sea Smooth, and 14 I was aware that the radar showing Sea Smooth continued 15 on past the Lamma IV after the accident for 16 approximately 9, 10 seconds. 17 Q. Which you referred to as spurious? 18 A. Which I used the word "spurious", obviously incorrectly, 19 because at this stage in my opinion Sea Smooth was 20 stationary and within Lamma IV for a period of time. So 21 I did wonder if we were seeing the wake carrying on. 22 Q. So basically the large wake generated could provide 23 a possible explanation as to why the radar images showed 24 Sea Smooth to continue moving on past Lamma IV for 25 a period of around 9-10 seconds?</p>	<p style="text-align: right;">Page 35</p> <p>1 A. Well, I'm aware that people of Chinese origin tend to be 2 less weight than fat Americans -- thank goodness -- and 3 therefore I felt 85 was a little exaggerated. But the 4 fact that people's weight is known throughout the world 5 to be increasing, I chose to try and replicate what was 6 happening on the night of October 2012 more accurately 7 by increasing the weight a little to 70 kg. I accept 8 there were children -- a lot of children, sadly -- on 9 board. But that 85 kg also allows for children. So 10 70 kg was my best attempt to replicate the weight of 11 passengers. 12 Fuel oil, I took from the comments of the engineer 13 on board and the master on board, which is documented. 14 And the freshwater, I assumed a figure. 15 For stores and crew effects, I again assumed 16 a reasonable figure, and the heights and centroids of 17 all those items I took from the existing Stability Book. 18 Q. Thank you. Could I take you to paragraph 14 of your 19 first report, at page 406, where you refer to 20 appendix IV, item 4 of your report, which we can see at 21 page 452. You say: 22 "This diagram shows close correlation with the 23 extent of damage to the bow of Sea Smooth and to the 24 sequence of structural failure on Lamma IV as further 25 explained."</p>
<p style="text-align: right;">Page 34</p> <p>1 A. It is a possibility. 2 Q. We'll come to that when we get to your second 3 supplemental report. 4 We now come to Lamma IV at paragraph 12. 5 You say: 6 "The draft of Lamma IV at the location of the damage 7 was also calculated using standard naval Architecture 8 Procedures ..." 9 There you set out various assumptions. 10 At this juncture, could I trouble you to turn to 11 your second report at page 471 of this bundle. 12 A. Perhaps you mean page 481. 13 Q. Yes. Do you have anything to supplement paragraph 12 of 14 your first report in relation to estimation of the draft 15 of Lamma IV at the location of the damage? 16 A. Thank you, sir. There are some assumptions I would like 17 to comment on. For example, passenger weight. The 1995 18 Instructions from Mardep require you to assume a weight 19 of 68 kg, and the previous Blue Book assumes 64 kg. 20 I chose to ignore those, because I thought they were 21 somewhat old, and the accident happened recently. I'm 22 in mind that IMO has been tracking the average weight of 23 passengers over the years and has recently increased the 24 average weight of a passenger to 85 kg. 25 Q. Yes, because people are generally heavier now?</p>	<p style="text-align: right;">Page 36</p> <p>1 So this is a diagram which depicts the manner in 2 which the two vessels were positioned at the point of 3 collision? 4 A. Correct. 5 Q. Could you explain to me the meaning of "foreshortened" 6 here, "Sea Smooth appears to be foreshortened"? 7 A. Yes, indeed. The two vessels were of course in three 8 dimensions, and here I'm trying to represent them on 9 a two-dimensional page. So Sea Smooth is at roughly 10 40 degrees to the paper. It is not coming in from the 11 left; it is coming in from somewhere behind the paper at 12 an angle of 40 degrees. So this is how it would look to 13 someone looking at a film, as it were. The vessel looks 14 a little shorter than it would otherwise do. In fact, 15 on page 455, I do show a diagram where it's not 16 foreshortened, because I believe that the situation 17 shown on page 455 at the bottom, it was lying at 18 perpendicular to Lamma IV. 19 Q. Yes. 20 A. So it's just an attempt to account for the geometrical 21 angle at which Sea Smooth was lying. 22 Q. Now, talking about the geometrical angle, you have seen 23 Dr Cheng's measurement about the angle taken from the 24 middle of the gash, being 30 degrees. But he actually 25 gave evidence that what he did was simply to measure the</p>

<p style="text-align: right;">Page 37</p> <p>1 physical angle, whereas your evidence tried to work out 2 the angle of collision -- 3 A. Correct. 4 Q. -- and you came up with the figure of 40 degrees. That, 5 I believe, is the combined effect of paragraph 15 of 6 your first report at pages 406 to 407, as well as your 7 supplemental report in the same bundle at page 475(d). 8 Could you comment on this issue of the angle of impact? 9 A. I'm sorry, could you give me the reference again in the 10 second bundle? 11 Q. Your supplemental report. Page 475, subparagraph (d). 12 A. Excuse me, Mr Chairman, whilst I locate it. 13 THE CHAIRMAN: Yes. Take your time. 14 A. May I refer also to the diagram on page 487. 15 MR SHIEH: Yes. This is the vector diagram? 16 A. This is the vector diagram. If we assume that Lamma IV 17 was travelling at 11 knots up the page, and Sea Smooth 18 was travelling at 22 knots down towards the right, with 19 an angle between them, a true angle between them of, in 20 this case, 41.6 degrees, then the resultant vector -- 21 that is, the angle that would appear on Lamma IV when 22 struck by Sea Smooth -- would be the angle of 28 degrees 23 as shown here, and that would be the line of the cut 24 that you would expect to see in the deck. 25 I've also put on this diagram that the relative</p>	<p style="text-align: right;">Page 39</p> <p>1 A. It was deliberately taken from directly above the gash, 2 so that I could use this to measure angles. 3 Q. You're on the deck? 4 A. I'm on the deck above. I'm not even on the deck -- I'm 5 leaning over the deck above, held by my legs so I didn't 6 fall over. I also, I should add, took some measurements 7 on the deck itself and also from underneath. So this is 8 just one piece of evidence, trying to get information on 9 the shape of this. And I did plot it out on a piece of 10 graph paper. 11 The point about the angles is that the line of the 12 stem bar extends from just to the right of the tyre at 13 the top of the picture, and the gash line at the top is 14 very close to a straight line, although it's a rather 15 jagged straight line -- thank you, that's exactly right, 16 where the cursor has gone -- and that is exactly 17 28 degrees. 18 However, you can see that the gash itself is wider 19 to the left of the picture, and the angle down the 20 middle of the gash is closer to 30 degrees, which is 21 what Dr Cheng measured. So I think we are in agreement. 22 But I believe that 28 is more representative of the 23 angle of the stem bar coming in. 24 Q. Could I come back to the text of paragraph 15 of your 25 first report. There, you refer to various photographs</p>
<p style="text-align: right;">Page 38</p> <p>1 speed of one to the other along that cut line would be 2 31.3 knots. 3 Now, the 11 knots and the 22 knots are assumed, and 4 therefore I gave the other relevant values on page 407, 5 assuming that the vessels had been travelling at a range 6 of other speeds. I did this because I thought it would 7 be useful for the Inquiry to know that the vessels had 8 actually met, according to this evidence, at an angle of 9 about 40 degrees, maybe even more than 40 degrees, which 10 indicated to me that one or other of the vessels had 11 changed heading at the last moment. 12 Q. So the long and short of it is that the diagram, the 13 vector diagram that we see on this page, is the result 14 of taking two assumed values of the speed of Lamma IV 15 and Sea Smooth that we can find at page 407, but you 16 could result in slightly different vector diagrams if 17 you were to pick different combinations of assumed 18 speeds? 19 A. Correct, and the results of those are given on page 487 20 in the table. 21 Could I possibly refer you to another diagram, which 22 is page 955 in the second expert bundle. 23 Q. Yes. 24 A. This is a photograph of the gash in Lamma IV. 25 Q. Yes.</p>	<p style="text-align: right;">Page 40</p> <p>1 and diagrams, some of which we have seen and some of 2 which not yet, and I would wish you to assist us by 3 commenting briefly on them. 4 Paragraph 15 at page 406, you refer to appendix IV, 5 item 2, which is a picture that we have seen at 6 page 447, the bottom. But also you have prepared some 7 diagram showing sequentially the generation of the 8 various holes and gashes, starting at page 448. so could 9 I ask you to look at page 448, which is appendix IV, 10 item 3.1, all the way down to 3.7. Could I ask you to 11 look at, first of all, the picture showing "First point 12 of contact, at deck level", and perhaps you can comment 13 on these various diagrams. 14 A. Yes. That first diagram shows the first point of 15 contact, and that is taken from the position of the gash 16 in the deck. Where the arrow is is actually a little 17 further aft than it should be; it was just aft of 18 frame 7. But the point was that it was just in front of 19 the diagonal fendering, which is shown in heavy black -- 20 thank you, that's exactly the one. That seemed to drive 21 the shape of the damage. That diagonal fendering was so 22 strong that Sea Smooth's stem bar was not able to 23 penetrate it, and I believe distorted the stem bar as it 24 went in and caused it to fracture, which is one of the 25 reasons why the stem bar is in many component parts as</p>

<p style="text-align: right;">Page 41</p> <p>1 opposed to just being one. 2 If you can move down to the sketch below that. 3 I have been through this before, but it moves down along 4 the blue arrow and folds up the plating in the area 5 marked in yellow. 6 Then maybe moving on to the next diagram. 7 Q. Page 449, top of the page. 8 A. That's generated a gash, which I've shown. The stem bar 9 continues to move down, which hopefully you'll see in 10 the video, from inside the engine room. 11 If we could continue down. It then clears the 12 fender, and in the area B, starts to destroy the plating 13 at the ship side over a greater area, until it meets 14 frame 5. 15 Q. That is still within the engine room? 16 A. Still within the engine room. Although it is rather 17 simplistically explained here, of course within the 18 engine room, there are pieces of equipment and in this 19 location, there are two small but quite substantial oil 20 tanks. These were knocked over and were left lying on 21 the floor of the engine room. They are at about this 22 location. 23 At this point, the stem bar broke, at frame 5. 24 Moving on, the keelson remained within Lamma IV and 25 moved aft, creating the hole shown by the blue arrow,</p>	<p style="text-align: right;">Page 43</p> <p>1 A. Correct. 2 Q. Thank you. 3 That's the series of sketches in appendix IV, 4 item 3. 5 Appendix IV, item 4 is another series of sketches 6 depicting the positions of the two vessels from 7 a different perspective. 8 Could we have page 452. 9 We've looked at page 452 before. There is a series 10 of sketches following that, which show the penetration. 11 Would you comment on those? I think we can start from 12 page 452 and then you can ask for the screens to move 13 forward as and when you think appropriate. 14 A. Yes. If we can go to page 452. Thank you. 15 This shows Sea Smooth with quite a large angle on 16 it, but this is due to the depth Froude number that 17 I referred to earlier, and that is what I believe the 18 angle was on this vessel. I've marked in grey the stem 19 bar and the keelson, which are the strong parts that did 20 so much damage to the hull. I bring to your attention 21 that the deck of Lamma IV cut through the bow of Sea 22 Smooth, and that is marked as "Line of cut through bow". 23 The height of that line of cut through bow I did 24 establish by measuring it, by going on board Sea Smooth, 25 opening the manhole cover and reaching down with a tape</p>
<p style="text-align: right;">Page 42</p> <p>1 until it struck the engine room bulkhead at frame 4, 2 where it then broke off. 3 Thank you. If we can move on to the next one. 4 Q. D and E, yes. 5 A. Unfortunately the Sea Smooth still had enough forward 6 momentum to once again enter into Lamma IV's hull, and 7 there are deep scratches where it says "Location D" as 8 the stem bar moved forward and then eventually it 9 penetrated into the hull -- this is the tank room -- 10 until it broke off when it met frame 3 at "Location E" 11 in this diagram. At that stage, the collision bulkhead 12 of Sea Smooth struck the side of Lamma IV and stopped 13 any further penetration. 14 That coincided with the forward end of Sea Smooth 15 also meeting the air-conditioning unit inside the cabin, 16 which is a comment made by Dr Cheng. 17 Q. As we shall see in some later sketches that you have 18 done. We'll move on to that. 19 Location E is a location within the tank room. 20 A. It is. 21 Q. But before you get to the non-watertight bulkhead? 22 A. Correct. And the non-watertight bulkhead is shown there 23 at the after end of the vessel. 24 Q. Yes, in this diagram, the access opening, the 25 non-watertight bulkhead is further aft.</p>	<p style="text-align: right;">Page 44</p> <p>1 measure. It was along the line of a stiffener, so it 2 was a straight line. That line of cut through the bow 3 does match very closely with the deck height of 4 Lamma IV. 5 I'd also bring to your attention that the very 6 forward point of Sea Smooth, at the top of the stem bar, 7 strikes Lamma IV in this particular diagram just below 8 the window. In reality, looking at the marks on 9 Lamma IV, I believe it was a little higher than that. 10 In fact Dr Cheng's report does have a photograph of some 11 red pipework that was displaced. So it could be there 12 is some small discrepancy, and Sea Smooth was a little 13 higher than shown in this diagram. Either that or 14 Lamma IV was a little lower. 15 I cannot be sure that Lamma IV was upright, because 16 it depends on how the passengers were distributed. They 17 may have been to one side. And Lamma IV may, and 18 I believe was, turning. So if Lamma IV was turning to 19 starboard, it would mean that the left-hand side, as 20 seen here, would have been a little lower down. But 21 I don't have that information for sure. 22 Q. A little bit lower down, therefore the point of impact 23 would have been higher? 24 A. A little higher, yes. That would also agree with the 25 keelson entering Lamma IV just above what is called the</p>

<p style="text-align: right;">Page 45</p> <p>1 chine; that is, the change in shape underneath the 2 water. Just there, yes. So I suspect that the diagram 3 is not quite right. Lamma IV should be a little lower 4 in the water. 5 Q. Thank you. 6 A. If we can move on to the next diagram. 7 Q. Page 453, the top. 8 A. Page 453, the top. 9 Based on Sea Smooth doing 22 knots and stopping 10 within a certain distance, I have estimated the timing. 11 You can see here on the left-hand side, this is 0.15 of 12 a second later. The stem bar is cutting into the side 13 of Lamma IV, running down the sloping fender, as 14 I showed previously, and the top of the stem bar and 15 the -- you might recall Dr Cheng referred to 16 a triangular plate on the forward end, on the foredeck. 17 Q. Yes. The bit that fell off? 18 A. The bit that fell off. In fact that is shown by the 19 person using the cursor at the present time, striking 20 the superstructure. It's my belief that the Lamma IV 21 rolled inwards at this stage, which I've depicted in the 22 picture. 23 We can move on to the next one. 24 This is just meant to indicate a little later in the 25 stage, 0.31 of a second later. You can see that Sea</p>	<p style="text-align: right;">Page 47</p> <p>1 A. So the stem bar has knocked over the pillar, and the 2 keelson is entering into the tank room here, and at this 3 point the collision bulkhead, item 6.2, strikes the side 4 of Lamma IV. 5 Q. That's where you say: 6 "... the 'forward' motion of Sea Smooth is 7 effectively halted by the very strong collision bulkhead 8 ... meeting the hull of Lamma IV." 9 A. Correct. 10 I've then made some comments about how they were 11 rotating relative to one another, but perhaps, Mr Shieh, 12 we can wait until the video. 13 Q. Yes. Just pausing here. Had it not been for the strong 14 collision bulkhead on the port side hull, what would 15 have happened? 16 A. That is the purpose of the collision bulkhead, of 17 course. It's a very strong point, to allow the ship to 18 withstand such a collision. I understand there was 19 leakage, there has been evidence that there was leakage 20 in the next compartment, but I think it was quite 21 minimal, considering. 22 Q. So had it not been for a strong collision bulkhead, Sea 23 Smooth might even have penetrated beyond the centreline? 24 A. Yes, I believe that could be the case. I don't think 25 the resistance of the air-conditioning unit would have</p>
<p style="text-align: right;">Page 46</p> <p>1 Smooth is now entering the cabin of Lamma IV. 2 At the area marked "3.1", I believe this is where 3 the stem bar starts to break into pieces inside 4 Lamma IV, inside the engine room. 5 The next picture, on page 454 at the top, a little 6 later, 0.57 of a second, the stem bar strikes frame 5 7 and this is where the -- it has previously been 8 destroying quite a lot of the plating on the side of 9 Lamma IV. It strikes frame 5, and I believe the stem 10 bar breaks up into pieces at that point. 11 In the main cabin, the stem bar comes very close to 12 a vertical pillar and in fact hits this pillar and 13 displaces it. It doesn't knock it over; it just knocks 14 it to one side. That can be seen in photographs lying 15 at an angle of about 30 degrees. 16 At the bottom of the page -- 17 Q. That's where you referred to displacing the supporting 18 pillar in the last note? 19 A. Yes. 20 Q. "... foredeck of Sea Smooth makes contact with 21 a supporting pillar within the cabin and displaces it to 22 an angle of about 10 degrees." 23 A. And indeed on the next page I have illustrated that, at 24 the top. 25 Q. Page 455. Yes.</p>	<p style="text-align: right;">Page 48</p> <p>1 been as large as a resistance as the collision bulkhead. 2 So I think it would have gone further. But there is 3 another photograph which I might refer to later, if 4 that's okay, which will reinforce that point. 5 THE CHAIRMAN: But they operated in conjunction with one 6 another, the air-conditioning unit and the collision 7 bulkhead on the other vessel? 8 A. They both occurred at the same time. 9 THE CHAIRMAN: And both had the effect of slowing down the 10 progress of Sea Smooth into Lamma IV? 11 A. Correct, Mr Chairman. But I believe the collision 12 bulkhead had the greater effect. 13 THE CHAIRMAN: Yes. Thank you. 14 Do we have a drawing that shows us where the 15 collision bulkhead is on Sea Smooth? 16 A. The next series of photographs might assist in that 17 regard. 18 THE CHAIRMAN: Thank you. 19 MR SHIEH: Because the next series of drawings are viewed 20 from the top? 21 A. I meant the next series of sketches, not photographs. 22 Q. Perhaps let's finish off with the sketches from this 23 particular perspective first. You've commented on 4.6.2 24 at page 455, if we can move down. Anything you wish to 25 add to the last sketch? You mentioned the rotation of</p>

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1 the two vessels.
2 A. I think the rotation might be better shown in the next
3 series of slides.
4 Q. Okay.
5 A. It's difficult to talk about rotation when looking from
6 the side.
7 MR SHIEH: Mr Chairman, now we are moving on to the next
8 series, appendix IV, item 5. I wonder whether it would
9 be an appropriate moment, being 11.30?
10 THE CHAIRMAN: Yes, certainly.
11 Dr Armstrong, we'll take a break now. You're
12 familiar with our procedures. We'll take a break now
13 for 20 minutes.
14 (11.30 am)
15 (A short break)
16 (11.50 am)
17 THE CHAIRMAN: Mr Shieh, before you go on, there's something
18 we'd like to address Mr Pao about, and it is this.
19 The Commission would be assisted by some information
20 to be provided by Cheoy Lee about the contract it
21 awarded to the New Zealand fabricators of the
22 superstructure of Lamma IV, and we'd be grateful to be
23 provided with design plans or the contract, the
24 instructions, and what we're particularly interested in
25 is the upper deck; that is to say, the floor on the

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1 upper deck or the ceiling, as it was, on the main deck.
2 Would you be in a position to assist us with that?
3 MR PAO: I shall take instructions on that.
4 THE CHAIRMAN: Thank you very much.
5 MR SHIEH: Dr Armstrong, before the mid-morning break we
6 looked at two series of sketches that you had done for
7 the purpose of your first report.
8 Can we now move on to the third series, which is
9 item 5 of appendix IV, which we can find in the bundle
10 at page 456. Again, following a similar pattern, this
11 starts from 0 seconds all the way down to page 462,
12 which is 2 seconds. Perhaps we can ask you to start
13 from 0 seconds, page 456, and perhaps talk us through
14 these various sketches.
15 A. Yes, Mr Shieh.
16 This series of diagrams is based on speeds of
17 Lamma IV of 11.5 knots, and Sea Smooth of 22.5 knots.
18 I understand that the speeds may not be exactly known,
19 but this is what I chose for this particular exercise,
20 and a relative heading of 40 degrees.
21 Can I first of all explain, on Sea Smooth, there are
22 some features that I would like you to bear in mind. On
23 the port side at the bow, you may be able to see
24 a dotted line.
25 Q. Do you want it close up?

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1 A. Thank you. The dotted line there. That dotted line
2 represents the shape of Sea Smooth at the deck of
3 Lamma IV. At the front end of that, there is a dot
4 which represents -- the forward end of the dotted line,
5 there is a heavy dot which represents the stem bar on
6 Sea Smooth where it would be in line with the deck.
7 Q. Would it be better if we look at the lower one, which
8 says "In greater detail" because it is a close-up?
9 A. I think that would be good.
10 Q. Yes.
11 A. And maybe up a little bit. Thank you.
12 So item C is the dotted line, which is the line of
13 the deck of Sea Smooth in line with the deck of
14 Lamma IV. The item B is the stem bar on Sea Smooth at
15 the same level as the deck of Lamma IV. You may be able
16 to see marked here "B" a small thin curved line, and
17 that is the gash in the deck of Lamma IV.
18 This indicates what I've called time 0. This is
19 when the stem bar of Sea Smooth first struck the side of
20 Lamma IV. In fact, at this stage a little bit of the
21 bow of Sea Smooth can be seen at position A, having hit
22 the side of the deckhouse, and those marks are clearly
23 visible just above the window in one of the pictures,
24 which I can locate if necessary.
25 Q. Which bundle do you want? Dr Cheng's report or the

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1 police bundle?
2 A. I'm sorry, I don't have my report in front of me.
3 Q. Take your time.
4 A. Dr Cheng in fact does have a picture of it.
5 Q. Dr Cheng's photos start at page 382.
6 A. Keep going, please.
7 Okay, that will do.
8 Just above where it says "The gash", and to the left
9 of that, there is a vertical white support between two
10 windows. To the left again. Okay, just to the right of
11 where you are. Okay. There is a white vertical support
12 between windows. Above that, there is indentation with
13 red marks. I believe that is where the upper part of
14 Sea Smooth first struck the side of the deckhouse.
15 If we can go back to page 456.
16 Q. That would correspond to which part in that lower
17 diagram?
18 A. That would correspond with -- I can show you.
19 Q. Is it further down point A?
20 A. If you look at page 453, item 2.1, it's the top of the
21 triangular plate or the very forward end of that
22 triangular plate.
23 Q. Yes.
24 A. Okay. I'm back on page 456. As you correctly say,
25 Mr Shieh, it's "A" on that diagram.

<p style="text-align: right;">Page 53</p> <p>1 Q. Yes.</p> <p>2 A. If I might move on to the next diagram, time 0.15. This</p> <p>3 is meant to show that the stem bar, shown here with the</p> <p>4 letter D, is following the cut line in the deck. I also</p> <p>5 noted here that there is some vent trunking on the</p> <p>6 vessel, and I believe that I could see marks on the stem</p> <p>7 of Sea Smooth corresponding with having struck that vent</p> <p>8 trunk. But I would not be 100 per cent sure of that.</p> <p>9 There were many marks on the front end.</p> <p>10 If I might move on one.</p> <p>11 Q. Yes.</p> <p>12 A. Time 0.31. Still following the cut line, with item F,</p> <p>13 but whilst I am on this picture could I draw your</p> <p>14 attention to above the letter F, in rather dark, thick</p> <p>15 ink, there is what looks like a letter T on its side.</p> <p>16 The left-hand side of that is the collision bulkhead.</p> <p>17 Directly in front of the three seats. Yes, that part.</p> <p>18 Thank you.</p> <p>19 Q. Yes, right.</p> <p>20 A. That is the position of the collision bulkhead. Then</p> <p>21 running down and to the right is the keelson. So the</p> <p>22 purpose of those two dark lines is to illustrate where</p> <p>23 the collision bulkhead is, and where the keelson is.</p> <p>24 It's at about this point that the stem bar meets frame 5</p> <p>25 and breaks off, and at that point the cut line in the</p>	<p style="text-align: right;">Page 55</p> <p>1 end just above the chine line, in the engine room.</p> <p>2 If we might move on one more. This is time</p> <p>3 0.82 seconds. At this stage the keelson strikes</p> <p>4 bulkhead 4 at the after end of the engine room and</p> <p>5 breaks off. I do not know for certain what angle Sea</p> <p>6 Smooth is at here, but I do know that the collision</p> <p>7 bulkhead has not yet contacted the side of Lamma IV. So</p> <p>8 that gives me some idea of what the angle is. I also</p> <p>9 know how much penetration occurred in the toilet block,</p> <p>10 which is shown at the after end -- exactly, thank you.</p> <p>11 There -- because the deck that I previously described is</p> <p>12 cutting through the top of the toilet block but leaving</p> <p>13 the toilet block intact.</p> <p>14 I might be able to explain that, if I may, Mr Shieh,</p> <p>15 by referring to another photograph, which is in the</p> <p>16 second expert bundle on page 954. The top picture.</p> <p>17 Q. Yes.</p> <p>18 A. This is seen from the after end of Lamma IV, and above</p> <p>19 the blue you can see a white structure.</p> <p>20 Q. Yes.</p> <p>21 A. This is the remains of the toilet block. You can</p> <p>22 probably make out there is a shadow between the deck</p> <p>23 overhead and the toilet block, and that is because the</p> <p>24 deck of Sea Smooth cut right through there, lifting the</p> <p>25 deck away from the toilet block structure. Once Sea</p>
<p style="text-align: right;">Page 54</p> <p>1 deck stops, because the stem bar is broken off.</p> <p>2 May I move on?</p> <p>3 Q. 0.57 seconds.</p> <p>4 A. 0.31, I think. That's the one we've just done, yes.</p> <p>5 0.57. At this point, at part I, the very forward</p> <p>6 corner of Sea Smooth makes contact with a pillar,</p> <p>7 a vertical pillar between the seats on Lamma IV.</p> <p>8 I should explain that due to the construction of</p> <p>9 a catamaran, a catamaran has two hulls. I've been</p> <p>10 talking about the port hull. The starboard side hull is</p> <p>11 off to the bottom left and played no part in this</p> <p>12 incident at all. But between the two there is a deck,</p> <p>13 and the deck is above the, shall we say, head level</p> <p>14 inside the cabin, so it is destroying bits of structure</p> <p>15 on top, on the ceiling, if you like, above people's</p> <p>16 heads.</p> <p>17 It is also above the structure, the bottom left of</p> <p>18 Lamma IV, so is not causing any damage to Lamma IV at</p> <p>19 this stage, other than what is happening on the deckhead</p> <p>20 of the cabin.</p> <p>21 Here you can see the keelson marked "H" first</p> <p>22 entering into the hull and making what I called</p> <p>23 hole 4.5.</p> <p>24 Q. 4.5 is the hole still in the engine room?</p> <p>25 A. Correct. It's the long rectangular hole at the after</p>	<p style="text-align: right;">Page 56</p> <p>1 Smooth pulled away from Lamma IV, the deck then</p> <p>2 collapsed back onto it and broke, and you can actually</p> <p>3 see the break line about the middle of the picture.</p> <p>4 But the important part of this picture is, to the</p> <p>5 right of the toilet block, it has not severed completely</p> <p>6 through. The right-hand side at the deckhead is not</p> <p>7 broken through. A little bit to the right of there,</p> <p>8 thank you.</p> <p>9 So I maintain that is about as far as the Sea Smooth</p> <p>10 penetrated through the toilet block at that angle. We</p> <p>11 will see that it did penetrate into the vessel more, but</p> <p>12 at this particular angle, that's about as far as it</p> <p>13 went.</p> <p>14 I also note, whilst this photograph is here, that</p> <p>15 although the starboard hull would have blocked off the</p> <p>16 view that you see in this photograph, there is no damage</p> <p>17 to what is called the bulwark plating. The bulwark</p> <p>18 plating is the blue plating with "Lamma IV", where it's</p> <p>19 written on it, which extends round the left-hand side of</p> <p>20 the boat. In the lower picture on this page, on the</p> <p>21 right-hand side, you can actually see where the bulwark</p> <p>22 plating, which has a tyre hanging off it, is completely</p> <p>23 undamaged, even though it was lying between the two</p> <p>24 hulls and underneath the deck.</p> <p>25 This clearly indicates to me that Sea Smooth could</p>

<p style="text-align: right;">Page 57</p> <p>1 not have continued on past Lamma IV, but must have 2 stopped and pulled out. I'm not saying mechanically 3 pulled out, but in some way spun out. 4 Q. Right, spun out. 5 A. It could not have carried on, otherwise that bulwark 6 plating would have not been there, and certainly not 7 remained intact. 8 If I might go back to page 460. 9 Q. Yes, back to 0.82 seconds? 10 A. 0.82 seconds. I think I have explained that the keelson 11 now strikes bulkhead 4 and shears off, and the pillar 12 has been pushed over at position I. 13 Could we move on to 1.1 seconds. 14 Q. Page 461, yes. 15 A. At this point, the keelson has re-entered the shell 16 plating in the tank room behind the engine room bulkhead 17 at location L. 18 Moving on to the next timestamp. 19 Q. Could I stop here at page 461. What does the arrow 20 indicate in the bottom part of this page? 21 A. Sorry, it's meant to be the letter L. 22 Q. Right. It's not an arrow, it indicates the presence of 23 the letter L? Right. 24 A. The letter L is just meant to draw your attention to the 25 keelson, actually.</p>	<p style="text-align: right;">Page 59</p> <p>1 Q. The bottom photograph shows the damaged air-conditioning 2 unit, which was the block fore of the toilet; right? 3 A. Correct. 4 Q. And the top part shows the deep blue paint smears? 5 A. Correct. 6 Q. Which led to your comment at page 474 of this bundle. 7 A. Also on this photograph you can see damage to the 8 deckhead structure. 9 Q. You mean the top picture at page 391? 10 A. The top picture at page 391, showing damage to the 11 structure which is coming from the deck of Sea Smooth 12 after that level. 13 The blue paint also coincides with my diagram on 14 page 462. It indicates that the boat went in a little 15 bit further than I thought. But I'm quite happy to 16 accept Dr Cheng's expertise with regard to the paint 17 smear. 18 Q. You reproduced that diagram, at 2 seconds, at page 486 19 of your supplemental report. 20 A. Yes. Thank you for reminding me of that. Yes. In 21 fact, I think, as I say, Sea Smooth is a little further 22 in to have made that paint mark. Unfortunately I was 23 unaware of Dr Cheng's report when I wrote this, but it 24 shows quite good correlation nonetheless. 25 Q. Which is the point you made at paragraph 9(b) of your</p>
<p style="text-align: right;">Page 58</p> <p>1 Then at time 2.0, the keelson has broken off. There 2 is no part of Sea Smooth within the hull, that is below 3 the deck, other than those broken-off parts, and you can 4 see the collision bulkhead has struck the side of 5 Lamma IV just forward of frame 5. Also -- 6 Q. The three chairs? That's the hard, solid line in front 7 of the three chairs? 8 A. Correct. That is also indicated by damage on the side 9 of Sea Smooth in the way of the collision bulkhead. 10 You will also notice that just forward of the toilet 11 block on Lamma IV, there is a box, a rectangular box, 12 which is in fact the air-conditioning unit or the 13 air-handling unit. 14 Q. Yes. 15 A. I think the air-handling unit, supported by the toilet 16 block, which was quite a strong unit, also helped to 17 arrest the motion of the boat. 18 I believe this is the furthest that Sea Smooth 19 penetrated inside Lamma IV. 20 Q. Could you look at page 391 of this bundle, photo 20. In 21 fact, if you look at both photos because this leads on 22 to a comment that you make in your supplemental report. 23 Do you recognise these two photographs that Dr Cheng 24 appended to his report? 25 A. Yes.</p>	<p style="text-align: right;">Page 60</p> <p>1 supplemental report at page 474. 2 A. Yes. 3 Q. Thank you. 4 Could I now return to the text of your written 5 report, page 406. It is at page 406, at paragraph 15 6 where you introduced the various items in appendix IV, 7 which you have just kindly talked us through, the 8 various diagrams from various perspectives. So I think 9 that more or less covers the subject matter of 10 paragraphs 15 and also 16, because 16 I think is 11 a verbal presentation of what you have just told us just 12 now in the witness box; correct? 13 A. Correct. 14 Q. And also over the page at 408, at paragraph 17, you 15 commented on the strength of the materials from which 16 the stem bar and the keelson were made. I think that's 17 something that you commented on. 18 A. Correct. 19 Q. Paragraph 18, you describe the penetration of the 20 keelson, the resulting of the second hole, and glancing 21 off the side -- 22 A. In fact, Mr Shieh, if I may, I do have a typographical 23 error there. I intended to write "bounce off the side", 24 not "glance off the side". 25 Q. Yes, because I was about to ask you about this</p>

<p style="text-align: right;">Page 61</p> <p>1 phraseology of "glance off". You mean "bounce off"?</p> <p>2 A. It was a bad choice of words. I apologise I meant to</p> <p>3 say "bounce off the side".</p> <p>4 Q. Because later on, especially when you get to your second</p> <p>5 supplemental report, you actually went into greater</p> <p>6 detail as to the relative position and movement of the</p> <p>7 two vessels when one actually "extracted" from the</p> <p>8 other. But I'll come back to this question about</p> <p>9 "bouncing off" or "glancing off" later.</p> <p>10 Paragraph 19, you commented on the question of</p> <p>11 kinetic energy and the point that had it travelled at</p> <p>12 a slower speed, Sea Smooth might not have penetrated the</p> <p>13 hull a second time. By that, I take it to mean the</p> <p>14 penetration by the remains of the keelson into the tank</p> <p>15 room?</p> <p>16 A. Yes. I was just trying to emphasise for the Commission</p> <p>17 the point that when you go faster, you create a lot of</p> <p>18 energy because it's a function of velocity squared.</p> <p>19 Q. Yes.</p> <p>20 A. So going slower greatly reduces the kinetic energy of</p> <p>21 a vessel. And, yes, I was referring to the hole in the</p> <p>22 tank compartment may not have happened.</p> <p>23 Q. Paragraph 20. This relates to the missing stainless</p> <p>24 steel stem plate. But you have since seen Dr Cheng's --</p> <p>25 well, not explanation. Dr Cheng relayed what he had</p>	<p style="text-align: right;">Page 63</p> <p>1 THE CHAIRMAN: So this is an order given by Cheoy Lee to</p> <p>2 a contractor; is that how we're to understand this?</p> <p>3 MR SHIEH: Yes, somebody called Wu Bing-cheun. I may be</p> <p>4 able to look at the Chinese version and be in a better</p> <p>5 position.</p> <p>6 It's dated 24 September 2012, so about a week before</p> <p>7 the collision. It is to -- and then a number of names</p> <p>8 of individuals, they might be individual contractors,</p> <p>9 and below that, names of various foremen. And the yard</p> <p>10 building number, and then there is the name of "Sea</p> <p>11 Smooth", and under particulars, item 3 is what I have</p> <p>12 read out from the English. Can we move on to the</p> <p>13 English. Yes:</p> <p>14 "The metal plating on the port bow surface is</p> <p>15 missing. Make a new one and be installed in due</p> <p>16 course."</p> <p>17 24 September 2012.</p> <p>18 THE CHAIRMAN: Thank you.</p> <p>19 MR SHIEH: Dr Armstrong, could I now ask you to look at</p> <p>20 a cluster of paragraphs, because we are now getting to</p> <p>21 the point about the duration when they were "joined</p> <p>22 together", and the manner in which they separated, or</p> <p>23 one vessel became disengaged from the other. You're</p> <p>24 aware of that point?</p> <p>25 A. Yes.</p>
<p style="text-align: right;">Page 62</p> <p>1 been told about why that had gone missing.</p> <p>2 A. And I've also seen a letter from the Department of</p> <p>3 Justice yesterday in which the police have confirmed</p> <p>4 that -- I think it was the police -- an order was placed</p> <p>5 on Cheoy Lee for a replacement forefoot.</p> <p>6 MR SHIEH: Mr Chairman, I wonder whether or not you wish to</p> <p>7 pursue that bit of primary factual evidence or whether</p> <p>8 we continue with this line of questioning?</p> <p>9 THE CHAIRMAN: Perhaps it would be useful to touch on it.</p> <p>10 I've seen it myself this morning. Has this been</p> <p>11 paginated? Has it been scanned?</p> <p>12 MR SHIEH: I believe so. Perhaps we'll supplement the page</p> <p>13 number for the Commission's benefit once it has been</p> <p>14 located.</p> <p>15 THE CHAIRMAN: Yes.</p> <p>16 MR SHIEH: Here we are. It's Holman Fenwick Willan bundle</p> <p>17 page 122.</p> <p>18 THE CHAIRMAN: Yes.</p> <p>19 MR SHIEH: That is in Chinese.</p> <p>20 THE CHAIRMAN: Page 123 I think is the working translation.</p> <p>21 MR SHIEH: The next page is the translation, I think, yes.</p> <p>22 It's a job order by Cheoy Lee. Item 3:</p> <p>23 "The metal plating on the port bow surface is</p> <p>24 missing. Make a new one and be installed in due</p> <p>25 course."</p>	<p style="text-align: right;">Page 64</p> <p>1 Q. This is paragraph 21 that we start with:</p> <p>2 "The time duration of the collision was very short.</p> <p>3 By measurement of the extent of the damage and knowing</p> <p>4 the relative speeds of the two craft it is calculated</p> <p>5 that the time from the first penetration of the hull to</p> <p>6 the cessation of damage to the hull of Lamma IV between</p> <p>7 the two craft was about 1.1 seconds.</p> <p>8 22. In my opinion the Sea Smooth and the Lamma IV</p> <p>9 were never truly 'joined' together during the collision.</p> <p>10 All of the structure of Sea Smooth that penetrated the</p> <p>11 hull of Lamma IV and caused severe damage quickly broke</p> <p>12 up within the hull of Lamma IV as it travelled aft, and</p> <p>13 broke off from Sea Smooth when the collision bulkhead</p> <p>14 struck the side of Lamma IV. There remained no volume</p> <p>15 of the main body of Sea Smooth blocking the holes in</p> <p>16 Lamma IV's hull, only individual 'flat' shell plates and</p> <p>17 remnants of the shattered structure. The upper</p> <p>18 structure of Sea Smooth did enter the passenger cabin</p> <p>19 and remained there for at least two seconds as it moved</p> <p>20 aft creating damage, until it finally came to rest, but</p> <p>21 from that time on it is not clear what happened."</p> <p>22 Now, it is from that point onwards that I think you</p> <p>23 set out your views here in the alternative, but</p> <p>24 eventually elaborated or modified your view; would that</p> <p>25 be a fair way of putting it? Why don't I leave it to</p>

<p style="text-align: right;">Page 65</p> <p>1 you to develop your arguments basically for 2 paragraph 22, and also could I direct your attention to 3 page 934 of the same bundle, which is your second 4 supplemental report. I think it's better for me to 5 direct your attention to those parts and allow you to 6 develop the point. Paragraph 31 onwards of your second 7 supplemental report, page 934. Paragraph 31 all the way 8 down to paragraph 35.</p> <p>9 A. Yes. Thank you, Mr Shieh. I did indeed attempt to 10 reproduce what I could find about the movement of the 11 two boats following the time after 2 seconds from the 12 collision.</p> <p>13 Originally I looked at the radar tracks, but 14 I noticed that the radar tracks after the collision were 15 not, in my opinion, correct. I used the word "spurious" 16 in my report. Because they show that Sea Smooth 17 continued on for approximately 9-10 seconds after the 18 incident, continuing on the same course, and then 19 appeared to track backwards at some very high speed, 20 which was obviously not correct.</p> <p>21 Q. Pausing here. You mean if you perform a track of the 22 radar tracking data at three-second intervals, it would 23 show, contrary to what we have known, that Sea Smooth 24 actually rammed straight through Lamma IV and continued? 25 A. Or glanced off at a shallow angle, yes.</p>	<p style="text-align: right;">Page 67</p> <p>1 that AIS data may not be accurate in specific terms, but 2 I have always found it to be quite accurate in relative 3 terms. What I mean is, if you move from one point to 4 another, then the GPS will actually replicate that quite 5 accurately. It may not just tell you that you are here, 6 it may tell you that you are there, but it will tell you 7 that you have moved the requisite distance at the right 8 angle.</p> <p>9 With that in mind, I then plotted the AIS data of 10 Sea Smooth and the radar data from Lamma IV, and that is 11 reproduced --</p> <p>12 Q. Page 941?</p> <p>13 A. Page 941 in fact shows the radar track. If I might 14 refer you to page 941.</p> <p>15 Q. Page 941 is radar versus radar.</p> <p>16 A. Indeed. According to the Mardep radar.</p> <p>17 Q. Page 942 --</p> <p>18 A. Well, page 941 first of all shows the collision 19 occurring at approximately 20:20:17, and maybe a little 20 bit after. Then it looks as if Sea Smooth, travelling 21 from the top left and in black, continues down, or 22 glances off and continues on in almost a straight-line 23 course, for 20:20:20, 20:20:23, 20:20:28 -- those 24 signals cannot be right -- and then backtracks at 25 roughly 53 knots to the point at 20:20:29. After that,</p>
<p style="text-align: right;">Page 66</p> <p>1 I was aware that the radar here -- I am not 2 an expert in radar, I hasten to add, but I was aware 3 that the radar here has some predictive capability so 4 that it may associate the echoes with a particular known 5 vessel. I estimated that possibly what we were seeing 6 were spurious signals as the echo, the software driving 7 the radar was saying the echo should be here but was not 8 actually recording an echo.</p> <p>9 Q. Pausing here. Would that be affected also by the speed 10 at which Sea Smooth was travelling?</p> <p>11 A. Well, it could well be and it could have also been 12 influenced by the wake that Sea Smooth was generating. 13 I do not know this. I am not an expert in radar. But 14 I am aware that the radar is only historical. It's only 15 telling you what happened some seconds ago. And I'm 16 aware that there must be some predictive capability, 17 otherwise in a harbour like Hong Kong, it wouldn't be 18 possible to know which echo belonged to which ship.</p> <p>19 So I took the liberty of looking at the AIS data 20 from the GPS system on board Sea Smooth. I accept that 21 that's not a normally acceptable, accurate way of 22 plotting two vessels, one from the radar track and one 23 from the AIS track, but I nevertheless chose to see what 24 I could find.</p> <p>25 I was quite surprised -- I should first of all say</p>	<p style="text-align: right;">Page 68</p> <p>1 it actually shoots off north somewhere and obviously 2 those positions are quite spurious.</p> <p>3 Q. By "spurious", you mean "could not have been correct"?</p> <p>4 A. Could not have been correct. It is not possible from 5 the damage for Sea Smooth to have made the damage that 6 it did on Lamma IV and then continued on. As you saw, 7 it stopped in front of the toilet block. And also, the 8 bulwark remained intact, which would not otherwise be 9 possible.</p> <p>10 So, if I may move on, Mr Shieh, on the next page --</p> <p>11 Q. Page 942.</p> <p>12 A. Page 942. Here I have just plotted the radar track in 13 green for Sea Smooth against the AIS indication, shown 14 in black. You can see the track is slightly different.</p> <p>15 Q. Yes.</p> <p>16 A. But nevertheless I took the liberty of, if I can move on 17 to page 943, plotting the AIS in black for Sea Smooth, 18 and the radar for Lamma IV. From that information, 19 I then, to the correct scale -- and this is all to 20 scale -- in the next diagram on page 944 positioned the 21 two vessels. In this particular case, I chose to put 22 the Sea Smooth AIS data at the position of the antenna 23 on board, and for Lamma IV, I put it approximately where 24 I thought the echo would be showing, without being 25 an expert in radar and knowing where the echo centre</p>

<p style="text-align: right;">Page 69</p> <p>1 would be predicted by the software. So the position of 2 Lamma IV may be a little approximate. Nevertheless, the 3 red dot you can see almost in the middle of Lamma IV is 4 within Lamma IV. 5 If I may move to three seconds later, the next page. 6 We can see that Lamma IV has turned to starboard, 7 and in this diagram the two vessels are meeting at 8 40 degrees. 9 On the next page, 20:20:21 and a little bit more, 10 the vessels have collided and the damage location on 11 Lamma IV is exactly where it was recorded on the vessel. 12 There's now a series of pictures at three-second 13 intervals approximately which fit the radar and AIS data 14 and indicate how the vessels interacted and rotated, 15 according to the tracks. 16 So if we may move on to the next one. 17 Q. Page 947? 18 A. Page 947. You can see that Sea Smooth has pushed the 19 after end of Lamma IV to one side, and itself, because 20 only one hull has made impact, has started to stern to 21 port. 22 On page 948, that situation has continued, with both 23 rotating anti-clockwise. 24 Then three seconds later, on page 949, they have 25 separated. I believe at this stage that probably</p>	<p style="text-align: right;">Page 71</p> <p>1 a little to the south-west of where it is here. 2 There is a video simulation of these two tracks, if 3 you intend to show that, Mr Shieh. 4 Q. It is now the version that can be shown? 5 A. Yes, the white version can be shown. 6 Q. Yes. Can we have that. 7 A. This fits exactly those points that we have just seen 8 second by second. 9 Q. Thank you. Perhaps you would also give the relevant 10 commands to the secretariat, so Mr Lo would be able to 11 pause and restart at the appropriate time. 12 A. Okay. There are two videos here. One is small-scale, 13 seen from further away. But it may be more interesting 14 to watch the white one first. If you might pause just a 15 second, the yellow vessel is Sea Smooth and the white 16 vessel is Lamma IV. They've both been approaching each 17 other on a reasonably constant course, which we can see 18 from the smaller-scale video, if you would like to see 19 that. 20 If you just continue, please. 21 (Video played) 22 You might just see the white one turn to starboard 23 about now. Lamma IV goes backwards briefly, before 24 starting to move forward. And then because of the 25 rotation, Sea Smooth comes out. This is shown in real</p>
<p style="text-align: right;">Page 70</p> <p>1 Lamma IV's engines were still operating ahead, but it's 2 pure speculation on my part. It would have been quite 3 difficult in a few seconds for the coxswain to have 4 pulled the power off, but I'm a little unsure of that. 5 The radar track suggests that, when we see this in 6 video, when Sea Smooth hit Lamma IV, it did push it 7 backwards for a brief period of time before Lamma IV had 8 then moved forward again, and I believe that's because 9 the engines were still engaged. 10 Six seconds later, on page 950, Sea Smooth is 11 stationary and stationary for something like 15, 12 16 seconds at that location. Lamma IV remains roughly 13 at this location. I do not know what heading Lamma IV 14 had after this point. It could have continued to 15 rotate. I just have no information. I just know where 16 it was from the radar, but do not know what the heading 17 was. 18 Then on the next page, another six seconds later -- 19 Q. That's page 951? 20 A. Page 951. 21 Q. 20:20:41? 22 A. 20:20:41. Sea Smooth is still stationary at that 23 location, and Lamma IV has moved a little bit. But 24 there are no further tracks -- well, there's one further 25 point, which is not shown, for Lamma IV, which is</p>	<p style="text-align: right;">Page 72</p> <p>1 time and to scale. 2 (Video played) 3 You might want to show that again. 4 (Video played) 5 From about this point on, the AIS track of Sea 6 Smooth matches reasonably well with the radar of Sea 7 Smooth, which is by now logged on to Sea Smooth. Of 8 course, I can't be sure of the exact heading of Sea 9 Smooth, but it must have rotated because it moved off 10 towards the top right of the picture after this. I did 11 not show Lamma IV sinking at this point, but that is 12 where the vessel went down. 13 I accept that it's somewhat -- I can be criticised 14 for plotting the radar track of one vessel and the GPS 15 of another. 16 THE CHAIRMAN: Yes. You've made that clear at the outset. 17 A. But in fact they match the damage on both vessels, and 18 I believe it is an interesting illustration of what 19 really happened. 20 MR SHIEH: Dr Armstrong, I believe there is another video, 21 colloquially called the red one. Just now you had the 22 white one; I thought there's another one? 23 A. On the screen. There is another one. It's the same 24 picture, but just small-scale. It's a larger-scale 25 view. By all means, show it.</p>

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1 I have another video taken from inside the engine
2 room, but I have not yet downloaded that.
3 Q. Yes, that's the one that hopefully will be available
4 after lunch.
5 A. Correct.
6 Q. So you do not believe that we actually need the other
7 video?
8 A. Oh, by all means, if the court has time.
9 (Video played)
10 Once again, the speeds are correctly modelled and
11 the ships are the right size.
12 You can see that Sea Smooth was not inside Lamma IV
13 for very long at all. It is possible that Sea Smooth
14 was mechanically reversed out, but I don't believe so
15 because it would have come out of its own anyway.
16 (Video played)
17 Q. Thank you, Dr Armstrong.
18 Now, on this particular point about mechanically
19 reversing out versus coming out of its own under the
20 rules of physics, could I direct your attention to what
21 you said in your second supplemental report. It's
22 really paragraph 31 of your second supplemental report
23 that deals with your point about the problems caused by
24 the radar signal associated with Sea Smooth, and which
25 caused you to turn to the alternative of the AIS signal;

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1 right?
2 A. (Witness nods).
3 Q. That leads on to paragraph 33:
4 "Given the unreliability of the radar track,
5 I therefore looked at the AIS data produced by the
6 ship's GPS system."
7 Then at paragraph 32 and paragraphs 34 and 35, you
8 address this question about the possibility of Sea
9 Smooth having mechanically reversed itself versus the
10 conclusion that you drew at paragraph 35, that "Sea
11 Smooth probably came away from Lamma IV of its own
12 volition, and not by being backed out, although
13 witnesses in the cabin of Lamma IV could not know this
14 because of their limited view of the overall situation."
15 Dr Armstrong, you are aware -- I think you have been
16 shown the witness testimony of various Lamma IV
17 passengers who testified to having felt power
18 restarting, engine restarting, possibly the other vessel
19 backing out. You're aware of the effect of that
20 evidence?
21 A. I am aware of it, yes.
22 Q. Could you take on board that evidence and try to explain
23 to us your view as to the probable or possible reason
24 for the disengagement of the two vessels following the
25 collision?

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1 A. I do not know, Mr Shieh, but I can hypothesise that it
2 was a very confusing situation and things happened very
3 quickly. As you can see from the timing that I've
4 indicated, everything happened in a very short period of
5 time. At some stage, Sea Smooth was very close to
6 Lamma IV and stationary for a while, and then moved on.
7 So at that stage the engines must have been operating
8 for it to move forward. And I do not know, but it could
9 well be that the sound of the engines was heard as Sea
10 Smooth moved away.
11 I also note that when the two vessels collided with
12 each other, I believe that throttles were still pretty
13 much full on. Certainly there is evidence which I talk
14 about in my paragraphs 34 and 35, that Lamma IV was
15 attempting to turn, and I believe had throttles fully
16 open, trying to turn away. That could have -- well, it
17 would have been very difficult for the coxswain to take
18 power off quickly when the vessel was subject to
19 deceleration values and everything was chaotic. So
20 I don't know how long the engines were operated on full
21 power immediately after the collision, and it would have
22 taken time for the power to come off.
23 I think the whole confusing situation in a very
24 short period of time means that it's very difficult to
25 be sure as to exactly what noises were what. At some

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1 stages, of course, the main engines on Lamma were
2 flooded and there would have been some extraneous noises
3 there, as there would have been from the generator.
4 Q. But that would have been further down the timeline, when
5 you talk about the engines becoming flooded.
6 A. About 12 seconds later for the engine; about 18 seconds
7 later for the generator.
8 Q. But that would have been long after the disengagement of
9 the two?
10 A. A few seconds later, yes.
11 Q. When you say at paragraph 35 --
12 THE CHAIRMAN: Before you move on, those two time estimates
13 that you've given, do they relate -- the one for the
14 engine of 12 seconds, the other for the generator of
15 18 seconds -- what are they estimates of?
16 A. Mr Chairman, I'll be a bit more exact. And I'm sorry,
17 the figures are incorrect. 18 seconds was the time
18 I estimated the generator was flooded. That is based on
19 my flooding model. And it was based on that was the
20 time at which the water flooded more than half of the
21 immersed rotating alternator, so there must have been
22 electrical parts and essential components underwater at
23 that stage.
24 THE CHAIRMAN: Meaning it would cease to work?
25 A. Meaning it would cease to work. I believe it would have

<p style="text-align: right;">Page 77</p> <p>1 been accompanied by some extremely loud noises as the 2 electrical system tripped all the overload switches and 3 so on. 4 It is difficult to know when the main engines 5 stopped because they would operate for a while whilst 6 underwater, up to a point. But somewhere between 25 and 7 28 seconds. 8 THE CHAIRMAN: And what would bring them to a stop, what 9 aspect of water ingress? 10 A. I'm not expert enough to be able to tell you the answer 11 to that, Mr Chairman. I would suggest it would have 12 been electrical -- I'm sorry, I'm losing a word -- the 13 control system, anyway, for the speed. 14 THE CHAIRMAN: These were diesel engines? 15 A. These were diesel engines, yes. They have a speed 16 controller on them -- I'm sorry, I'm forgetting the 17 correct term for that -- that would have become 18 submerged. They're mounted quite high on the engines. 19 THE CHAIRMAN: It would be the submerging of the speed 20 controller that would bring them to a stop? 21 A. I believe so. 22 THE CHAIRMAN: Thank you. 23 A. But I don't profess to be an expert, Mr Chairman. 24 THE CHAIRMAN: Thank you. 25 A. Of course, eventually any air-intake system will become</p>	<p style="text-align: right;">Page 79</p> <p>1 At page 409 of the bundle, which is your first 2 report, in the middle of paragraph 22 you posed one 3 possibility: 4 "I consider it possible that Lamma IV could have 5 extracted itself quite quickly and without mechanical 6 power from Sea Smooth because it was by this stage 7 moving in an astern direction at about 3.5 knots owing 8 to the transfer of momentum from Sea Smooth, and there 9 was little to hold the upper part of Sea Smooth within 10 the confines of Lamma IV passenger cabin. However, it 11 is equally possible that Sea Smooth remained within 12 Lamma IV for a short time and was mechanically reversed 13 out. If this was the case, then the passengers within 14 the cabin would be unaware that there was no bow part of 15 the hull of Sea Smooth below their deck, even though the 16 upper part of the bow was obviously within their cabin, 17 and neither could they be aware that the reversing of 18 Sea Smooth would make no difference to the inflow of 19 water into the hull. If Sea Smooth was reversed out it 20 must have happened within about 10 seconds, as Lamma IV 21 was by now quickly sinking." 22 Now, in this paragraph, what do you say the 23 passengers within Lamma IV would be unaware of? Can you 24 explain in greater detail? Because you make the point 25 that if the passengers felt something, then it's because</p>
<p style="text-align: right;">Page 78</p> <p>1 submerged. 2 MR SHIEH: There are a couple of references to the awareness 3 of passengers within the cabin of Lamma IV that I draw 4 your attention to. One is page 409, your first report. 5 THE CHAIRMAN: Before we leave paragraph 34 on page 935, 6 Dr Armstrong makes reference to a number of witness 7 statements as opposed to transcripts of evidence. 8 MR SHIEH: Yes. 9 THE CHAIRMAN: Have all these witnesses given evidence, or 10 not? Tang Ying-kit? 11 MR SHIEH: Wong Tai-wah certainly gave evidence. 12 THE CHAIRMAN: Perhaps you can come back in due course. 13 MR SHIEH: We can come back and see which of those have 14 actually testified. It's being done, Mr Chairman. 15 THE CHAIRMAN: Thank you. In particular, Tang Ying-kit 16 seems to be relevant. 17 MR SHIEH: Ms Lam Muk-lin also did, but instead of doing it 18 bit by bit perhaps we'll compile a full list of those in 19 that cluster who have actually testified. 20 THE CHAIRMAN: What we're more interested in is if 21 Dr Armstrong has relied on from someone who hasn't given 22 testimony. 23 MR SHIEH: Dr Armstrong, the question that I'm going to pose 24 to you also relates to the reaction or perception of 25 those on board.</p>	<p style="text-align: right;">Page 80</p> <p>1 they were not aware of certain other things. 2 A. I'm referring to the probably fairly natural thought 3 that if a vessel is embedded within your vessel, then it 4 may be blocking the inflow of water into the hull; and 5 if it is reversed out, then it may be making the hole 6 bigger and the ship you are on will sink all that much 7 quicker. So in certain situations, it can be 8 advantageous to leave one vessel embedded within 9 another. 10 What I'm trying to say here is, some of the 11 passengers may have thought that, but in reality there 12 was no part of Sea Smooth within Lamma IV below the 13 deck. So that scenario was not the case. But the 14 passengers would not be aware of it, because they could 15 not see below the decks. 16 Q. So they were not aware of the breaking off of a huge 17 part of the stem bar? 18 A. They could not have been. 19 Q. Or the breaking of the keelson? 20 A. It was all happening inside the engine room, so they 21 could not be aware of that. 22 Q. Thank you. 23 A. I did write this part before I looked at the AIS data, 24 by the way, and I think the AIS approach probably 25 overrides my comment about "must have happened within</p>

<p style="text-align: right;">Page 81</p> <p>1 10 seconds".</p> <p>2 Q. The AIS data caused you to reformulate your opinion in</p> <p>3 respect of the last three lines of paragraph 22?</p> <p>4 A. Yes, sir.</p> <p>5 THE CHAIRMAN: So what do you say as to 10 seconds, or</p> <p>6 "within 10 seconds"?</p> <p>7 A. To be honest, Mr Chairman, I haven't looked at how long</p> <p>8 it would take using the AIS data. It might not be far</p> <p>9 away from 10 seconds; I just have not checked.</p> <p>10 MR SHIEH: And then at paragraph 35 of your second</p> <p>11 supplemental report, page 935, you said:</p> <p>12 "One conclusion from these diagrams is that Sea</p> <p>13 Smooth probably came away from Lamma IV of its own</p> <p>14 volition, and not by being backed out, although</p> <p>15 witnesses in the cabin of Lamma IV could not know this</p> <p>16 because of their limited view of the overall situation."</p> <p>17 That is more or less the same point that you told us</p> <p>18 earlier?</p> <p>19 A. Yes, sir.</p> <p>20 Q. That they would not have known there is little left</p> <p>21 really to join the two vessels together?</p> <p>22 A. Correct.</p> <p>23 Q. Could I now move on from your paragraph 22, not to the</p> <p>24 next paragraph, because the next paragraph onwards talks</p> <p>25 about the general structural condition -- I'm talking</p>	<p style="text-align: right;">Page 83</p> <p>1 sank". That is on page 412.</p> <p>2 Paragraph 29, Dr Armstrong, you made a general</p> <p>3 comment about the reason why a vessel floats. Could you</p> <p>4 very briefly summarise for us the purport of this</p> <p>5 general point in this paragraph? Further down --</p> <p>6 I think we'll leave it to after lunch -- we then get</p> <p>7 into a rather murky area of the applicable set of rules</p> <p>8 and 0.1L and matters of that sort.</p> <p>9 A. As I say in paragraph 29, a vessel floats and it floats</p> <p>10 because it displaces a certain amount of water in</p> <p>11 accordance with Archimedes' principle: the weight of</p> <p>12 water displaced is equal to the weight of the vessel.</p> <p>13 And it will remain in that state of equilibrium until</p> <p>14 something changes.</p> <p>15 It's essential, in that case, to have watertight</p> <p>16 integrity to make sure that no water comes inside the</p> <p>17 hull. Watertight integrity is an essential component of</p> <p>18 safety, obviously, and so there are many features in</p> <p>19 safety regulations to ensure that you maintain it in</p> <p>20 many different situations.</p> <p>21 One of those situations may well be a collision, and</p> <p>22 so most vessels are fitted with devices to allow them to</p> <p>23 withstand a certain amount of damage.</p> <p>24 The common standard for a small vessel may be</p> <p>25 something like one-compartment damage. What that means</p>
<p style="text-align: right;">Page 82</p> <p>1 about your first report, Dr Armstrong. Page 409 is</p> <p>2 paragraph 22.</p> <p>3 Page 410 starts a new topic, dealing with aluminium</p> <p>4 thickness, et cetera. We'll skip over that for the time</p> <p>5 being, because that belongs to a separate cluster.</p> <p>6 Mr Chairman, could I inform the Commission of the</p> <p>7 witnesses mentioned by Dr Armstrong in paragraph 34 of</p> <p>8 his second supplemental report, which of those have</p> <p>9 actually testified.</p> <p>10 THE CHAIRMAN: Well, it's those that haven't that I'm more</p> <p>11 interested in.</p> <p>12 MR SHIEH: Those who haven't. Cheung Kwok-hong has not</p> <p>13 testified. Angel To has not testified. To Nin-chee,</p> <p>14 Angel, has not testified.</p> <p>15 THE CHAIRMAN: Thank you.</p> <p>16 MR SHIEH: Lee Kin-fai, footnote 19, has not testified.</p> <p>17 Szeto Lan, footnote 20, has not testified. Tsu</p> <p>18 Chi-keung, footnote 22, has not testified. And Tang</p> <p>19 Ying-Kit, footnote 25, has not testified.</p> <p>20 So, of those, five have testified.</p> <p>21 THE CHAIRMAN: Yes.</p> <p>22 MR SHIEH: Thank you.</p> <p>23 Dr Armstrong, as I said, I will skip over those</p> <p>24 paragraphs about structure and I'll go straight to the</p> <p>25 section of your report starting "Opinion on why Lamma IV</p>	<p style="text-align: right;">Page 84</p> <p>1 is that you're allowed to flood one compartment, but the</p> <p>2 vessel still has to be able to float to a certain level,</p> <p>3 and certainly below what is called the margin line,</p> <p>4 which is a level of safety below the deck.</p> <p>5 Usually that watertight integrity when damaged is</p> <p>6 maintained by what are called bulkheads. These are</p> <p>7 transverse partitions running across the vessel. In</p> <p>8 some vessels they can be longitudinal, but in most</p> <p>9 vessels they are transverse. That restricts the amount</p> <p>10 of flooding that can occur in a vessel. The need for</p> <p>11 watertight transverse partitions was first recognised</p> <p>12 with the Titanic in 1912, and since then it's been</p> <p>13 a requirement in nearly all jurisdictions to have this</p> <p>14 way of limiting flooding on a vessel.</p> <p>15 There is a difficulty if you have more than one hull</p> <p>16 and you flood more than one compartment. So for large</p> <p>17 vessels such as passenger vessels, they may stipulate</p> <p>18 a two-compartment standard. And for the very largest</p> <p>19 vessels, such as, for example, Costa Concordia that sank</p> <p>20 recently, she had a three-compartment damage scenario to</p> <p>21 meet.</p> <p>22 As I say in my comments here, most launches in</p> <p>23 Hong Kong I understand to require five watertight</p> <p>24 bulkheads, being at the ends of the engine room; one at</p> <p>25 the forward end of the vessel, which is mandated for all</p>

<p style="text-align: right;">Page 85</p> <p>1 vessels and called a collision bulkhead, which is put 2 there because it's recognised that the most dangerous 3 place -- well, the most likely place to have a collision 4 is at the bow of the boat, because you're moving 5 forward. So, collision bulkheads are specified, where 6 they can be, and the fact they have to be watertight. 7 In my opinion, also there should be one at the after 8 end of the boat, for a variety of reasons. 9 Q. Which you call the aft peak bulkhead? 10 A. Which is usually called the aft peak bulkhead. Would 11 you like me to go into detail as to why there is an aft 12 peak bulkhead? 13 Q. It's paragraph 15 onwards of your second supplemental 14 report but I think that would be an appropriate moment 15 for the break. 16 THE CHAIRMAN: Yes. We'll hear you explain that later on. 17 A. I'll look forward to it, Mr Chairman. 18 THE CHAIRMAN: We'll do that after lunch. We'll take our 19 lunch break now and resume at 2.30 this afternoon. 20 (12.58 pm) 21 (The luncheon adjournment) 22 (2.30 pm) 23 THE CHAIRMAN: Dr Armstrong, may I remind you that you 24 continue to testify according to your original oath. 25 A. I understand.</p>	<p style="text-align: right;">Page 87</p> <p>1 ("Collision 8" image shown) 2 A. So this is a view inside the engine room looking from 3 the starboard side over to the port side. If one looks 4 carefully, you can just see at the top of the light-blue 5 portion in the middle, the stem of Sea Smooth entering 6 in, just below the red deck, where the cursor is now. 7 Just below that, there are two small oily water tanks, 8 small oil header tanks, on the left-hand side. The 9 yellow things on the right are the engines, of course. 10 If you can go to the next -- 11 Q. These two are water tanks? These two rectangular 12 objects are water tanks? 13 A. I think there were -- I'm sorry, I can't recall. 14 THE CHAIRMAN: But they're header tanks, not main tanks? 15 A. They're header tanks of some sort. 16 If we go to picture 9. 17 ("Collision 9" image shown) 18 In this particular case, the bow of Sea Smooth has 19 entered further in. I should explain, on the left-hand 20 side, in a sort of purple colour is the stem bar of Sea 21 Smooth. Following it on the right is some plating. 22 I would have liked to have got rid of the plating, but 23 the fact is it's there. But it does obstruct the view. 24 Behind the plating you can possibly just make out, also 25 in a dark-blue colour, the gash which is formed behind</p>
<p style="text-align: right;">Page 86</p> <p>1 THE CHAIRMAN: Mr Shieh. 2 MR SHIEH: Dr Armstrong, before the lunch adjournment we 3 stopped at a point when you were going to discuss the 4 concept of an aft peak bulkhead. But I understand that 5 over lunch, you or your staff or those helping you have 6 also managed to finalise a series of still frames, as 7 well as two videos, and they concern the manner in which 8 the collision or the impact took place. So perhaps, if 9 you don't mind, we'll deal with that first and you can 10 offer us your comments on the video and the frames 11 before we move on to aft peak bulkhead. 12 A. Certainly, Mr Shieh. I would like to add, though, that 13 I don't think they're finalised, but in the time 14 allowed, they're as good as we could make it. I think 15 the intention is clear, though. 16 Q. Thank you. I can see that there is a series of frames 17 or pictures, starting from "Collision 8" to 18 "Collision 16". I understand that you wish to show 19 those first, before seeing the video. 20 A. Yes, I'd like to show the individual slides first, if 21 that's permissible, and then once we've gone through 22 that -- which will allow me to talk to them -- we can 23 then show the video. 24 THE CHAIRMAN: Thank you. 25 MR SHIEH: Can we have "Collision 8".</p>	<p style="text-align: right;">Page 88</p> <p>1 the stem bar. 2 THE CHAIRMAN: The stem bar being the blue object that has 3 reached the third of the three frames, I take it they 4 are, reading from right to left? 5 A. Yes, Mr Chairman. Well, the stem bar is the purple part 6 which is -- 7 THE CHAIRMAN: I don't see purple. 8 A. -- to the left of -- 9 THE CHAIRMAN: Ah, yes. 10 A. Just above the tank. 11 THE CHAIRMAN: Yes. Thank you. 12 A. It should be horizontal across the top rather than 13 vertical on the left-hand side. 14 THE CHAIRMAN: Would it be possible to add a descriptive 15 text to these frames? 16 A. Indeed. Yes, it would. 17 THE CHAIRMAN: Thank you. That would help. 18 ("Collision 10" image shown) 19 A. In this case, one can see the purple stem bar has moved 20 down as it moved aft, and is close by the header tank, 21 in fact has displaced the header tank. You can see 22 behind that the gash in blue. Perhaps that's not quite 23 so obvious, because it's -- it's a bit more obvious on 24 my screen than the live screen over there. The plating, 25 unfortunately, is getting in the way. But there is</p>

<p style="text-align: right;">Page 89</p> <p>1 a gash diagonally from the stem bar running up to the 2 right. 3 ("Collision 11" image shown) 4 The tank is meant to be falling on the ground here. 5 You can see better in this case the diagonal gash as the 6 stem bar continues to enter into the engine room. 7 ("Collision 12" image shown) 8 In this particular shot, you can make out that the 9 gash has now become removal of more plating of the side. 10 Because it's come clear of the fender on the outside 11 of the structure. You might remember the fender on the 12 outside has two horizontal parts and a diagonal part. 13 And the purple stem bar can be seen to be still coming 14 in behind the oil tank on the ground. 15 ("Collision 13" image shown) 16 I think this -- maybe you can go to the next 17 picture. The colours seem to have changed in that 18 picture. 19 ("Collision 14" image shown) 20 A. So one can see the extent of the plating that's come 21 inside on the right-hand side from Sea Smooth. The dark 22 blue is meant to be the structural stiffeners on Sea 23 Smooth. The stem bar is shown on the left-hand side. 24 ("Collision 15" image shown) 25 The stem bar continues to move to the left, creating</p>	<p style="text-align: right;">Page 91</p> <p>1 Q. But as you said, they are not an attempt to portray the 2 situation in real time? 3 A. Correct. 4 Q. Could we now come back to the question or the concept of 5 an aft peak bulkhead. Just to remind you, you mentioned 6 this space called an aft peak in your first report at 7 paragraph 29, which is page 412. You mentioned: 8 "Five such bulkheads were fitted to Lamma IV, being 9 located at the bow to protect against collision, at 10 either end of the engine room, and at the after end to 11 form a space called the aft peak (it contains the 12 steering gear for the craft)." 13 So that's where the concept of aft peak was 14 mentioned. 15 Then could I ask you to look at your second 16 supplemental report, paragraph 15, which is expert 17 bundle 2, page 930. Paragraphs 15 to 18 of your second 18 supplemental report are where you discuss the 19 understanding of the term "aft peak". Could I invite 20 you to develop your discussion on the meaning and the 21 use of an aft peak bulkhead? 22 A. Yes. Thank you. The term "aft peak" to me indicates 23 the extreme after end of the ship inside the hull. It 24 has its origins in ancient history, which may or may not 25 be relevant, Mr Chairman.</p>
<p style="text-align: right;">Page 90</p> <p>1 the horizontal opening, the hole. 2 ("Collision 16" image shown) 3 And in the final shot it strikes a bulkhead and 4 breaks off. 5 THE CHAIRMAN: That's the bulkhead, the watertight bulkhead 6 between the engine room and the tank room? 7 A. Correct, sir. If you would like to show the slow 8 motion ... 9 (Video played) 10 This has some additional video at the start. 11 Because, of course, we had to model the structure of 12 both boats to do this. 13 (Video played) 14 The stem bar keeps breaking as it comes in. 15 And then maybe the faster version. 16 (Video played) 17 I do not believe this is in real time, though. 18 I think this is still slowed down a little. 19 (Video played) 20 MR SHIEH: Dr Armstrong, it would be helpful if you could 21 add narrative text to each of "Collision 8" down to the 22 last piece, as requested by the Chairman, so we could 23 actually see any particular comment or verbal 24 descriptions of what they depict individually. 25 A. Very good.</p>	<p style="text-align: right;">Page 92</p> <p>1 THE CHAIRMAN: No, I think it's very interesting. In fact, 2 I'd invite you to read this out and then you can add to 3 it. 4 A. Wooden ships of old had a very vulnerable part because 5 there was a lot of timber coming into one position, 6 which was the after end of the ship. It was very 7 difficult from a shipwright's point of view to make all 8 that timber watertight at the back end, and it was 9 recognised as the most vulnerable part of the ship. 10 There are many stories of ships being lost because of 11 this. It was also the location where the rudder was 12 hinged. 13 Because these spaces invariably leaked, they were 14 usually fitted with a bulkhead at the after end to make 15 a small triangular space which was allowed to flood and 16 was pumped out occasionally. This became -- 17 MR SHIEH: Could I pause you here. The reason why it was 18 difficult to, in your words, "make all the timber 19 watertight at the back end" is because of the shape? 20 A. Some very large pieces of timber were all trying to come 21 to one space, so it was necessary to make them all fit 22 together, which meant they needed some very clever 23 shapes to be cut into them. It was a very skilled art 24 of the shipwright to make those timbers fit together. 25 In addition, there was a space called a fore peak at</p>

<p style="text-align: right;">Page 93</p> <p>1 the other end of the ship, and on wooden sailing ships 2 traditionally the shape was such that the deck rose up 3 quite steeply at the forward end, certainly on European 4 designs, and that space, because it was higher than the 5 rest of the deck, became known as a peak space. It was 6 also used to support the bowsprit, which is a mast 7 running forward and used to carry a sail and also to 8 support the stays for the other main masts. 9 This became known as the fore peak because it was at 10 the forward end and it was the peak of the deck. There 11 wasn't much use for this space. It was traditionally 12 used as storage space and sometimes for putting 13 recalcitrant sailors into. 14 I think the aft peak bulkhead became known as the 15 aft peak because it was the opposite end of the fore 16 peak. The modern usage of the term relates more to the 17 same function, but for a different reason, and that is 18 that many ships had a propeller at the after end, with 19 a propeller shaft running through the hull, and that 20 represented a breach of the watertight integrity. The 21 watertight integrity was held by a seal. Occasionally 22 the seals failed, and water would come in around the 23 shaft. So to minimise the risk to the ship, 24 a watertight bulkhead was put at the after end and 25 called an aft peak bulkhead, in order to limit the</p>	<p style="text-align: right;">Page 95</p> <p>1 too sure, there is a recognition of an aft peak bulkhead 2 and it clearly makes it known that it should be 3 watertight. 4 I also note in passing, and I think I've mentioned 5 this in my report, that regulation 7 of Cap 369AM also 6 refers to the aft peak bulkhead as being watertight. 7 But of course regulation 7 is not called up in the 8 instructions. 9 MR SHIEH: Mr Chairman, I don't believe we have SOLAS 10 chapter II-1, regulation 18, but we will try to track 11 that down and perhaps produce that. 12 THE CHAIRMAN: Thank you. 13 A. I have a copy at Lo & Lo. 14 MR SHIEH: You have a copy here? 15 A. I have a copy at Lo & Lo, unfortunately. It's a 1995 16 version, so it's -- 17 Q. We'll track that down and produce a copy in the bundle 18 and perhaps scan it for the Commission. 19 THE CHAIRMAN: Thank you. 20 MR SHIEH: Dr Armstrong, you also mentioned in paragraph 18: 21 "I have never previously seen a ship design in which 22 the aft peak bulkhead was located anywhere other than 23 close to the stern of the vessel." 24 A. That is correct. 25 Q. At this juncture could I direct your attention to one</p>
<p style="text-align: right;">Page 94</p> <p>1 inflow of water. 2 Having said that, Mr Chairman, it's important to 3 recognise Lamma IV did not have shafts running through 4 the bulkhead. It had shafts running down through the 5 after end of the engine room. Nevertheless, it was 6 accepted that this aft peak bulkhead did also restrict 7 any leakage past the rudder posts; that is, the shafts 8 running down to the rudders. Lamma IV had two such 9 rudder shafts in the steering gear compartment. So one 10 could argue that the aft peak did have the function, if 11 it was watertight, to restrict the amount of water 12 coming in through the rudder shaft, if it had leaked. 13 So that is my understanding of the term "aft peak". 14 It's something that is at the after end of the ship, to 15 restrict the flow of water in case of some problem. 16 Q. So is it your evidence or suggestion that, irrespective 17 of any stipulation, verbal stipulation, in regulations 18 or rules or instructions inherent in the concept of 19 an aft peak bulkhead, to perform the functions that you 20 have just mentioned, it just had to be watertight? 21 A. Yes, I would agree with that, Mr Shieh. Furthermore, if 22 I may add, a lot of my work has been on vessels built to 23 SOLAS. SOLAS is recognised as the highest level of 24 safety. It stands for Safety of Life at Sea. In SOLAS, 25 in chapter II-1, it might be regulation 18, but I'm not</p>	<p style="text-align: right;">Page 96</p> <p>1 part of the transcript. Could I have Day 19, the 2 evidence of Mr Lo from Cheoy Lee. Day 19, page 110. 3 THE CHAIRMAN: What's is Day 19 in the Gregorian calendar? 4 MR SHIEH: In the Gregorian calendar, it is 21 January. 5 THE CHAIRMAN: Thank you. 6 MR SHIEH: This is Mr Beresford examining Mr Lo from Cheoy 7 Lee. He is there being referred to the position of the 8 bulkhead for the steering gear compartment. I think 9 Mr Beresford is asking Mr Lo this question: The bulkhead 10 for the steering gear compartment -- that is frame 1/2. 11 A. (Witness nods). 12 Q. It's marine bundle 2, page 479. That will help you to 13 visualise what the witness was being asked about. 14 MR BERESFORD: It's on the screen. 15 MR SHIEH: It's on the screen, yes. 16 Mr Beresford is asking Mr Lo, the witness -- now, 17 this document is a document dated 21 October, if you 18 look at page 472. This encloses a set of the damage 19 stability booklets in the final form, in 1998; that is 20 after the addition of ballasts. Just to put you in 21 context. 22 The page which Mr Beresford asked the witness to 23 look at is, first of all, page 479. The witness was 24 asked to look at the aft bulkhead for the steering gear 25 compartment. It's basically the transom. It's 12.445.</p>

<p style="text-align: right;">Page 97</p> <p>1 The engine room aft bulkhead -- the engine room aft 2 bulkhead is the bulkhead which separated the engine room 3 from the tank room. Because the suggestion would be -- 4 put it this way. If frame 1/2 is not watertight -- it 5 has an access door, so it is not watertight, so the 6 suggestion would be, which would count as the aft peak 7 bulkhead? It would be the next bulkhead which is 8 watertight, which would be the bulkhead separating 9 engine room from the tank room.</p> <p>10 Mr Beresford is there putting the suggestion that 11 the engine room aft bulkhead is 57 per cent of the 12 distance between the transom and midships. The answer 13 is:</p> <p>14 "Yes.</p> <p>15 Question: It's not exactly at the end of the 16 vessel, is it?</p> <p>17 Answer: No.</p> <p>18 Question: So is it really your opinion that that 19 satisfied the requirement for a peak bulkhead at one 20 end?</p> <p>21 Answer: Yes ..."</p> <p>22 So the suggestion would appear to be, as 23 I understand it, frame 1/2 has an access opening, so 24 it's not watertight. Next one down is the watertight 25 bulkhead between tank and engine. The suggestion is</p>	<p style="text-align: right;">Page 99</p> <p>1 calculations were submitted to the Marine Department on 2 10 October ..."</p> <p>3 Perhaps at this juncture I would like to clarify the 4 sequence of the various plans.</p> <p>5 At footnote 37, you say:</p> <p>6 "This scenario was examined by the builder and the 7 calculations and results formally submitted to Mardep at 8 the time of completion of the craft construction."</p> <p>9 The footnote is footnote 37, where you refer to:</p> <p>10 "Watertight subdivision calculations as originally 11 submitted by Cheoy Lee to Mardep 10 March 1998."</p> <p>12 Would you agree now, having looked at the entire or 13 a fuller set of documentation that what counts as the 14 original set of calculations submitted to Mardep should 15 be the one submitted in 1996?</p> <p>16 A. Correct; it is an error.</p> <p>17 Q. Could I just, for the purpose of the record -- it is 18 marine bundle 2, page 337. This is from Cheoy Lee to 19 Mardep, March 1996. So that fits in with the time of 20 completion, first completion of the vessel. I think we 21 have been through this. For the purpose of these 22 calculations, the steering gear compartment was treated 23 as a compartment on its own, and the calculations 24 proceeded on the basis that frame 1/2 was watertight. 25 That accords with your understanding, having looked as</p>
<p style="text-align: right;">Page 98</p> <p>1 that that would count as an aft peak bulkhead, even 2 though it is 57 per cent of the distance between transom 3 and midships. Now, would you agree with that 4 suggestion, that an aft peak bulkhead would be so 5 located, somewhere halfway between midships and transom?</p> <p>6 A. Mr Shieh, I have the greatest respect for Mr Lo, who is 7 a well-respected man in my industry. In this case, 8 I would disagree with him. I would be of the opinion 9 that this vessel did not have an aft peak bulkhead, 10 because an aft peak bulkhead should be at the after end 11 of the vessel. I could not agree that it would be the 12 aft end of the engine room. I would just see it as not 13 having an aft peak bulkhead.</p> <p>14 Q. Thank you. Could we now come back to the text of your 15 first report, your opinion on why Lamma IV sank.</p> <p>16 Paragraph 30:</p> <p>17 "The regulations that were applicable at the time of 18 the collision required that the vessel be capable of 19 surviving a collision that resulted in the flooding of 20 any one compartment. This scenario was examined by the 21 builder and the calculations and results formally 22 submitted to the Marine Department at the time of 23 completion of the craft construction. Following 24 subsequent modifications to the craft to change the 25 location of the solid lead ballast, another set of</p>	<p style="text-align: right;">Page 100</p> <p>1 these calculations?</p> <p>2 A. Correct.</p> <p>3 Q. Then you referred to another set of calculations 4 submitted to Mardep in October, after adding the 5 ballast. That is marine bundle 3, page 472. This is 6 Cheoy Lee to Mardep, October 1998. Damage stability 7 calculations. Again, treating the steering gear 8 compartment as a separate compartment, and treating the 9 relevant bulkhead as watertight --</p> <p>10 A. (Witness nods).</p> <p>11 Q. -- and that is your reading of this set of calculations?</p> <p>12 A. Yes.</p> <p>13 Q. Lastly, 2005, after the ballast had been raised. Marine 14 bundle 4, page 695. We can see here that a new software 15 had been used, and so the layout is rather different 16 from that we have seen for the previous two sets of 17 calculations. In fact, this whole document starts at 18 page 667. September 2005. The relevant page is 19 page 697 --</p> <p>20 THE CHAIRMAN: What we're dealing with is the original 21 arrangement of the vessel --</p> <p>22 MR SHIEH: 1996.</p> <p>23 THE CHAIRMAN: -- 1996. 1998 is lead ballast being added?</p> <p>24 MR SHIEH: Correct.</p> <p>25 THE CHAIRMAN: 2005 is lead ballast being raised by</p>

<p style="text-align: right;">Page 101</p> <p>1 10 inches? 2 MR SHIEH: That's right. So this represents a presentation 3 to Mardep of the Stability Booklet after that last 4 exercise in 2005, having raised the ballast by Cheoy 5 Lee, September 2005. Again, these calculations 6 proceeded on the basis that steering gear compartment is 7 a separate and self-standing compartment, and the 8 relevant bulkhead is watertight. That's your 9 understanding of the basis of these calculations? 10 A. They very clearly show to me that that bulkhead is 11 watertight. 12 Q. If you look at page 697, when they look at 13 one-compartment flooding, they look at individual 14 compartments, they actually -- "Damage Case 1: After 15 Peak damaged", so they actually took that last 16 compartment, the steering gear compartment, as the aft 17 peak? 18 A. Indeed. 19 Q. Halfway through your paragraph 30, if we could go back 20 to the expert bundle, page 412: 21 "All of the above documents entitled 'Damaged 22 Stability Information' show that the vessel could 23 survive a breach of watertight integrity into any one 24 compartment, and thus complied with the regulation." 25 Pausing here. "Any one compartment" would mean</p>	<p style="text-align: right;">Page 103</p> <p>1 Rather, we understand from Mardep that the content of 2 this fax to a particular builder represents the -- 3 I should put it this way -- self-imposed guidelines by 4 Mardep, referring in item 3, you can see, to schedules 1 5 and 3. It says: 6 "For every vessel carrying more than 100 passengers, 7 the watertight subdivision (one-compartment flooding) 8 requirements are to be complied with (see attached 9 copies, schedules 1 and 3)." 10 So is that what you mean by "the regulations that 11 were applicable at the time of the collision"? 12 A. Correct, yes. 13 Q. You refer to this fax? 14 A. Yes. 15 Q. Because schedules 1 and 3 were schedules 1 and 3 to the 16 relevant ordinance in 1991, but that ordinance only 17 applies to ocean-going vessels. So in the capacity as 18 written law, I understand that that ordinance doesn't 19 actually apply to a vessel like the Lamma IV, but Mardep 20 says that its practice is to -- I'm sorry. 21 THE CHAIRMAN: Carry on. I'm wondering how you're going to 22 get round the word "requirement". The text says 23 "requirement". 24 MR SHIEH: Yes. I'm not seeking to actually say it is not 25 a requirement, but I'm saying it is not a "requirement"</p>
<p style="text-align: right;">Page 102</p> <p>1 treating the compartments as enclosed by the relevant 2 bulkheads as one compartment? 3 A. My comment here about "one-compartment standard" only 4 applied to the steering gear compartment having 5 a watertight bulkhead at the forward end of it. So the 6 aft peak bulkhead was watertight. 7 Q. Yes. And you say "thus complied with the Regulation. 8 "They also included an examination of the stability 9 of the vessel in the damaged condition with one 10 compartment open to the sea. I am advised by Marine 11 Department that is not a requirement of licensing or 12 certification that damaged stability is approved, which 13 is presumably why the booklet is only stamped by the 14 Marine Department as 'seen' rather than 'approved'. In 15 this case the builder appears to have done additional 16 calculations to ensure safety." 17 Now, at the beginning of this paragraph, you 18 referred to: 19 "The regulations that were applicable at the time of 20 the collision required that the vessel be capable of 21 surviving a collision ..." 22 Footnote 36 refers us to a fax from Mardep attaching 23 some regulations. That is marine bundle 8, page 2081. 24 This is not a fax concerning this particular vessel. 25 I think we have seen this in this Inquiry previously.</p>	<p style="text-align: right;">Page 104</p> <p>1 because it is a force of law. 2 THE CHAIRMAN: That's why you called it self-imposed? 3 MR SHIEH: That's why I say it's self-imposed. 4 THE CHAIRMAN: Right. Within the discretionary powers of 5 the Marine Department? 6 MR SHIEH: Pursuant to the exercise of its powers under the 7 law, Mardep says -- 8 THE CHAIRMAN: "We won't be approving this vessel unless it 9 passes this guidance." 10 MR SHIEH: Yes. 11 THE CHAIRMAN: Is that how you understand it? 12 A. Yes, sir. 13 MR SHIEH: "It doesn't apply because statute says so; it 14 applies because we, Mardep, say in the exercise of our 15 powers that you should do so." 16 If we then look at schedule 1 and schedule 3. 17 Schedule 1 -- 18 A. Mr Shieh, would you mind if I interrupted you a second? 19 Q. Go ahead. 20 A. Just thinking about what Mr Chairman has just said. 21 I have heard it said that damage stability was not 22 mandatory, only watertight subdivision was mandatory. 23 So schedule 1 was mandatory, and schedule 3 was not. 24 I don't know whether that is the truth of the matter or 25 not, but the fact is that these documents were only</p>

<p style="text-align: right;">Page 105</p> <p>1 returned as "seen" and not as "approved", and to me that 2 implies that if they weren't approved, then they weren't 3 seen as being mandatory documents. 4 Thank you. 5 Q. This question about schedule 1 and schedule 3 perhaps 6 can be traced back to the Blue Book. You know the Blue 7 Book, the pre-1995 Regulations? 8 A. Yes, yes. 9 Q. There is a question about when Mardep began to apply the 10 1995 Regulations. Previous witnesses have given 11 evidence about it. The pre-1995 Instructions -- 12 I should say "Instructions" -- are commonly referred to 13 as the Blue Book. You're aware of that? 14 A. Yes, sir. 15 Q. Perhaps we'll look at the Blue Book. I think the best 16 way -- there's a legislation bundle. It's marine 17 bundle 8, page 1761. 18 According to Mardep, these are the instructions -- 19 this is the Blue Book. 20 A. Yes, I know it well. 21 Q. This is the Blue Book. According to Mardep, these are 22 the instructions that they applied at the relevant time. 23 A. Yes. 24 Q. In the relevant part of the Blue Book, at paragraph 15, 25 page 1770, it says:</p>	<p style="text-align: right;">Page 107</p> <p>1 schedule 1 to these regulations as apply to that ship. 2 Every other portion of the internal structure which 3 affects the efficiency of the subdivision of the ship 4 shall be watertight, and shall be of a design which will 5 maintain the integrity of the subdivision." 6 So this is what was intended to be referred to by 7 that erroneous reference to regulation 5, and you would 8 agree that that is an obvious mistake; this should be 9 the relevant regulation? 10 A. I agree. 11 Q. Now, this tells you the maximum length of compartments 12 which should be formed by watertight bulkheads in 13 accordance with schedule 1? 14 A. Yes. 15 Q. So is it your understanding that schedule 1 actually 16 stipulates the manner in which you arrive at the maximum 17 length of a compartment to be separated by bulkheads at 18 each end? 19 A. It does, and it states that it shall be done without any 20 list on the vessel, so it's upright. 21 Q. Thank you. We now return to schedule 1 and see what 22 schedule 1 seeks to do. For that, we shall return to 23 that fax at marine bundle 8, page 2082. 24 THE CHAIRMAN: That's 1 October 1994? 25 MR SHIEH: That's right. That is the Mardep fax to the --</p>
<p style="text-align: right;">Page 106</p> <p>1 "All new launches, designed to carry more than 2 100 passengers, must comply with the watertight 3 subdivision requirements. Regulation 5 of the Merchant 4 Shipping (Passenger Ship Construction and Survey) 5 Regulations 1984 refers." 6 Now, we have heard that this actually should be 7 a reference to regulation 6. You have heard that? 8 A. I have heard that, and it makes very much sense to me. 9 Q. I would like to find out -- 10 Could I ask you to look at marine bundle 11. 11 THE CHAIRMAN: What are we going to now? 12 MR SHIEH: Regulation 6. 13 THE CHAIRMAN: Thank you. 14 MR SHIEH: Because Dr Armstrong brought out this question of 15 the distinction between schedule 1 and schedule 3. This 16 forms the subject matter of Wong Chi-kin's evidence. 17 Wong Chi-kin obviously testified before the Commission. 18 Wong Chi-kin's witness statement is marine bundle 11, 19 page 3869. 20 At page 3874, Wong Chi-kin, you can see at 21 paragraph 24: 22 "Every ship shall be subdivided by bulkheads, which 23 shall be watertight up to the bulkhead deck, into 24 compartments the maximum length of which shall be 25 calculated in accordance with such of the provisions of</p>	<p style="text-align: right;">Page 108</p> <p>1 it is August. 1 August 1994. That is, I think, to the 2 Singapore shipbuilder. 3 Schedule 1 can be found at page 2082. 4 It sets out in rather technical language calculation 5 of the maximum length of watertight compartments, and 6 there we have various concepts such as permissible 7 length, et cetera. But in very brief terms, what does 8 schedule 1 tell us about how the maximum length of 9 a compartment should be calculated? 10 A. Perhaps I can help there, Mr Shieh. 11 THE CHAIRMAN: Well, to start with, do we have all of the 12 relevant schedule in what we're now looking at, or do we 13 need something else? 14 A. I think you've hit the nail on the head, Mr Chairman. 15 There is a need to define the words "floodable length", 16 which is contained in the definitions section of this 17 particular regulation. 18 MR SHIEH: Which imports the concept of margin line? 19 A. Correct. 20 Q. That's in the legislation bundle. We have a legislation 21 bundle. Tab 11. We are looking at the Merchant 22 Shipping (Safety) (Passenger Ship Construction and 23 Survey) Ships Built On or After 1 September 1984) 24 Regulations. 25 A. I believe it's page AM7 in that regulation.</p>

<p style="text-align: right;">Page 109</p> <p>1 Q. Yes. Which part would you like to direct our attention 2 to? 3 A. The definition of "floodable length". 4 Q. Yes. "Floodable length" should be on the second page. 5 "... in relation to any portion of a ship at any 6 draught means the maximum length of that portion having 7 its centre at a given point in the ship which, at that 8 draught and under such of the assumptions ... can be 9 flooded without submerging any part of the ship's margin 10 line when the ship has no list." 11 That's what you have in mind? 12 A. Correct. 13 THE CHAIRMAN: So it's the latter part that's the key 14 requirement? That is to say, "can be flooded without 15 submerging any part of the ship's margin line when the 16 ship has no list"? 17 A. Correct. 18 MR SHIEH: Therefore, even though the language of schedule 1 19 does not utilise the language of "submersion of margin 20 line", but because it refers to the concept of floodable 21 length, which under the definition of this entire 22 ordinance imports the concept of no submersion of margin 23 line, and that is how margin line comes in? 24 A. Yes, and should be read in context with regulation 6 as 25 much as schedule 1.</p>	<p style="text-align: right;">Page 111</p> <p>1 Do you see that, Dr Armstrong? 2 A. Yes, sir. 3 Q. "... means a line drawn at least 76 millimetres below 4 the upper surface of the bulkhead deck at the side of 5 the ship." 6 A. 76 mm has its origin in the fact that the old UK 7 regulations used to be 3 inches. It's a margin of 8 safety which says that if the deck is immersed -- 9 essentially you are losing the ship if the deck is 10 immersed. So this is a margin drawn a nominal 3 inches 11 below the deck to give you that margin of safety. That, 12 I believe, was based on previous experience over many 13 years of looking at ships that had survived, and ones 14 that had not. It allows you to have waves and other -- 15 well, principally waves, washing over the ship and it's 16 given you 3 inches of leeway to allow for those waves. 17 Q. Therefore if we simply look at the concept of floodable 18 length, without looking at regulation 6, floodable 19 length simply tells you the length, notional length that 20 can be flooded without the margin line being submerged? 21 That itself has nothing to do with the building of 22 bulkheads or compartments, because that is all to do 23 with a notional compartment being flooded? 24 A. Correct. 25 Q. The way in which this concept of floodable length is</p>
<p style="text-align: right;">Page 110</p> <p>1 Q. Yes. Regulation 6 as discussed by Wong Chi-kin's 2 statement? 3 A. (Witness nods). 4 Q. So, bringing regulation 6, schedule 1 together, and also 5 the definition of "floodable length", what would you 6 describe to be the effect or purport of regulation 6? 7 Which in turn is brought in through the Blue Book. It's 8 quite a mouthful. 9 A. Yes. Schedule 1 is a rather technical description of 10 how to carry out a calculation, and does not really 11 assist one with understanding the concept. It is mainly 12 there for the naval architect to understand how to do 13 it. But the key is regulation 6 read in association 14 with the definition of "floodable length". 15 Q. Yes. 16 A. Essentially, it means that at any point along a ship, 17 you can calculate the maximum length of a mythical 18 compartment, a hypothetical compartment, with its centre 19 at that point on the ship's length, at which you can put 20 bulkheads such that if they are flooded, the margin line 21 is not immersed. 22 I need to explain "margin line". 23 Q. Which is defined, I think, also? 24 A. It is, in fact, defined in the regulations. 25 Q. Could I move on to the next page.</p>	<p style="text-align: right;">Page 112</p> <p>1 brought in to how a ship or the relevant bulkhead should 2 be placed is via regulation 6; that is the point you are 3 trying to ask us to bear in mind by saying you have to 4 read it in context? 5 A. Correct. 6 Q. Thank you. Basically regulation 6 says that bulkheads, 7 or watertight bulkheads, should be so placed so as to 8 form compartments, the maximum length of which shall be 9 a length such that for that compartment, if it is 10 flooded, would not result in the submersion of the 11 margin line? 12 A. Correct. 13 Q. Thank you. In fact if you look at page 7 of this 14 document, this is a 1991 Ordinance but it contains 15 a same regulation 6 as the regulation 6 which Mr Wong 16 Chi-kin refers to: 17 "Every ship shall be subdivided by bulkheads which 18 shall be watertight up to the bulkhead deck ..." 19 So that is schedule 1. So when you say you have 20 been told or you have been given to understand that 21 schedule 1 is mandatory, do you understand that to mean 22 that schedule 1 is required to be imported by 23 regulation 6, which in turn was imported by the Blue 24 Book, which at that time was the set of instructions 25 Mardep was seeking to apply?</p>

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<p>1 A. I would agree exactly with that, yes. That's the case. 2 Q. That is what you had been given to understand? 3 A. That is what I was given to understand. I'm not too 4 sure about which rules were in force though at the time. 5 THE CHAIRMAN: By that you mean the Blue Book Instructions 6 or the 1995 Instructions? 7 A. Correct, Mr Chairman. 8 MR SHIEH: Basically, by a certain set of instructions which 9 Mardep imposes on builders, it brings in schedule 1? 10 A. Yes. 11 Q. Thank you. As for schedule 3, we have seen -- the Blue 12 Book doesn't mention schedule 3. Schedule 3 was however 13 mentioned in that fax to the shipbuilder. If we look at 14 schedule 3 -- I call it a self-imposed requirement by 15 Mardep. If we look at that fax again. I think it's 16 marine bundle 8, page 2085. 17 Mr Beresford reminds me that one can actually find 18 these schedules at various places, but we have page 2085 19 open so we may as well use it. 20 Schedule 3, "Stability in Damaged Condition". So, 21 "Calculations of stability in damaged condition". One 22 point you have noted is at (3)(a), where it says: 23 "The extent of damage shall be assumed to be as 24 follows ..." 25 I think we should look at what this whole heading is</p>	<p>1 (1) In the event of symmetrical flooding -- 2 ... 3 (c) at the final stage of flooding the margin line 4 shall not be submerged and there shall be a positive 5 residual metacentric height of at least 50 mm as 6 calculated by the constant displacement method." 7 "Metacentric height" is usually referred to as GMT; 8 correct? 9 A. Correct. 10 Q. I'm afraid we get a little technical. 11 You have made some comments on the effect of 12 deleting that particular assumption which contains the 13 reference to 10 per cent of the length of the vessel in 14 your first report? 15 A. Yes, I have. It seemed to me that in deleting 16 paragraph (3)(a) and going to one-compartment flooding, 17 it had also deleted the 10 per cent of the length of the 18 ship, whichever is the least. After all, it does have 19 a line through it. 20 I would also comment the last part of this 21 paragraph, where it's talking about the required factor 22 of subdivision is 0.33 or less, is immaterial because 23 that only applies to very large boats. So it's only the 24 first part that really is a little contentious. 25 Q. Right. Now, could you explain to us the significance or</p>
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<p>1 about. 2 "Calculations of stability in damaged condition. 3 The sufficiency of intact stability of every ship to 4 which part IIA of these regulations applies shall be 5 determined by calculation which has regard to the design 6 and construction of the ship, and the damaged 7 compartments, and which is in accordance with the 8 following assumptions ..." 9 So it mandates the person applying these rules to 10 make certain assumptions as to the way in which a vessel 11 is damaged. At subparagraph (3)(a), it originally says: 12 "longitudinal extent: 3.00 metres plus 3% of the 13 length of the ship, or 11.00 metres or 10% of the length 14 of the ship, whichever is the least. Provided that 15 where the required factor of subdivision is 0.33 or 16 less, the assumed longitudinal extent of damage shall be 17 increased as necessary ..." 18 So that has been deleted; you see that, 19 Dr Armstrong? 20 A. I see that, yes. 21 Q. Further down: 22 "The intact stability of the ship shall be deemed to 23 be sufficient if the calculation specified in 24 paragraph 1 shows that, after the assumed damage, the 25 condition of the ship ..."</p>	<p>1 relevance of this concept of 0.1L or 10 per cent of the 2 length of the vessel, in this context of damage 3 stability? 4 A. I will attempt to. There is an assumption of the size 5 of damage that will occur in a hypothetical collision. 6 It has its origins in SOLAS once more, and it's given us 7 a longitudinal extent which you can see in (3)(a), and 8 a transverse extent in (3)(b), and a vertical extent in 9 (3)(c), which is without limit, straight up. There are 10 variations on the longitudinal extent. I think in 1995, 11 the longitudinal extent did not include 10 per cent in 12 SOLAS. I think that may have been added, maybe from the 13 UK regulations for smaller ships. 14 So what it's trying to say is, it's trying to limit 15 the size of the hull to the least of 3 metres plus 3 per 16 cent, or 11 metres, or 10 per cent of the length of the 17 ship, whichever is the least, meaning that you don't 18 have to comply with a really large hull; you have to 19 only look at the survivability of the vessel in 20 a hypothetical crash with another vessel, which in this 21 case has a hole which is at least 10 per cent of the 22 length of the ship. The relevance here is that, of 23 course, the steering gear compartment is shorter than 24 10 per cent of the length of the ship, and therefore one 25 could argue that if one looked at the steering gear</p>

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<p>1 compartment with a hole longer than 10 per cent of the 2 length, then the steering gear compartment and the tank 3 room would both be flooded. The watertight bulkhead 4 would have no effect. 5 But as I read this paragraph which has been struck 6 out and replaced with the words "one-compartment 7 flooding", then I believe that what Cheoy Lee prevented 8 in their Stability Book appeared to be right; they had 9 just done one-compartment flooding and had ignored the 10 10 per cent length. 11 Q. In other words, you, looking at the deletion and the 12 typed-in words of "one-compartment flooding", understood 13 that to be saying that for the purpose of assuming the 14 damage that the vessel would suffer, for the purpose of 15 applying the subsequent dual test of no submersion of 16 margin line, plus GMT more than whatever the figure, 17 there is no need to satisfy the 0.1L requirement, but 18 you only need to satisfy the one-compartment flooding 19 requirement, however long or short that compartment may 20 be? 21 A. That is how I read the damage stability requirements in 22 schedule 3, yes. 23 Q. As modified by this deletion and the typed-in words? 24 A. Modified by this deletion. I think, Mr Shieh, that 25 there is a reference to 10 per cent, though, in</p>	<p>1 in turn referred to schedule 1 but not schedule 3 of 2 those regulations. That being the case, the principle 3 of 0.1L (by way of minimum space of bulkheads) set out 4 in paragraph 6(6) of part II of schedule 1 was 5 applicable independently of paragraph 1(3)(a) of 6 schedule 3." 7 That is what I refer to as meaning 0.1L being 8 brought back in not by schedule 3, but by schedule 1. 9 Can we look at schedule 1 in marine bundle 8, 10 page 2084. At the top of that page, (6) "Minimum space 11 of bulkheads". 12 Mr Chairman, Mr Commissioner, this is taken from the 13 same attachment to that fax to the Singapore 14 shipbuilder. This is part of schedule 1, and the (6) is 15 part of paragraph 6, so it's paragraph 6(6), "Minimum 16 space of bulkheads": 17 "If the distance between two adjacent main 18 transverse bulkheads required by these regulations to be 19 watertight, or their equivalent plane bulkheads ... is 20 less than [various things, including 0.1L], whichever is 21 the least, only one of these bulkheads shall be regarded 22 as forming part of the subdivision of the ship." 23 Perhaps you can tell us -- I mean, I think I know 24 what this means, but I think I should obviously defer to 25 you. Could you tell us what you understand to be the</p>
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<p>1 schedule 1. 2 Q. Schedule 1, 6(6), which is actually how Mr Wong Chi-kin 3 would explain it. 4 A. Yes. 5 Q. Perhaps I will do it step by step. Because he says the 6 0.1L has not been completely done away with, because it 7 actually remains via schedule 1, paragraph 6(6), which 8 I'm now coming to. 9 A. Thank you. 10 Q. Could I direct your attention to what Mr Wong Chi-kin 11 says as to what he was trying to achieve when he deleted 12 that paragraph and inserted the typed-in words. 13 Marine bundle 11, page 3878. At paragraph 41, he 14 says: 15 "I was the one who made the said deletion and 16 insertion to reflect my understanding of the then 17 practice of the Section. I now explain the intended 18 effect of these notations." 19 Dr Armstrong, I take it you have had a chance to 20 look at what Mr Wong said previously. 21 A. I was here in the room and did hear him, but I haven't 22 refreshed my memory recently. 23 Q. We can take it slowly. 24 "First, as stated above, the Blue Book ... only 25 referred to regulation 6 of the 1984 Regulations, which</p>	<p>1 meaning of this? 2 A. My understanding of this paragraph, where it says "only 3 one of these bulkheads shall be regarded as forming part 4 of the subdivision of the ship" is that you don't have 5 a choice as to which one you use; you should use the one 6 that gives the longest length in terms of which bulkhead 7 you use. 8 For example, in the case of the steering gear -- 9 Q. Sorry, can you pause here. When you say "which bulkhead 10 to use", you mean which bulkhead to use as defining 11 a compartment? 12 A. Where it says "only one of these bulkheads shall be 13 regarded", I don't believe it's giving you a choice; 14 it's telling you to use the bulkhead which gives the 15 longest floodable length. Commonsense would suggest 16 that. 17 So, for example, it becomes rather awkward when it's 18 at the end of the ship. In the steering gear 19 compartment it is telling me that you cannot use the aft 20 peak bulkhead as a watertight bulkhead for the purposes 21 of watertight subdivision for floodable length. 22 Q. Because if you count up from the aft peak bulkhead to 23 the aft, that -- 24 A. If you go from the transom to the aft peak bulkhead, you 25 have lesser distance than 0.1L. So you can't use that</p>

<p style="text-align: right;">Page 121</p> <p>1 bulkhead; you have to use the next bulkhead. 2 THE CHAIRMAN: Is it necessary to have a doctorate in law to 3 become a naval architect? 4 A. If I might answer that, Mr Chairman, I do know of 5 a person who has a law degree and is a well-respected 6 naval architect, and he finds it difficult to find any 7 work. 8 THE CHAIRMAN: Thank you. 9 MR SHIEH: So Mr Wong Chi-kin says that the requirement of 10 0.1L, or, put negatively, the need to disregard any 11 bulkhead which would otherwise form a compartment less 12 than 0.1L, can be found in this particular paragraph in 13 schedule 1? 14 A. Repeat that for me, please? 15 Q. Mr Wong Chi-kin's evidence is that the principle of 16 0.1L, the principle, in his language, of 0.1L, which 17 requires you basically to disregard any bulkhead which 18 would otherwise enclose or form a compartment with 19 a length of less than 0.1L, is to be found in 20 schedule 1, paragraph 6(6)? 21 A. Correct, yes. 22 Q. That's what he says? 23 A. Yes. 24 Q. You would agree that that is the face meaning of 25 paragraph 6(6) of schedule 1?</p>	<p style="text-align: right;">Page 123</p> <p>1 to determine whether a vessel would be submerged below 2 the ship's margin line in the event that any watertight 3 compartment of the vessel is flooded. 'Margin line' 4 means a line drawn at least 76 ..." 5 I think that's the definition. 6 "Put simply, the 'floodable length' refers to the 7 maximum permissible length between two watertight 8 bulkheads in order to ensure that the vessel is not 9 submerged below the margin line in the event of 10 flooding. As explained in paragraphs 33 and 34 above, 11 in the case of Lamma IV, paragraph 6(6) of part II of 12 schedule 1 requires that any space between two bulkheads 13 which is less than 0.1L shall not be regarded as forming 14 part of the subdivision of the ship for the purpose of 15 calculating the floodable length. The rationale for 16 this principle is that, where a compartment is too 17 short, a collision event may be expected to damage both 18 watertight bulkheads on the two sides of that 19 compartment." 20 What is your comment on that, Dr Armstrong? 21 A. I think Mr Wong put it much more succinctly than I did. 22 I would agree with that. 23 Q. Thank you. But that is a result of reading schedule 1 24 in conjunction with regulation 6 of the Blue Book? 25 A. Correct.</p>
<p style="text-align: right;">Page 122</p> <p>1 A. I would. Yes, I would. 2 Q. He continues to say: 3 "Secondly, the concept of damage stability ... is 4 completely different from that of floodable length ... 5 Whilst both of these concepts have to do with the safety 6 of the vessel, the requirements under them are quite 7 distinct." 8 You would agree with that? 9 A. I have used the same comment in my report, yes. 10 Q. Yes. Because schedule 1 by itself is not concerned with 11 the building of bulkheads or calculation of 12 one-compartment flooding or that sort of thing? 13 A. Yes. In fact, they both contain a requirement for the 14 margin line not to be submerged. 15 Q. Yes. 16 A. But in the case of watertight subdivision, it's clear 17 that that is done without any list on the vessel. So 18 the margin line can only be immersed at the ends. 19 Whereas under damage stability, we're talking about the 20 vessel moving transversely, so it is usual for the 21 margin line to immerse at the side of the ship, which is 22 a different science, essentially, different physics 23 involved. 24 Q. Paragraph 44: 25 "'Floodable length' is relevant to the calculation</p>	<p style="text-align: right;">Page 124</p> <p>1 Q. Because always remembering, schedule 1 on its own is 2 about that notional concept of floodable length. To 3 bring it to the floor, talking about bulkheads and so on 4 would require you to read regulation 6? Thank you. 5 Paragraph 45: 6 "'Stability in damaged condition', on the other 7 hand, is concerned with the ability of a vessel to 8 maintain itself in a state of positive residual 9 stability in the event that some part of the ship is 10 flooded. The calculation of stability is dependent on 11 an assumed extent of damage to the vessel in the event 12 of an incident such as collision impacting on any part 13 of the ship. In the case of a vessel such as Lamma IV, 14 the extent of damage is assumed under 15 paragraph 1(3)(a) ... to be 0.1L of the vessel. 16 However, if such assumption is applied, at least two 17 watertight compartments would be engaged, no matter how 18 long these compartments are. It was felt that such 19 a requirement was too stringent for non-seagoing local 20 vessels which are normally smaller in size. It was 21 therefore decided that, for vessels with more [than] 100 22 passengers, the 'one-compartment flooding' standard was 23 to be applied. 24 It was for the above reason that paragraph 1(3)(a) 25 of schedule 3 ... was deleted. I should, however,</p>

<p style="text-align: right;">Page 125</p> <p>1 emphasise that the effect of such deletion was only 2 remove the assumption of two-compartment flooding 3 reflected in such provision (which is concerned only 4 with the assumed 'extent of damage'). The deletion was 5 never intended, and indeed it did not, do away with the 6 principle of minimum space of bulkheads for the purpose 7 of determining what the 'one-compartment' is when 8 applying the 'one-compartment flooding' standard." 9 What do you say of Mr Wong Chi-kin's explanation as 10 to his rationale for deletion and typing in that remark? 11 A. I can accept his explanation, but I would say it's not 12 how I read what was written when it was deleted. It 13 makes sense, especially when considering that many other 14 jurisdictions accept a one-compartment standard for this 15 type of vessel. 16 Q. And at paragraph 47, he says: 17 "In summary, my intention in deleting paragraph 1(3) 18 of schedule 3 and the insertion of the words 19 'one-compartment flooding' was not to remove the 20 requirement of 0.1L minimum space when calculating the 21 damage stability of a vessel. I am therefore unable to 22 agree with one of the comments by Dr Armstrong on this 23 subject when he states, at paragraph 60 of his report, 24 that the consequence of the deletion and replacement on 25 the attachment to the said fax transmission 'was that</p>	<p style="text-align: right;">Page 127</p> <p>1 have to take in the volume of the tank compartment as 2 well. So tank plus steering forms one compartment for 3 the purpose of calculating damage stability. That 4 really is the intended purport of what Mr Wong Chi-kin 5 had set out to achieve? 6 A. That's what he appears to be saying, yes. 7 Q. That's what you understand him to be saying? 8 A. That's what I understand him to be saying. 9 Q. On that basis, it would have been an incorrect 10 application of the relevant regime to treat the steering 11 compartment as a compartment for the purpose of 12 calculating damage, or one-compartment flooding? 13 A. Correct, yes. 14 Q. It would be incorrect to treat the tank compartment as 15 a self-standing, separate compartment for the purpose of 16 calculating one-compartment flooding; correct? 17 A. It would. Tank compartment is one compartment; but the 18 steering gear, effectively two. 19 Q. So watertight door or no watertight door for present 20 purposes is not that relevant because even if there is 21 a watertight door, you still have to treat those two 22 together as one compartment for the purpose of 23 calculating one-compartment flooding, and then move on 24 to see GMT or submersion of margin line? 25 A. Correct.</p>
<p style="text-align: right;">Page 126</p> <p>1 small compartments with a length of less than 10%L were 2 considered like any other compartment'. This is not the 3 case, so far as the intention of the deletion and 4 replacement was concerned." 5 What do you have to say about that? I mean, it 6 depends on how you read his -- 7 A. Exactly. It depends on how you read it. 8 Q. The way you read it, it is agreed, but it's because he 9 doesn't actually think that you have correctly 10 understood him? 11 A. Yes, and I can only make my opinions known on the 12 evidence that's presented to me, and I had evidence 13 which was scrubbed through. So I took it on face value. 14 Q. If we proceed on the basis of Mr Wong Chi-kin's intended 15 meaning to be ascribed to the relevant deletion and 16 insertion of the words "one-compartment flooding", let's 17 see whether or not we can get to some common ground as 18 to what we understand to be his intended meaning. We 19 know what you have read it to mean. 20 What he was saying is that -- I mean, transposed to 21 the facts of this case, the distance between the transom 22 and frame 1/2 is less than 0.1, or 10 per cent of the 23 length of the vessel. So for the purpose of calculating 24 one-compartment flooding, you don't take that as 25 a compartment; you disregard the aft peak bulkhead. You</p>	<p style="text-align: right;">Page 128</p> <p>1 Q. If, therefore, in a particular scenario, let's say 2 ballast had been added to this vessel, which is actually 3 what happened, if in a particular scenario flooding of 4 steering gear compartment plus flooding of tank room, 5 which together forms one compartment, if flooding of 6 these two compartments results in submersion of margin 7 line, it would amount to a breach of the relevant 8 requirement under schedule 3? Because, if you remember, 9 schedule 3 requires as one of the conditions that margin 10 line should not be submerged. 11 A. It would, yes. And I suspect would also breach 12 schedule 1. 13 Q. Because the relevant compartment, the notional 14 compartment, comprising steering gear compartment and 15 tank room, would have exceeded the floodable length, 16 because by definition the length of that compartment is 17 such that the margin line had submerged? 18 A. Yes. It's always difficult to add weight to a vessel 19 without checking the floodable length, because if you 20 add weight to a vessel, the deck comes down closer to 21 the water. If the deck is closer to the water, you have 22 less leeway until the margin line is submerged. 23 That almost always means the floodable length 24 reduces, and you run the risk of the floodable length 25 becoming less than the distance between the bulkheads</p>

<p style="text-align: right;">Page 129</p> <p>1 when you add a weight. 2 Q. But using lawyerly language, if in a particular 3 configuration it results in breach of schedule 3, in 4 submerging the margin line, it would by definition have 5 resulted in a breach of the floodable length requirement 6 in schedule 1. Because by definition, that particular 7 compartment must have been too long. 8 A. Not necessarily, to be strictly accurate, because 9 schedule 3, margin line immersion, could have happened 10 with some heel on the vessel. Whereas schedule 1 11 requires it to be upright. You only need two or three 12 degrees of heel for there to be a difference. 13 Q. But assuming no heel? 14 A. Assuming no heel, they will be the same, yes, sir. 15 Q. Thank you. Could we now turn -- this is actually what 16 you -- this is the subject matter of your second 17 supplemental report at expert bundle 2 at page 925. 18 Under the heading "Watertight Subdivision and Damage 19 Stability Information". 20 "Both sets of instructions ..." 21 By that I take it you mean the Blue Book and the 22 1995 Instructions. 23 A. Correct. 24 Q. "... refer to the need for watertight subdivision in 25 accordance with regulation 6 ... Regulation 6 requires</p>	<p style="text-align: right;">Page 131</p> <p>1 Q. "Schedule 3 covers the damage stability requirement 2 (which are non-mandatory according to my understanding 3 of Mardep's comments)." 4 We shall deal with what's meant by "non-mandatory" 5 perhaps by way of submission to the Commission, because 6 from what we have seen, it is actually also required by 7 Mardep by way of that fax, but we'll skip over this 8 question of whether or not it's called "mandatory". 9 A. I don't have a -- 10 Q. "The requirement is that the vessel maintains 11 a metacentric height of at least 50 mm and also that the 12 margin line is not immersed. There are also some other 13 requirements concerning interim values ... but these 14 would not apply to Lamma IV." 15 So far we've been discussing this question of margin 16 line submersion. For reasons that will become obvious 17 when we come to the effect of the 1998 and 2005 18 modifications to the vessel -- because I believe it's 19 common ground that had the correct compartments been 20 counted, the margin line would have been submerged after 21 1998 and also after 2005, after the modifications. 22 You're aware of that? 23 A. Yes. 24 Q. But coming to the question of GMT, can you briefly 25 explain to us the meaning or significance of GMT and</p>
<p style="text-align: right;">Page 130</p> <p>1 compliance with schedule 1. In addition the damage 2 stability, requirements in force in force at that time 3 required compliance with schedule 3 ..." 4 That's the fax to the shipbuilder? 5 A. Correct. 6 Q. We can skip over that. 7 "The following summary is given by way of 8 explanation of the effect of these schedules on the 9 design of Lamma IV." 10 Paragraph 6 basically sets out what you have told us 11 about the effect of schedule 1. 12 Then we move on. Perhaps about five or six lines 13 from the bottom of paragraph 6: 14 "It should be noted that the specified regulatory 15 criteria is that the margin line is not immersed, and no 16 reference is made as to the vessel might sink or not. 17 The margin line criteria provides some 'margin' over the 18 deck becoming immersed or the vessel sinking, and in 19 this way makes some allowance for the effect of any 20 waves swamping the craft." 21 A. Correct. 22 Q. So there is no necessary correlation between submerging 23 the margin line and sinking? 24 A. No, the criteria is quite clear that it's the margin 25 line being immersed.</p>	<p style="text-align: right;">Page 132</p> <p>1 whether it is of any relevance to this case? 2 A. Without a diagram, Mr Shieh? 3 Q. If not, then we can perhaps deal with it with 4 proportionate brevity. 5 A. I'm quite prepared to submit an explanation in writing 6 at some stage if it would help. But in the meantime, 7 a vessel that is upright has a certain weight which acts 8 downwards through the centre of the volume underwater. 9 The centre of the volume underwater we call the centre 10 of buoyancy, and the buoyant forces act upwards through 11 the centre of gravity. Everything is in equilibrium, 12 and the boat is stable and upright. 13 If you now displace the boat to one side, the weight 14 acts downwards, but because the boat has shifted 15 slightly through some angle, which I'll theta -- please 16 excuse the use of Greek, but it is convention -- then 17 the centre of the volume shifts further out, and 18 therefore the buoyancy acts upwards outside of the line 19 of the weight acting downwards. Because the weight 20 acting downwards has another force acting upwards 21 outside of it, there is essentially a moment, or more 22 correctly a couple. Where the force of buoyancy acts 23 upwards, where it crosses the centreline of the vessel, 24 is called the metacentric height. Whilst it may not 25 sound very exciting, it's actually of great value to</p>

<p style="text-align: right;">Page 133</p> <p>1 naval architects because it is an indication of the 2 amount of energy, for want of a better description, 3 remaining in the boat to bring it back upright. 4 It is used in several different ways when examining 5 stability of a ship, but it is only accurate for very 6 small angles. It has little value at large angles. 7 There, you have to get more technical. 8 Q. But then, for present purposes, the focus of the 9 discussion and analysis has been on margin line 10 submersion. 11 A. Indeed, and margin line is quite a different science. 12 This is the deck edge going underwater and may depend on 13 the vessel geometry, such as how much freeboard it has. 14 Freeboard is the distance from the deck down to the 15 water. It's affected by the beam of the boat. It's 16 just a different science to the GM value the vessel has, 17 which is a function of the underwater volume and the 18 height of the centre of gravity. 19 Q. So basically GMT and submersion of margin line, although 20 they both had to do with stability, they actually 21 measure different attributes of stability or 22 characteristics? 23 A. I've never thought of margin line as being really 24 related to stability. Margin line is all about flooding 25 of the vessel. So if the deck edge goes underwater and</p>	<p style="text-align: right;">Page 135</p> <p>1 in the stability book, the length of the two 2 compartments when considered together after the ballast 3 had been added in 1998 would exceed the maximum 4 floodable length for that location." 5 That is because on the calculation taking two 6 compartments as both flooded, the margin line would be 7 submerged? 8 A. Correct. 9 Q. And that means the maximum or the maximum floodable 10 length had been exceeded, because a compartment of that 11 length being flooded would submerge the margin line? 12 A. Margin line, correct. 13 Q. Thank you. 14 "Before 1998 when the ballast was added, it appears 15 to me that the floodable length was not exceeded, and 16 therefore the watertight door could have been omitted 17 without breaching the requirements for floodable length 18 and for damage stability, but this was not the case 19 after the ballast was added." 20 Could I perhaps invite you to consider this part of 21 your report, because I think we need to get some 22 assumptions correct. 23 Before 1998, when the vessel was originally built, 24 we know as a matter of fact that the shipyard and 25 Mardep, in the damage stability calculations, assumed</p>
<p style="text-align: right;">Page 134</p> <p>1 the vessel floods, then, yes, the vessel loses all 2 stability and it can be catastrophic. But it's not 3 usually considered as a normal part of transverse 4 stability of a ship. Obviously it is important. 5 Q. Removing the word "stability", they both measure 6 attributes of a ship in the event of a marine casualty, 7 the way the ship would behave? 8 A. In the sideways direction, yes. 9 Q. Yes. But they each measure different characteristics? 10 A. Yes. 11 Q. Could I now look at your second supplemental report. 12 Paragraph 9 discusses the question of GMT, which you 13 have just described for us. 14 Paragraph 10: 15 "The damage stability book issued in 1998 assumes 16 one-compartment damage in accordance with the practice 17 at the time, but the information in the book assumes 18 a watertight door was fitted at frame 1/2. There does 19 not appear to have been a calculation done to assess the 20 result of flooding both the tank room and the steering 21 gear compartment, and thus representing the real 22 situation with no watertight door at frame 1/2. 23 According to my calculation using the spreadsheet of the 24 flooding model referred in my report at paragraphs 36 25 & 37, for the condition known as 'full load departure'</p>	<p style="text-align: right;">Page 136</p> <p>1 watertight frame 1/2. 2 A. (Witness nods). 3 Q. They took steering gear compartment as one compartment; 4 they took tank room as a separate compartment. 5 A. They did. 6 Q. They passed the margin line test. Floodable length not 7 exceeded. That was factually what they did at the time. 8 A. Correct. 9 Q. We know that from the stability booklets. We now know 10 that's not quite right, because length of steering gear 11 compartment is actually less than 0.1L, and so steering 12 compartment and tank room had to be merged as one for 13 the purpose of calculating one-compartment damage. 14 You've done the calculations -- in fact the results 15 are set out at the back. But the calculations are that 16 had the 0.1L criterion been adopted and applied in 1996 17 when Lamma IV was completed, the margin line test would 18 have been passed? 19 A. I believe so, yes. 20 Q. With or without door? 21 A. With or without door. 22 Q. With or without door, it would have been passed? 23 Because it doesn't matter, because even with door, you 24 disregard that watertight bulkhead anyway -- 25 A. Correct, yes.</p>

<p style="text-align: right;">Page 137</p> <p>1 Q. -- for the purpose of ascertaining "the compartment"; 2 correct? 3 A. Correct. 4 Q. Come 1998, after adding the ballast, under the 5 calculations as performed by the shipyard and as checked 6 or calculated by Mardep, margin line test was passed. 7 You could see that in the stability booklets; correct? 8 A. Apparently in the Stability Book, yes. 9 Q. Sorry? 10 A. Yes. 11 Q. That was because they mistakenly assumed that each 12 compartment could be regarded as separate? 13 A. Exactly, yes. 14 Q. If they had applied the correct test, if they had 15 treated steering and tank as forming one compartment, 16 the margin line test would have failed? 17 A. Correct. 18 Q. That's the result of your calculation; in fact, that's 19 the result of I think Cheoy Lee's latest calculation, as 20 well as Dr Peter Cheng's calculation. 21 A. Correct. 22 Q. Applying the correct test, taking into account 0.1L, 23 margin line test would have failed in 1998? 24 A. Yes. 25 Q. By the same exercise, applying the correct 0.1 test,</p>	<p style="text-align: right;">Page 139</p> <p>1 2005? 2 THE CHAIRMAN: 2005 is where we are at the moment, when the 3 lead ballast has been raised. 4 A. 2005, with the tank room only, with a watertight door, 5 would have passed. I refer you to page 928 at the 6 bottom. The 1.046 value. 7 MR SHIEH: Yes. I think we are perhaps at cross-purposes 8 there. Because you say with watertight door, it would 9 have passed. But that would mean you disregard any 10 flooding of the steering compartment; right? 11 A. If there was a door -- yes, I see what you're saying. 12 Q. Yes. 13 A. If the steering gear compartment had been flooded and 14 you had applied the 0.1L regulation, then of course 15 there would be no watertight door there. Because -- 16 Q. And it would have failed? 17 A. And it would have failed. 18 Q. Perhaps let me start again. 19 THE CHAIRMAN: Well, the reality is this is a vessel that 20 didn't have a watertight door. And in 2005, when the 21 lead was raised, according to what you say at page 928, 22 without a watertight door, it would have failed. That 23 was the actuality. 24 A. In 1998, without a watertight door -- 25 THE CHAIRMAN: I beg your pardon, in 2005. In 2005.</p>
<p style="text-align: right;">Page 138</p> <p>1 disregarding whatever bulkhead existed between steering 2 compartment and tank room, margin line test would 3 likewise have failed after raising the ballast in the 4 year 2005; correct? 5 A. Sorry, could you say that again, Mr Shieh? 6 Q. Again, applying the correct test, 0.1L -- in other 7 words, disregarding the bulkhead between steering 8 compartment and tank room -- in 2005, after the ballast 9 had been raised, margin line test would have failed? 10 A. Correct. 11 Q. That's the result of your calculation, which we will 12 come to I think in a couple of pages. 13 A. Correct. 14 Q. But you've done the calculation, and margin line test 15 would have failed? 16 A. Correct. 17 Q. With or without a door, because for this purpose you 18 basically -- for the purpose of applying the correct 0.1 19 test -- 20 A. In fact, hypothetically, with a door, it would have 21 passed, but of course would have failed a 0.1L criteria. 22 So you can't assume ... 23 Q. Well, with the watertight door, but not applying 0.1, it 24 would have passed? 25 A. With a watertight door it would have passed. In 1998 or</p>	<p style="text-align: right;">Page 140</p> <p>1 A. In 2005, without a watertight door, it would have 2 failed, sir, yes. 3 THE CHAIRMAN: And it would have failed in 1998 without 4 a watertight door? 5 A. Correct. 6 THE CHAIRMAN: If anyone had bothered to inspect the vessel, 7 as opposed to poring over their calculations that naval 8 architects made, they would have known it didn't have 9 a watertight door; isn't that the reality? 10 A. I believe so, yes. 11 MR SHIEH: Yes. The reality, obviously, is that had any -- 12 well, what any reasonable inspection would have shown is 13 obviously a matter of later submission. But obviously 14 if it had been spotted that there was no watertight door 15 and the plan was checked, obviously things might have 16 turned out rather differently. But what I'm testing 17 with Dr Armstrong is the result of any calculation and 18 the proper interpretation or assumption which underlie 19 his paragraph 12. 20 Dr Armstrong, could I test you a bit on your 21 paragraph 12. You say "Tank room only". There you say 22 "Tank room only". "With Ballast" in 1998, without 23 watertight door, it would have failed? 24 A. Correct. 25 Q. Without watertight door, it would mean that flooding</p>

<p style="text-align: right;">Page 141</p> <p>1 would have occurred to both tank room and steering 2 compartment? 3 A. Correct. 4 Q. Which would be the scenario as mandated by the 0.1L 5 rule, because 0.1L rule requires you to -- 6 A. Not quite, because here it states "Tank room only", and 7 the tank room is longer than 0.1L. 8 Q. Ah. 9 A. But if you now put to me that the steering gear had been 10 flooded, which of course is longer than 0.1L, then yes, 11 it would have failed. 12 Q. I understand. Yes, I understand. I see. 13 Application of 0.1L rule may mean that you can't 14 simply treat steering gear compartment as 15 a self-standing compartment for the purpose of 16 calculating damage stability? 17 A. Yes. 18 Q. But since tank room is a compartment with a length more 19 than 0.1L, and therefore one-compartment flooding test 20 could perfectly well have applied only to the tank 21 room -- is that what you mean? 22 A. Correct. 23 Q. Thank you. In fact we are now getting to page 928, 24 paragraph 12. This is the result of a calculation of 25 floodable length calculation for damage to the tank room</p>	<p style="text-align: right;">Page 143</p> <p>1 MR SHIEH: And the application of the 0.1L rule may well 2 mandate you not to treat the steering room compartment 3 as one compartment. It doesn't mean that you can 4 disregard the tank room as a single compartment insofar 5 as its length exceeds 0.1L? 6 A. Yes, that's right. 7 Q. Thank you. We now move on. 8 1998, with watertight door, it would have passed; 9 without door, it would have failed. Correct? 10 A. Correct. 11 Q. Because without watertight door, it would effectively 12 mean flooding of tank room and steering compartment? 13 A. Correct. 14 Q. Same goes for 2005 after raising of the ballast; 15 correct? 16 A. Correct. Could I also comment that there were more 17 changes than just the ballast being added. 18 Q. In 2005? 19 A. In 2005. There were also some changes to this 20 fendering, I believe. Another 6 tonnes was added quite 21 high up. So it was not just the adding of ballast. 22 Q. Sorry, in 1998 or 2005? 23 A. 1998. 24 Q. 1998. 25 A. Also, there was something rather odd in 2008 because,</p>
<p style="text-align: right;">Page 142</p> <p>1 only; correct, Dr Armstrong? 2 A. Correct. 3 Q. We focus on damage to the tank room only because engine 4 room we can disregard as being immaterial for present 5 purposes because of the watertight bulkhead between tank 6 and engine. Is that the reason? 7 A. In fact the next page covers the scenario as it was in 8 October last year with the engine room and tank room 9 flooded. 10 Q. Yes, but for present purposes you focus on the tank 11 room? 12 A. Correct, as a one-compartment standard. 13 Q. Yes, one compartment. It's really the bottom of this 14 page. As constructed with or without watertight door, 15 margin line test would have passed. 16 A. Right. 17 Q. And always remembering tank room is a compartment more 18 than 0.1L, and therefore one-compartment flooding can 19 perfectly sensibly be applied to the tank room on its 20 own; correct? 21 THE CHAIRMAN: What percentage of the length of the vessel 22 was the tank room? 23 A. It's 5 frames long, and the ship is 27 frames long, so 24 roughly 20, 21 per cent or something. 25 THE CHAIRMAN: Thank you.</p>	<p style="text-align: right;">Page 144</p> <p>1 although the ballast was lifted by 10 inches, according 2 to the Stability Book, the centre of gravity went down 3 by 6 inches. 4 Q. 2005, you mean? 5 A. 2008, when the ballast was lifted. 6 Q. That's 2005. 7 A. Sorry, 2005. I've been here too long. 8 2005, when the ballast was lifted by 10 inches, the 9 centre of gravity of the boat went down by 6 inches, for 10 reasons I do not know. 11 THE CHAIRMAN: You'd expect the opposite, if you were 12 raising the -- 13 A. The ballast, the centre of gravity should go up. 14 THE CHAIRMAN: Yes. 15 A. So there is some error in the calculations somewhere in 16 the Stability Book. 17 MR SHIEH: Paragraph 13: 18 "A similar investigation of the margin line 19 immersion under schedule 1 ... was carried out with both 20 the engine room and the tank room flooded, both with 21 a watertight door at frame 1/2 and without, using 22 a lightship according to the inclining experiment ..." 23 This basically sets out an assumption based on 24 engine room and tank room flooded, and we can see the 25 same format of the table at the bottom; yes?</p>

<p style="text-align: right;">Page 145</p> <p>1 A. Yes. 2 Q. So if tank room and engine room flooded, without 3 watertight door, in other words in the state of the 4 vessel as built in 1996, because that was the situation 5 of the vessel as built, engine room and tank room with 6 no watertight door, not only would the margin line test 7 fail, the vessel would actually sink? 8 A. Correct. 9 Q. And in 1998, if engine room and tank room were flooded, 10 but with a watertight door, margin line would immerse; 11 but without watertight door, vessel would sink? 12 A. Correct. 13 Q. Likewise, 2005; without watertight door, the vessel 14 would sink? 15 A. With no watertight door, correct. 16 Q. Yes. Put very bluntly, even in the state of the vessel 17 when built, in a three-compartment flooding scenario, 18 which would have been the case had there been no 19 watertight door in frame 1/2, and if there is flooding 20 of tank and engine, the vessel would have sunk? 21 A. Correct. 22 Q. Even in the state as built in 1996? 23 A. Correct. 24 Q. Irrespective of adding of ballast and irrespective of 25 raising of ballast?</p>	<p style="text-align: right;">Page 147</p> <p>1 Paragraph 31: 2 "The regulations only required investigation of the 3 effects of flooding one compartment, but the collision 4 between Lamma IV and Sea Smooth resulted in holes in two 5 compartments, the engine room and the tank room. This 6 scenario was not examined by the builder as there was no 7 requirement to do so." 8 That's correct, because the requirement is 9 one-compartment flooding? 10 A. Correct, yes. 11 Q. "During my inspection of the structure inside Lamma IV 12 after the collision it was noted that the watertight 13 bulkhead between the aft peak and the tank room 14 contained a large access opening ..." 15 We've seen numerous photographs of that. The 16 handiest one is page 389 of this bundle. That's the 17 access opening, Dr Armstrong? 18 A. It is, yes. 19 Q. "The effect of this 'missing door' was that there were 20 three compartments flooded at the after end of the ship, 21 as there was no impediment to the flow of water from the 22 tank room into the aft peak. Three flooded compartments 23 is a considerably worse scenario than was assumed by the 24 regulations to which Lamma IV was constructed." 25 Then paragraph 33:</p>
<p style="text-align: right;">Page 146</p> <p>1 A. (Witness nods). 2 Q. Thank you. You had mentioned the problematic phenomenon 3 about the lowering of the centre of gravity over the 4 next page at paragraph 14. 5 A. Yes, and the numbers can be seen in the table on the 6 previous page. 7 Q. Yes. 8 A. Under "Lightship". It says KG with ballast, 2.43 -- 9 THE CHAIRMAN: "KG" being? 10 A. The vertical centre of gravity, sir. 11 THE CHAIRMAN: Thank you. 12 A. And then when the ballast was raised by 10 inches, the 13 vertical centre of gravity went down by 160 mm. I do 14 not know the cause of that. I can only think that there 15 is an error either in the inclining experiment itself, 16 or in the calculation in the Stability Book. 17 MR SHIEH: LCG is longitudinal centre of gravity? 18 A. Correct. 19 Q. Measured along the length? 20 A. Measured in this case along the length from frame 0. 21 Q. Thank you, Dr Armstrong. We have now dealt with the 22 rather heavy topic of 0.1L, and the margin line. 23 Could we now come back to your opinion, your main 24 report, your first report, the section on your opinion 25 as to why Lamma IV sank.</p>	<p style="text-align: right;">Page 148</p> <p>1 "The drafts of Lamma IV at the time immediately 2 before the collision was estimated from the ship's 3 stability book with the stated number of passengers and 4 crew on board distributed as indicated by the coxswain 5 at the start of the voyage a few minutes earlier ..." 6 Then you refer to the use of various software, and 7 you refer to appendix IV, item 6.1. 8 Pausing here for a moment. There you have set out 9 various visual output, in 6.1. But as I understand it, 10 you then did a revised timeline by using a wider 11 collection of data; is that correct, Dr Armstrong? 12 A. (Witness nods). 13 Q. If you look at the same bundle, page 471, under the 14 heading "Estimate of time to sink, Lamma IV", you say: 15 "I originally estimated the displacement, drafts and 16 trim of Lamma IV at the time of the collision during my 17 first visit to Hong Kong ... This was based upon the 18 vessel characteristics contained within the 'approved' 19 vessel Stability Booklet." 20 Then you refer to the existence of several such 21 stability booklets, and then you refer to the use of 22 softwares, et cetera. 23 Ultimately at paragraph 5 you make the point: 24 "[These] modifications make no difference to the 25 vessel sinking, or the impact of the omission of</p>

<p style="text-align: right;">Page 149</p> <p>1 a watertight door in the aft peak bulkhead. The only 2 change the shape of the plot of the vessel angle against 3 time, and add some seconds to the estimated time to rest 4 resting on the seabed. 5 The revised timeline is given in appendix IV, 6 item 15." 7 So does it mean, Dr Armstrong, that for the purpose 8 of really visualising the way the vessel had tilted, we 9 should go straight to the revised timeline and the 10 various depictions that you have given from that page 11 onwards? Because it is in paragraph 6 of your 12 supplemental report that you set out your revised 13 timeline. 14 A. Appendix IV, item 6 would be modified by using the later 15 Stability Book. I am unsure as to whether you would be 16 able to visually notice the difference. I think the -- 17 I know that the ultimate result will be similar, but -- 18 for example, in 6.3, the vessel would assume the 19 75 degrees shown there. 6.2 may have the waterline in 20 a slightly different place. But based on calculations 21 I have done since, I know it would not be fundamentally 22 different. 23 Q. Right. Let's look at your 6.1 and 6.2 in your first 24 report, because this is referred to in paragraph 33 of 25 your first report, at page 413.</p>	<p style="text-align: right;">Page 151</p> <p>1 A. Yes. Roughly 6 inches in the old language. 2 Q. Yes. But appendix IV, 6.3, three-compartment damage, 3 which is what happened -- 4 A. Yes. 5 Q. That shows the final shape, attitude? 6 A. Not quite, sir, because as I mention in the report, that 7 particular stability software can only calculate up to 8 a maximum of 75 degrees. So it would be lost, but 9 I cannot say that that would be the angle that it would 10 assume. 11 Q. Yes. That's the penultimate line of your paragraph 33? 12 A. Correct. 13 Q. But then that was modified, and we can see that in your 14 supplemental report at paragraph 6 and appendix IV, 15 item 15, which is page 482. 16 THE CHAIRMAN: Can we see the lower part of that page, 17 please. 18 MR SHIEH: The lower part of page 482. 19 Dr Armstrong, as I understand it, the top -- could 20 you explain the difference between the top part of this 21 page and the bottom part of this page and what they 22 respectively depict or indicate? 23 A. Yes, sir. The top graph represents the elapsed time 24 against the trim angle of the boat, up to the point 25 where the deck goes underwater at the transom. The</p>
<p style="text-align: right;">Page 150</p> <p>1 A. It is. 2 Q. You say: 3 "The visual output from the software is reproduced 4 in appendix 4, item 6.1 ..." 5 Which is at page 463. 6.1 is the very top one; yes? 6 A. Correct. 7 Q. It assumes one-compartment damage; damage only to the 8 engine room. 9 6.2, which is the middle diagram, depicts damage to 10 the engine room and tank compartment, but with 11 a watertight door; correct? 12 A. Correct. 13 Q. In that case, you say: 14 "... the stern is almost submerged, but the vessel 15 remains afloat." 16 A. Correct. 17 Q. So that would be the ultimate stationary position of the 18 vessel? 19 A. Correct. If you would like to know the freeboard, 20 Mr Shieh? 21 Q. Yes. 22 A. It's roughly 125 mm at that point. 23 Q. Sorry? 24 A. It's roughly 120 mm at the after end to the margin line. 25 Q. That's 12.5 cm?</p>	<p style="text-align: right;">Page 152</p> <p>1 margin line is well-immersed, but the deck goes under. 2 Q. So that is not about sinking; that only deals with 3 immersion of the deck? 4 A. Correct, but my rule of thumb was that once the deck is 5 underwater, there's very little stopping the boat from 6 sinking. So the top part was my idea of what would 7 happen, how quickly it would get to the position at 8 which I could call it sunk. It shows two graphs, one 9 with the watertight door closed and one with the 10 watertight door open. 11 Q. Well, without watertight door. 12 A. Without watertight door. 13 You can see that one of them sinks in roughly 14 110 seconds for the deck edge to go under, and the other 15 one remains afloat, although at an angle of 5 degrees. 16 That is assuming certain blockages in the hole due to 17 the remains of Sea Smooth in the hole. I then took that 18 model -- 19 Q. Can you pause there. When you say the vessel sinks 20 in -- about roughly 110 seconds for the deck edge to go 21 under, and the other one remains afloat -- you could see 22 whether one goes under or remains afloat by looking at 23 the way the curve actually gradually tails off, right, 24 because the green line actually gradually tails off 25 horizontally?</p>

<p style="text-align: right;">Page 153</p> <p>1 A. It's asymptotic, as we say, to 5 degrees, so, yes, 2 it tails off and goes no higher. 3 Q. Whereas the red one -- 4 A. Continues upwards, and indeed gets steeper. 5 Q. Thank you. 6 A. I then looked at what would happen next, and that is 7 a different physics. You have to think about the boat 8 rotating in the water, and the forces on -- it becomes 9 a hydrodynamic problem then. What is the resistance of 10 a rotating boat, and how quickly would it rotate to 11 a large angle. I made some assumptions to attempt to 12 understand how quickly it would rotate from that 13 7 degrees to 70 degrees, with a certain degree of 14 success, although I don't think it was perfect, which is 15 shown in the bottom diagram. 16 So in fact, all the way up to 110 seconds, the graph 17 is the same as the upper one. The point of the lower 18 graph is to show you what happens after the 110 seconds. 19 And it rotates very quickly until it hits the sea floor. 20 Q. Yes. We can actually see variables that have been 21 factored in, such as choke factors and stuff like that. 22 A. I looked at different choke factors to see if they were 23 important. I think I gave two graphs in my report on. 24 Q. Yes. 25 A. On the next page there are some different values. They</p>	<p style="text-align: right;">Page 155</p> <p>1 14 December. 2 So, coming to you first of all, Mr Sussex. Do you 3 have questions for Captain Pryke? 4 MR SUSSEX: Yes, definitely, sir. 5 THE CHAIRMAN: Can you indicate any estimate -- I appreciate 6 it's difficult -- as to the likely length of that 7 questioning? 8 MR SUSSEX: Well, I imagine it would be at least half a day. 9 I mean, my intention is to submit an expert report, and 10 it may be that a large measure of agreement can be 11 reached. I mean, these people being experts, one would 12 assume that a large measure of agreement will be 13 reached. 14 Frankly, our problem with Captain Pryke's evidence 15 so far is that Captain Pryke hasn't sufficiently 16 concentrated on the aspect, the light aspect which the 17 vessels would display to one another. 18 THE CHAIRMAN: No doubt he will when you question him. 19 MR SUSSEX: Well, that's right. And it's our submission 20 that it's wrong to regard this all the way through as 21 a head-on situation. 22 THE CHAIRMAN: Yes. I'm not asking you to disclose what it 23 is you want to question him about. I'm looking forward, 24 that's all. 25 MR SUSSEX: Yes.</p>
<p style="text-align: right;">Page 154</p> <p>1 made a few seconds' difference. Certainly not enough 2 time in which the crew would have been able to organise 3 evacuation from the ship. 4 MR SHIEH: Thank you. 5 Would that be an appropriate moment, Mr Chairman? 6 THE CHAIRMAN: Yes, certainly. 7 Dr Armstrong, I'm sure it's been a long day for you, 8 but we're going to adjourn now and we'll resume with 9 your testimony tomorrow at 10 o'clock. You're free to 10 leave the witness box now. There are one or two matters 11 I wish to raise with counsel. 12 10 o'clock tomorrow. Thank you. 13 (The witness stood down) 14 THE CHAIRMAN: Mr Sussex, can I come to you and ask you 15 this. On 14 December, when Captain Pryke was finishing 16 his questioning, you indicated that you obviously, as 17 you put it, had questions you wished to raise with 18 Captain Pryke. You weren't ready to do so. You were 19 waiting for views from experts. And you asked that you 20 be permitted to ask questions, but that you deferred 21 putting the questioning until a later stage. 22 MR SUSSEX: Yes, sir. 23 THE CHAIRMAN: Mr Mok for his part indicated that he wished 24 to reserve the issue of questioning. He also wanted to 25 consult experts. This is page 73 of the transcript of</p>	<p style="text-align: right;">Page 156</p> <p>1 THE CHAIRMAN: Are you in a position then to provide the 2 Commission with a draft of this report that you say you 3 intend submitting? 4 MR SUSSEX: I imagine I certainly will be within this week. 5 I have a conference this afternoon -- 6 THE CHAIRMAN: I have in mind that we would invite Captain 7 Pryke to return to give evidence next week, and that 8 would be an opportunity for you to question him. 9 MR SUSSEX: Oh, I see. 10 THE CHAIRMAN: I have also in mind the indication we gave at 11 the outset, that a seven-day limit, as Mr Grossman has 12 identified, is a matter that you ought to address. So 13 that gives Captain Pryke -- 14 MR SUSSEX: I'm sorry, but I had been given to understand by 15 counsel for the Commission that Captain Pryke wouldn't 16 be here until after Chinese New Year. 17 THE CHAIRMAN: Maybe things have changed. But when I last 18 gave directions I asked that he be available next week. 19 MR SUSSEX: I see. Obviously not knowing what target we're 20 aiming at, it's difficult to work back seven days. 21 THE CHAIRMAN: I follow that. 22 MR SUSSEX: But we will expedite the provision of a draft. 23 THE CHAIRMAN: Thank you very much. 24 It may be that Captain Pryke is not available, but 25 with the timetable as it's developing, I'd ask that he</p>

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<p>1 be available for next week, for this part 1 questioning, 2 that is the issue of the collision. 3 MR SUSSEX: Thank you. 4 THE CHAIRMAN: Mr Mok, can I come to you and ask you what 5 your position is? 6 MR MOK: I think my position is I would have very few 7 questions for Captain Pryke, so it won't take up much 8 time at all. 9 THE CHAIRMAN: Thank you. Do you seek to tender an expert's 10 report in this respect or not? 11 MR MOK: Not on my present instructions. 12 THE CHAIRMAN: Thank you. 13 Very well. We'll leave things as they are then, as 14 far as that's concerned, Mr Sussex. Perhaps counsel can 15 put their heads together. You may have a more 16 up-to-date position than I have on the matter. 17 MR SUSSEX: Thank you, sir. 18 THE CHAIRMAN: Mr Yeung, I saw you rising to your feet. 19 MR YEUNG: Yes, Mr Chairman, if I may. I have 20 an application to make. We're seeking leave to recall 21 two witnesses. 22 THE CHAIRMAN: Yes, I received a letter. It was put on my 23 desk at 2.30, as I came into the hearing. So I know 24 there's a letter from DLA Piper but I don't know what it 25 says.</p>	<p>1 THE CHAIRMAN: When were these witnesses called? 2 MR YEUNG: For Mr Fung Wai-man of the Marine Department, 3 I would like to ask questions about -- 4 THE CHAIRMAN: No, when were they called? 5 MR YEUNG: I'm sorry. Mr Fung was called on Day 17; that 6 is, 17 January. And Mr Lo was called on Day 19; that 7 is, 21 January. 8 THE CHAIRMAN: That's some time after you'd been informed by 9 way of the Salmon letter, is it not? 10 MR YEUNG: Yes, after we received it. 11 THE CHAIRMAN: In other words, you hadn't made the 12 application which would have allowed you to be present, 13 participating in the examination at the time? 14 MR YEUNG: Quite true. 15 THE CHAIRMAN: Give some thought as to why we should require 16 witnesses to be recalled because those instructing you 17 were dilatory in making the application, and we'll deal 18 with your application tomorrow. 19 MR YEUNG: Thank you. 20 THE CHAIRMAN: 10 o'clock tomorrow. 21 (4.37 pm) 22 (The hearing adjourned until 10 am on the following day) 23 24 25</p>
Page 158	Page 160
<p>1 MR YEUNG: Maybe I'll come back tomorrow morning then. 2 THE CHAIRMAN: Do you want to just flag the nature of what 3 it is you're seeking? Is there information you want, as 4 well as recalling witnesses? 5 MR YEUNG: I'm sorry? 6 THE CHAIRMAN: Is there information that you seek, as well 7 as the separate issue of recalling witnesses called 8 hitherto? 9 MR YEUNG: Yes, sir. We seek a direction from the 10 Commission for Cheoy Lee to produce documents set out in 11 paragraph 4, ie all communications between Cheoy Lee and 12 Wuzhou Shipyard, and the covering letter -- 13 THE CHAIRMAN: Has this letter been copied to the other 14 parties? 15 MR YEUNG: Yes. 16 THE CHAIRMAN: So you have a copy of this, Mr Pao? 17 MR PAO: Yes, I do. Those instructing me are in the course 18 of drafting a reply to DLA Piper, informing them that 19 the only surviving document in our client's possession 20 is a draft contract made between Cheoy Lee and the agent 21 of the Wuzhou Shipyard, and the rest of it they don't 22 have. 23 THE CHAIRMAN: Thank you. You have an answer to part of it. 24 What other matter do you wish to raise? 25 MR YEUNG: Just the recall of two witnesses.</p>	<p style="text-align: center;">I N D E X</p> <p>DR NEVILLE ANTHONY ARMSTRONG (sworn)2 Examination by MR SHIEH2 (The witness stood down)154</p> <p>1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25</p>