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	Page 1		Page 3
1	Tuesday, 29 January 2013	1	that correct? You're referring to that?
2	(10.00 am)	2	A. Yes, correct. It's also shown in the diagram at the top
3	DR NEVILLE ANTHONY ARMSTRONG (on former oath)	3	of page 482 and the bottom of page 482.
4	THE CHAIRMAN: Good morning, Dr Armstrong. May I remind yo		Q. Yes.
5	that you continue to testify according to your original	5	A. So the 0.8 refers to the diagonal gash which had a lot
6	oath.	6	of debris into it, and the 0.4 refers to the opening
7	A. I'm aware of that, Mr Chairman. Good morning.	7	into the tank room, which appears to me not to have had
8	THE CHAIRMAN: Mr Shieh?	8	a lot of debris in it. The 0.2 is referring to the
9	Examination by MR SHIEH (continued)	9	access opening in frame $1/2$.
10	MR SHIEH: Good morning, Dr Armstrong.	10	I did look at the exercise of changing the choke
11	Yesterday afternoon I think we stopped at the place	11	factors, of course, to see how much reliance there was
12	when you were discussing the various graphs or plots	12	on these choke factors in changing the sinking time.
13	that you had done, at the expert bundle, pages 482	13	I chose some other choke factors which I thought were
14	and 483; being appendix IV, items 15 and 16 of your	14	realistic, based on my experience. And that appears on
15	supplemental report.	15	page 483, where I made some variation. It can be seen
16	These plots or graphs are basically based on	16	that there is not a lot of difference in time to sink:
17	different assumptions as to what you have described as	17	a matter of some seconds, and it is not a matter of
18	"choke factors", to take into account the effect of the	18	minutes. The time to sink is very, very short and
19	debris and the various things that could prevent water	19	clearly it's not enough time for the crew to have
20	ingress through the various holes and gashes; correct?	20	organised evacuation in an organised manner. And
21	A. Correct.	21	I think the difference between the choke factors
22	Q. Could you explain to us perhaps in greater detail the	22	probably is not very material.
23	significance of the various choke factors? Because we	23	Yes, I can be criticised for getting the wrong choke
24	see 0.3, 0.45 and 0.85. These are numbers, but in	24	factors, but at the end of the day I don't think it made
25	real-life terms, what do they denote?	25	a lot of difference.
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	Page 2		Page 4
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2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22	 A. Yes. Good morning, Mr Shieh. The holes in Lamma IV were choked with debris from the Sea Smooth, as can be seen in a variety of pictures of the Lamma IV on the hard stand. It is difficult to know how much of the hole was blocked by this debris. Particularly the diagonal gash had quite a lot of debris in it. I put into the calculation the ability to choke the hole, make it essentially or reduce the flow through that hole. I kept the size the same. And I estimated what I thought the amount of blockage was, based on looking at the photographs from both the inside and the outside of the hole. It is a somewhat arbitrary choice of choke factors. For example, the door, the non-watertight access opening, I should say, should have a value of zero because it is not choked. But the reality is that the flow of water through a hole will contract. It has a technical name called a vena contracta, which means that the flow through a hole is actually smaller than the hole size. Q. So a choke factor of zero means no blockage, no choking? A. A choke factor of zero means that there is no debris in the opening. So the choke factor you can see there of 0.8 is for the diagonal gash. 	2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24	 THE CHAIRMAN: Didn't make a lot of difference to the speed at which the vessel sank, and therefore the time available to evacuate safely? A. That is the point I was trying to make, yes, Mr Chairman. MR SHIEH: Which is I think probably the last point you made yesterday afternoon: that the difference in time caused by these variations in choke factors that you have chosen is probably immaterial for the purpose of deciding whether or not, let's say, more lives could have been saved? A. Correct. And even if the choke factors had been wrong by a factor of 2, which I think is a very large difference, then it did not make a lot of difference to the overall time to sink. Q. Thank you. Could I just ascertain the various choke factors. Let's say that the first choke factor, 0.8, represents the diagonal gash, you say A. Correct. Q together with the hole associated with it still in the engine room? A. Right. Q. The next one, 0.4, or in the other chart, 0.45, represents the hole in the tank room?

1 Q. And the last one, 0.2 or 0.3, represents really the

2access opening?2will look at because we are reasonably familiar with4Q. Thar's the hole connecting the tank room and the steering compartment.3that.7Q. Can we now move on in your main report, your first report, to the section at page 414 on the subject of your opinion on why Lamma IV sank so quickly. In paragraph 34, you said you were asked to examine why the 11We turn over to the next page at the top:11Lamma IV sank so quickly. In paragraph 34, you said you were asked to examine why the solution. By that Tlack it that you mean it could only a solution. By that Tlack it that you mean it could only to solution. By that Tlack it that you mean it could only to solve this problem a numerical model was generated or you had used only give you an idea as to the timefarma to wold no tactually give you an idea as to the timefarma to wold no tactually give you an idea as to the timefarma to wold no tactually give you an idea as to the timefarma to you by predict or to work out what the final satic calculation.15A. (Witness nods).16Q. To solve this problem a numerical model was generated and design drawing The result from Massud to you be related information contained in the something called a numerical simulation model in terms of the final vessel2N. It is acclulate the amount of water sectific to work out even the time factor, and you compare the result day uge by using the Hydromax were useful to compare the oppart. Basically the point you were making is that you used something called a numerical simulation model which would allowy out tow ow tore were the mestor. This is furty easy to graph that 'fy you have a hole in the side of a surface and a head of water rowide head previses the pressure? <th>-</th> <th>Q. This the last one, 0.2 of 0.5, represents really the</th> <th>-</th> <th>note in the tank compartment, which I don't think we</th>	-	Q. This the last one, 0.2 of 0.5, represents really the	-	note in the tank compartment, which I don't think we
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1

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hole in the tank compartment, which I don't think we

2 (Pages 5 to 8)

	Page 9		Page 11
1	It's not the same size as the hole; it's slightly	1	volume of the main engines, the fuel tank"
2	smaller due to the fact that the water speeds up.	2	So all these matters have been factored into your
3	So you have to use one equation for a jet-like flow	3	equation when working out what happened every second?
4	through a hole, and then as soon as water starts to	4	A. (Witness nods).
5	approach the hole inside the vessel, you change to	5	Mr Shieh, I just realised I have made an error in
6	a different form of equation, because the pressure	6	something I've said. If we may go back.
7	inside is different and then once the hole inside is	7	Q. Yes. Could you point out which part? You have the
8	submerged, you then have to account for the pressure	8	transcript in front of you.
9	inside the vessel owing to the depth of water inside.	9	A. Talking about the choke factors.
10	All of that, of course, is reasonably simple on	10	Q. Choke factors? Yes. Do you need the actual diagram or
11	a fixed structure that's sitting on the ground. But	11	the graph to make your correction?
12	here we have a vessel that when water is coming in, the	12	A. The actual choke factors used, Mr Shieh.
13	vessel starts to move because of the weight of the	13	THE CHAIRMAN: 0.8, 0.4, 0.2?
14	water. So it starts to trim. I did not consider the	14	A. You asked me the question which holes did they refer to?
15	vessel heeling, because I considered that the vessel was	15	I gave an erroneous response. I'm sorry, Mr Chairman.
16	sinking upright by all accounts. But I had to allow the	16	MR SHIEH: Right. Could you tell us which hole these three
17			choke factors relate to?
18	as a result of the water coming in.	18	A. Correct. The 0.8 refers to the diagonal gash. The 0.4
19	The trimming then of course changed the depth of	19	refers to the small hole in the engine room near the
20	water outside in way of the hole and therefore changed	20	bulkhead. The 0.2 refers to the hole into the tank
21	the pressure outside. So it's quite a complicated	21	room. And the open access value is not given. It was
22	calculation, because everything is moving, which is why	22	a little more than zero. But essentially it was close
23	I treated it as a discrete problem fixed in time, solved	23	to zero for when it was open, and if I made it 1, it was
24	it, and then I said, "Well, in one second, how much	24	equivalent to it being closed.
25	water has flowed in?" And then checked after one second		I'm sorry, it was done some time ago and I had
		2.5	
	Page ()		Pade 1/
1	Page 10	1	Page 12
1	how much the vessel would have moved because of that	1	forgotten.
2	how much the vessel would have moved because of that water, making allowance for how quickly the water flowed	2	forgotten. Q. Thank you. So basically zero is as if it's clear; 1 is
2 3	how much the vessel would have moved because of that water, making allowance for how quickly the water flowed into the compartment. That was reproduced every second.	2 3	forgotten. Q. Thank you. So basically zero is as if it's clear; 1 is as if it's watertight. So the value would only be
2 3 4	how much the vessel would have moved because of that water, making allowance for how quickly the water flowed into the compartment. That was reproduced every second. I did check the accuracy of the model by looking at	2 3 4	forgotten. Q. Thank you. So basically zero is as if it's clear; 1 is as if it's watertight. So the value would only be somewhere between zero and 1?
2 3 4 5	how much the vessel would have moved because of that water, making allowance for how quickly the water flowed into the compartment. That was reproduced every second. I did check the accuracy of the model by looking at every half-second, which made for a very much longer	2 3 4 5	forgotten.Q. Thank you. So basically zero is as if it's clear; 1 is as if it's watertight. So the value would only be somewhere between zero and 1?A. Correct.
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	Derre 10		Dama 15
	Page 13		Page 15
1	drafts 1.47 and 1.27.	1	A is incorrect, where it says "as shown in appendix IV,
2	Q. Yes, but that says "engine room only".	2	item 7".
3	A. And that's engine room only, which is the ah.	3	THE CHAIRMAN: So paragraph 38-1 does deal with the tank
4	Q. But paragraph 38-1 says "tank".	4	compartment or not?
5	A. Correct. I'm not sure if that's not a typographical	5	A. It does deal with the tank compartment.
6	error and should be "tank room only", perhaps. I would	6	THE CHAIRMAN: It does. And the reference to appendix IV,
7	need to	7	item 7 is to be deleted?
8	THE CHAIRMAN: Take your time. Read it through.	8	A. Should be deleted.
9	A. I cannot be sure, unfortunately, without going back to	9	THE CHAIRMAN: The other matter that you adverted to was
10	the original calculations.	10	this calculated by reference to the 1998 stability book
11	THE CHAIRMAN: Do you have them with you?	11	or to the 2005 book? Do you need to check your
12	A. On the computer, Mr Chairman.	12	calculations?
13	MR SHIEH: Perhaps we can do that in the mid-morning break.	13	A. I would like to check to be sure, Mr Chairman.
14	We'll make a mental note of that, Mr Chairman.	14	THE CHAIRMAN: Yes, please do.
15	THE CHAIRMAN: Yes.	15	A. I certainly started with the 1998 one, but at some
16	MR SHIEH: But I believe it is reasonably established that	16	stage, when I found the 2005 book, I did change over to
17	for Lamma IV, to put it very bluntly, if you only flood	17	that.
18	the tank room, it won't sink. If you only flood the	18	THE CHAIRMAN: Thank you.
19	engine room, it won't sink either. Is that the broad	19	MR SHIEH: Also, if the reference to appendix IV, item 7,
20	recollection or impression that you had, by having done	20	those calculations or those figures, is actually
21	the various calculations?	21	an error, so I presume that there should be equivalent
22	A. Yes, correct.	22	calculations which do refer to the tank compartment?
23	Q. So it is simply a matter of	23	A. Yes. I'm not so sure it was an error, Mr Shieh, because
24	THE CHAIRMAN: Are you dealing there with the three	24	I looked at a lot of one-compartment damage. I just
25	different periods, 1996, 1998 and 2005?	25	chose to refer here to the tank room flooded because
	Page 14		Page 16
1	A. At this stage, when I wrote this report, Mr Chairman,	1	probably it was a greater draft. There are other
2	I was actually using the 1998 stability book. I made	2	calculations which are for the engine room.
3	the comment in my first supplemental that I subsequently	3	Q. I know. Perhaps "error" is probably not the correct
4	discovered there was a later stability book dated 2005.	4	word to use, because as Mr Chairman asked,
5	So these comments here are related to the 1998 stability	5	paragraph 38-1 does intend to refer to the scenario of
6	book.	6	tank compartment flooded.
7	I think the comparison, however, in appendix IV,	7	But you say the reference to appendix IV, item 7
8	item 7, is against the 2005 stability book.	8	should be deleted because those calculations set out in
9	MR SHIEH: Dr Armstrong, could I remind you that at page 464		item 7 related to the engine room. So what I am asking
10	you actually referred to the stability book in 2005.	10	is that there would presumably, in your working papers
11	A. Correct. That is in the second supplemental, I think.	11	or in your computer, be a set of calculations which do
12	Q. No, this is in your first report.	12	depict something similar to appendix IV, item 7, but
13	A. Ah. Okay.	13	relating to the scenario of tank compartment only
14	MR MOK: Mr Chairman, I think the reference in item 7, where	14	flooded.
15	it refers to the stability book 2005, it is a reference	15	A. Yes. I can recall now what happened. I did not have
16	to the engine room. The page reference is bundle 4,	16	a Hydromax solution for the tank room flooded, only for
17	page 701. On the top left-hand corner there is a figure	17	the engine room flooded, and therefore I chose to use
18	for draft front perpendicular, which is 1.29, which is	18	the engine room only in appendix IV, item 7 for the
19	the figure used in the table.	19	comparison purposes.
20	THE CHAIRMAN: Yes.	20	Q. Right.
21	A. Thank you, Mr Mok. You had the advantage of having	21	A. So the data in appendix IV, item 7 is correct, engine
22	a stability book, which I did not in front of me. In	22	room only. And paragraph 38-1, as we have said, should
23	which case I would suggest that the item under	23	have not referred to that.
24	paragraph 38-1	24	Q. Thank you. Paragraph 38-2:
25		25	"With the tank compartment and the engine room
	internetion on the second on the second on the second seco	25	when the tank comparation and the engine room

	Page 17		Page 19
1	flooded (two-compartment damage). This replicated the	1	The revised timeline is given in appendix IV,
2	damage to the craft, but assumed that a watertight door	2	item 15. It is to that that we now turn. Page 482.
3	had been fitted to the aft peak bulkhead. The vessel	3	That's the diagram we looked at yesterday.
4	eventually became stable after about 165 seconds	4	"The time to sink, given in my original report at
5	from the time of collision. The inflow rate of water	5	paragraph 38-3" which is the paragraph we were just
6	varied considerably between 0.4-1.4 tonnes/second. The	6	looking at prior to jumping to your first supplemental
7	flow rate constantly changes because the water level	7	report "of about 87 seconds from initial contact to
8	inside changes as the craft trims and the outside water	8	the deck at the stern going below the water, has
9	level also changes with both trim and sinkage."	9	extended to 96 seconds. The time of 102 seconds from
10	But for this scenario, the vessel remained "afloat"?	10	the initial contact to assuming a position of 70 degrees
11	A. Yes, correct.	11	to the horizontal, given in my original report at
12	Q. Thank you. Scenario 3:	12	paragraph 40, is amended to 118 seconds."
13	"With the tank compartment, engine room"	13	Which is the result as depicted in the two charts at
14	THE CHAIRMAN: Before we go further.	14	page 482, and which you explained to us yesterday.
15	Is this based on the 2005 position, namely the	15	A. Yes.
16	raised lead ballast?	16	Q. Page 482, you would say perhaps forgive me for my
17	A. No, Mr Chairman, this is based on the 1998, and my first	17	rather layman-like analogy is a more microscale for
18	supplemental corrects the information to the 2005	18	the bottom of page 482. The top chart deals with
19	stability book.	19	a microscale, it deals with when the deck is
20	THE CHAIRMAN: Thank you. So this is the tank room and the		submerged
21	steering gear compartment now have 8.25 tonnes of lead	21	A. Yes.
22	in them, and this is the calculation with the tank room	22	Q whereas page 482, the bottom chart looks at the
23	and engine room flooded, but with a watertight bulkhead	23	matter in a more macro way, it looks at whether the
24	for the steering compartment?	24	vessel actually began to go stern-down and eventually,
25	A. Correct.	25	colloquially, sink?
	Page 18		Page 20
1	THE CHAIRMAN: Do I understand it correctly?	1	A. Correct.
2	A. Correct. With the 8.25 tonnes of ballast, and also the	2	Q. Because, as you say, the last part of the bottom chart
3	additional weight.	3	of page 482 involved much more complex interaction of
4	THE CHAIRMAN: Thank you.	4	various factors such as water going in and all that?
5	MR SHIEH: In fact you mentioned your first supplemental	5	
6			A. Correct, and is probably a little less accurate because
7	report, when you took into account what one may call the	6	it is so complex.
	fuller set of stability booklet information, and that	6 7	it is so complex. Q. Thank you. That was I think the effect of what you said
8	fuller set of stability booklet information, and that can be seen at page 471 of this bundle.	6 7 8	it is so complex.Q. Thank you. That was I think the effect of what you said yesterday when we first visited these two charts.
9	fuller set of stability booklet information, and that can be seen at page 471 of this bundle. At paragraph 3, you make the point that there were	6 7 8 9	it is so complex. Q. Thank you. That was I think the effect of what you said yesterday when we first visited these two charts. Could I now ask you to look at paragraph 39 of your
9 10	fuller set of stability booklet information, and that can be seen at page 471 of this bundle. At paragraph 3, you make the point that there were several stability books and damage stability books for	6 7 8 9 10	it is so complex.Q. Thank you. That was I think the effect of what you said yesterday when we first visited these two charts. Could I now ask you to look at paragraph 39 of your first report at page 416.
9 10 11	fuller set of stability booklet information, and that can be seen at page 471 of this bundle. At paragraph 3, you make the point that there were several stability books and damage stability books for the vessel. You discovered a later-approved stability	6 7 8 9 10 11	it is so complex. Q. Thank you. That was I think the effect of what you said yesterday when we first visited these two charts. Could I now ask you to look at paragraph 39 of your first report at page 416. "It can be seen from the various photographs that
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9 10 11 12 13	fuller set of stability booklet information, and that can be seen at page 471 of this bundle. At paragraph 3, you make the point that there were several stability books and damage stability books for the vessel. You discovered a later-approved stability book, which is the 2005 one, in a new format and based on different computer software.	6 7 9 10 11 12 13	 it is so complex. Q. Thank you. That was I think the effect of what you said yesterday when we first visited these two charts. Could I now ask you to look at paragraph 39 of your first report at page 416. "It can be seen from the various photographs that there was a considerable amount of debris remaining in the hole into the engine room mainly being the bow
9 10 11 12 13 14	fuller set of stability booklet information, and that can be seen at page 471 of this bundle. At paragraph 3, you make the point that there were several stability books and damage stability books for the vessel. You discovered a later-approved stability book, which is the 2005 one, in a new format and based on different computer software. Basically, at pages 471 and 472, in this whole	6 7 9 10 11 12 13 14	 it is so complex. Q. Thank you. That was I think the effect of what you said yesterday when we first visited these two charts. Could I now ask you to look at paragraph 39 of your first report at page 416. "It can be seen from the various photographs that there was a considerable amount of debris remaining in the hole into the engine room mainly being the bow structure This debris appears to have been firmly
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	Page 21		Page 23
1		1	-
1	A. Sorry, could you repeat that?	1	So reading that in conjunction with paragraph 38-3,
2 3	Q. This whole paragraph deals with a subject matter you	2 3	which we passed over, this is the actual situation in
	have already explained to us orally, that is to say the subject of choke factors?		paragraph 38-3, is it not, and, as you say at about line 5:
4 5	A. Yes.	4 5	
6	Q. So we'll skip over that.	6	" the main deck at the stern sinking below the water level about 87 seconds from the time of the
	Paragraph 40:	7	collision".
7 8		8	
9	"Having simulated the flooding process, a second numerical model was made to simulate the sinking	9	A. Paragraph 3 is of course related to the 1998 stability book
10	process, based on the output from the flooding model.	10	THE CHAIRMAN: Thank you.
11	This was necessary because of the different physics	11	A which was corrected in my first supplemental.
12	involved in the flow of water The sinking simulation	12	THE CHAIRMAN: So what's the time for the deck being
13	illustrated in appendix IV, item 9.2 indicated that the	13	submerged in the actual situation? 2005, lead raised by
14	vessel would continue to increase trim by the stern	14	10 inches, 2.5 compartments flooded?
15	until such time as the transom hit the seabed, at	15	A. That is given on page 472, Mr Chairman.
16	which time the vessel would have an approximate attitude		THE CHAIRMAN: Thank you.
17	of 70 degrees to the horizontal, with the forward part	17	MR SHIEH: As I understand it, Mr Chairman, page 472,
18	of the vessel remaining above the water as a result of	18	Dr Armstrong at paragraph 6 made two corrections to
19	the buoyancy of the forward hull compartments. This is	19	numbers. One is correcting "87" to "96". That deals
20	illustrated in appendix IV, item 9.3."	20	with what I call the micro situation, the submersion of
21	Can we turn to page 466. This is the illustration	21	the deck. The next correction is to amend "102 seconds"
22	that you refer to; correct?	22	to "118 seconds". That deals with the time that it took
23	A. Correct.	23	to sink, as we call it colloquially.
24	Q. "According to the sinking simulation model the time to	24	Is that a correct way of putting it, Dr Armstrong?
25	reach this position was 102 seconds after the initial	25	A. Correct.
	Page 22		Page 24
1	collision, and it probably remained at this attitude for	1	THE CHAIRMAN: Thank you.
2	some time, say 10-20 minutes."	2	A. And the attitude given on page 466 would not be
3	The figure of 102 seconds has been subsequently	3	affected, in my opinion, by those differences between
4	modified in your first supplemental report, paragraph 6,	4	1998 and 2005.
5	to become 118 seconds; correct?	5	MR SHIEH: And the depiction at page 466 remains good,
6	A. Correct.	6	despite the amendment to the time factor; that is
7	Q. So we strike "102" and basically insert "118". Would	7	correct?
8	that be the right way of doing it?	8	A. Correct.
9	A. Correct.	9	Q. Because the amendments you've made only relate to the
10	Q. "There is a photograph of the vessel in this condition	10	time it would have taken for the deck to submerge and
11	published by the media, before the incoming tide and	11	for the vessel to sink; it does not affect the position?
12	local currents appear to have allowed the craft to	12	A. That is correct.
13	assume a more vertical attitude as the water became	13	Q. Can we come back to this question about the position or
14	deeper, and eventually to have allowed the craft to	14	the condition of the vessel. You refer to a photograph
15	'turn over' to an angle of about 110 degrees, which was	15	published in the media. In fact we have seen a good
16	photographed and circulated by the media."	16	deal of photographs from various media, most of which
17	THE CHAIRMAN: Before we get to that.	17	actually depicted the vessel at an angle of about
18	Paragraph 40, which of the various permutations are	18 19	110 degrees. A. Correct.
19 20	we dealing with there now? Are we dealing with the	20	Q. But from your calculation, and from your software, you
20	actual situation, 2005, raised lead, tank room, engine room and aft peak all flooded?	20	came up with a situation as depicted at page 466.
21	A. Correct.	22	A. (Witness nods).
	THE CHAIRMAN: That's what we're dealing with?	23	Q. So one perhaps had to look for contemporaneous evidence
23			
23 24		24	and perhaps explanation as to how the situation at
23 24 25	A. Correct. THE CHAIRMAN: Just give me a moment.	24 25	and perhaps explanation as to how the situation at page 466 could eventually become the widely publicised

	Page 25		Page 27
1	photographs of the Lamma IV, as eventually depicted in	1	would have started to fill that compartment and the
2	a wide series of media photographs. So that is the	2	vessel would have continued to sink further, if the
3	exercise you were embarking upon?	3	seabed allowed it. But I had no means of knowing how
4	A. Yes. I was trying to justify my conclusions.	4	much water was coming into that buoyant compartment, so
5	Q. And you located a photograph of the vessel in the	5	I stopped by investigation at that point. But I thought
6	position at page 466 in the media.	6	there was very good correlation between that and the
7	Mr Chairman, it is actually the South China Morning	7	photograph.
8	Post. Dr Armstrong had actually we have actually	8	Q. Thank you, Dr Armstrong.
9	scanned a copy of the photograph. Perhaps we should	9	Could we now look at your first supplemental report.
10	acknowledge that the photograph comes from the South	10	We have looked at paragraph 6, which is at page 472.
11	China Morning Post.	11	Paragraph 6, you have set out the corrections that you
12	Perhaps we can scan that put up the scanned version.	12	have made, which we have looked at.
13	It has just been inserted into the bundle this	13	Paragraph 7 deals with the point that we have
14	morning.	14	touched on, namely the effect of using different assumed
15	How would you comment on this photograph,	15	choke factors. We'll skip over that.
16	Dr Armstrong?	16	Now, we get to the question of the final attitude of
17	A. I do not know at what stage this photograph was taken,	17	Lamma IV. You say at paragraph 8:
18	but I'm sure somebody can work it out because of the	18	"There are various representations of the final
19	presence of what looks to me like a fireboat in the	19	attitude of Lamma IV after sinking and before salvage,
20	background, with a red hull, and the obvious rescue that	20	and an explanation of these attitudes is offered to
21	is going on in the foreground. It appears to be of	21	avoid possible confusion."
22	rescuers taking people out through the windows. So I'm	22	That is the point I mentioned earlier, because
23	sure a time could be put against it.	23	different media have actually shown pictures depicting
24	It is obvious that the vessel is in an attitude	24	different angles and different attitudes.
25	similar to that on page 466.	25	A. Yes, sir.
	Page 26		Page 28
1	Q. We'll turn to page 466.	1	Q. So you set out these various phases to assist us in
2	A. If one looks at the if we can go back to the	2	understanding the various stages that the vessel had
3	photograph, thank you.	3	gone through.
4	Q. Page 487-1.	4	A. That was the intention, yes.
5	A. If one looks at the masts and the radars, from the	5	Q. Thank you.
6	shadows, it is obviously in a similar attitude to that	6	"Phase 1: Consequent to the flooding, Lamma IV sank
7	shown in my diagram. Judging by the water surface,	7	by the stern until the deck edge on the transom went
8	which is quite white in places, there is obviously air	8	below the waterline. When this happened there was no
9	escaping from the vessel. Presumably that's because the	9	further reserve of buoyancy and the vessel could only
10 11	vessel is still continuing to settle a bit further in the water. In that regard, if we can go hack to the	10 11	sink further. The trim angle at this point was a little more than 6.5 degrees, and this occurred at about
11	the water. In that regard, if we can go back to the diagram on page 466, there is a compartment forward of	12	97 seconds after the collision."
13	the engine room which is a crew compartment, nominally	13	Could I ask you to look at page 484 in the same
14	a crew compartment	14	bundle.
15	Q. That's what you you have marked it "Buoyant	15	The paragraph you just looked at is depicted in the
16	compartment"?	16	second diagram here, "End of Phase 1"; correct?
17	A. Yes, it is actually marked there as "Buoyant	17	A. Correct, and that is for the vessel using the 2005
18	compartment". I have assumed that at this stage it was	18	stability book.
		19	Q. 2005 figures, all three compartments flooded?
19			Q. 2003 figures, all three compartments hooded.
19 20	buoyant. In fact there was an access opening down into		A. Correct, yes.
20	buoyant. In fact there was an access opening down into that compartment and eventually water would have found	20	A. Correct, yes.
20 21	buoyant. In fact there was an access opening down into that compartment and eventually water would have found its way down	20 21	A. Correct, yes.Q. "Transom immersed at 6.5 degrees".
20 21 22	buoyant. In fact there was an access opening down into that compartment and eventually water would have found its way downQ. Access opening down from the deck?	20 21 22	A. Correct, yes.Q. "Transom immersed at 6.5 degrees". Could we turn back to page 482. If we try to check

	Page 29		Page 31
1	red line, and we pull it down, it's actually 100-odd	1	report, which is a view of the after end of the vessel.
2	seconds rather than the 97 seconds that you mentioned in		Q. Yes.
3	the text.	3	A. I mention that because, to me, there's not a lot of
4	A. Mm.	4	damage there, and I suspect the seabed in that region is
5	Q. Is there any	5	probably quite soft mud rather than hard mud or indeed
6	A. Yes, I notice that.	6	rocks. I could see no obvious I mean, the handrail,
7	Q. Sorry?	7	for example, is still intact. So I think the bottom was
8	A. I notice that.	8	probably not an obvious bottom. It may have slowly gone
9	Q. Yes. Could there be any explanation? Because you	9	from water to mud in a rather amorphous fashion.
10	mentioned 97 seconds, but when I tried to check it	10	THE CHAIRMAN: There was a layer of mud, was there not, on
11	against the graph, it's 100-odd seconds.	11	the open area, mud and shells?
12	A. I may have taken the figure, when writing the report,	12	A. A considerable amount of mud on the open area, sir, and
13	from the next page, appendix IV, item 16.	13	also in the steering gear compartment and some other
14	Q. Yes. That would yield a time of 90-odd seconds, based	14	areas. But I have no means of knowing whether that mud
15	on a different set of assumed choke values.	15	came I suspect it came from when the vessel was in
16	A. Correct.	16	this attitude. But it could, I suppose, have also come
17	Q. Thank you. Phase 2 or if we actually look at the	17	from when the vessel was on the shore, I think on Lamma
18	chart at page 482. If we had used the chart at page 482	18	Island somewhere, where it rested for a while after the
19	instead, for the vessel to achieve a trim angle of	19	rescue.
20	6.5 degrees, it would have taken about, what,	20	THE CHAIRMAN: Yes.
21	105 seconds, 106 seconds?	21	MR SHIEH: Then we move on to phase 3:
22	A. Something like that, yes.	22	"The vessel further settled in the mud, assisted by
23	Q. Around about that?	23	the effects of the current and the incoming tide, and
24	A. Yes.	24	assumed an attitude of 90 degrees, as illustrated by the
25	Q. So the difference could well be less than 10 seconds,	25	Fire Services Department during the rescue."
	Page 30		Page 32
1	depending on which chart you use.	1	At footnote 6 you refer to an exhibit in the witness
2	We move on to phase 2 at page 473:	2	statement of Yau Wai-keung, which is FSD bundle 3,
3	"The vessel continued to rotate by the stern until	3	page 652.
4	the transom hit the seabed at approximately 118 seconds	4	THE CHAIRMAN: Has this witness given oral testimony?
5	at an angle of 62 degrees. There are two witnesses who	5	MR SHIEH: Yes, Yau Wai-keung did.
6	comment about a heel to starboard during the descent.	6	Mr Chairman, in relation to the other two witnesses
7	This may have been the result of hydrodynamic forces	7	who Dr Armstrong refers to in footnotes 3 and 4, Wong
8	generated around the hull whilst sinking, or from the	8	Tai-wah did give evidence and Leung Yuk-chuen
9	rudders which were most likely positioned to one side,	9	I understood did not. I understood Mr Chairman had some
10	or even from the initial contact with soft mud."	10	directions as to the manner in which witnesses whose
11	That is the phase 2 diagram at page 484, left-hand	11	statements have been referred to
12	side, bottom. Is that so, Dr Armstrong? "End of	12	THE CHAIRMAN: That's correct, because the way we're
13	Phase 2"?	13	proceeding is to deal with everything publicly, openly,
14	Is that so, Dr Armstrong? Phase 2 corresponds to	14	transparently. We've gathered together a huge volume of
15	the bottom left-hand diagram?	15	material. The material that we've used so far, as far
16	A. Correct.	16	as witnesses are concerned, has always involved the
17	Q. "Phase 2a: The vessel settled in the mud to some	17	witness giving oral testimony and adopting the
18	unknown extent, but I have estimated this as initially	18	out-of-hearing-room statement.
19	70 degrees based on the depth of water and an assumption	19	So that everyone understands what it is the
20	as to the depth of mud, supported by the attitude of the	20	Commission is having regard to when it makes its
21	vessel illustrated in a photograph owned by the South	21	findings, it is that which has been advanced openly in
<i></i>	China Morning Post"	22	this hearing.
22	•		-
22 23	Which is the one we saw just now; correct?	23	MR SHIEH: And therefore, insofar as Dr Armstrong might have
	Which is the one we saw just now; correct? A. Correct. Could I also draw your attention to the	23 24	MR SHIEH: And therefore, insofar as Dr Armstrong might have referred to statements of witnesses who have not

non-testifying witnesses, subject to --

juncture, perhaps after Dr Armstrong has completed his

THE CHAIRMAN: Certainly that's one way of dealing with it.

testimony, I will read out the relevant parts of the

Another way of dealing with it, dealing with the

Another way of dealing with it, dealing with the	5	ourselves with reading it out.
witnesses we came across yesterday, and there are six of	6	THE CHAIRMAN: That's the way in which I invite you to
them to whom he refers, and the issue there was	7	approach the issue.
witnesses who spoke to the vessel accelerating prior to	8	MR SHIEH: Thank you.
collision.	9	Dr Armstrong, coming back to phase 3. That also
MR SHIEH: Yes.	10	vertical, 90-degree attitude is what you have in mind as
THE CHAIRMAN: In fact only two of them speak to that, of	11	being phase 3?
the six that are nominated there. But that was	12	A. No, sir. I was really referring to I think
a general issue that was dealt with by other witnesses,	13	a slightly yes, correct.
so	14	Q. That is exhibit 3 to Mr Yau's witness statement?
MR SHIEH: Who have testified.		A. Correct.
THE CHAIRMAN: Who have testified. But there is one	16	Q. So that is phase 3, a 90-degree attitude?
witness, and he is Tang Ying-kit, who speaks about the	17	A. Yes.
change in the wake of the vessel, the white water he	18	THE CHAIRMAN: Before we go further I was distracted
noticed. He speaks about the vessel accelerating twice.	19	there for a moment. This is the overview provided by
He's a witness we wish to hear from.	20	the senior fire officer, is it?
MR SHIEH: Yes. I have the relevant reference to his	21	MR SHIEH: Yes.
statement, so perhaps as an appropriate juncture, maybe	22	
		THE CHAIRMAN: Yes. Thank you.
not now so as not to break up the flow of Dr Armstrong's	23	MR SHIEH: Lastly, phase 4, at page 474 of the bundle:
evidence	24	"Pushed by the current and with a receding tide, the
THE CHAIRMAN: No.	25	vessel was trapped at an angle of greater than
Page 34		Page 36
MR SHIEH: I will read out the relevant parts of Tang	1	90 degrees, estimated from photographs as approximately
Ying-kit's	2	110-115 degrees. This attitude is widely presented in
THE CHAIRMAN: We wish to hear from Mr Tang. I think this	3	the media, but by this time I believe that all practical
is an issue that is relevant to Lamma IV and to the	4	rescues of passengers had been completed. It is not
coxswain's account.	5	known how much of the vessel was supported by the mud at
MR SHIEH: So we will make arrangements for the live	6	this time, as the inside of the cabin has little obvious
testimony.	7	mud within it when it was inspected and there was little
THE CHAIRMAN: From him only. The others, for our part,	8	damage in the cabin area and upper deck from lying at
seem to fall into the general pattern, subject to any	9	the bottom. I can only assume that the vessel had dug
submissions that counsel have to make. But he seems to	10	a hole in the mud during the previous hours whilst it
fit into a different category, and potentially of	11	lay at lesser angles."
assistance to the coxswain of Lamma IV.	12	Now, phase 4 is depicted at page 485. That is
MR SHIEH: Thank you. So the way the matter will proceed is	13	phase 4 that you referred to?
the Commission would like, subject to hearing	14	A. Yes.
submissions, Tang Ying-kit to be called live, whereas		Q. In the text of your discussion, page 474, you refer to
the others	16	there being "little damage in the cabin area and upper
THE CHAIRMAN: The others I don't think we need to trouble	17	deck from lying at the bottom".
with, frankly. If counsel want their statements read	18	That is the point that you made just now by
out, we'll consider that. But they seem to be subsumed	19	directing our attention to the expert bundle, the
in the general testimony.	20	picture at page 954?
MR SHIEH: And the same would go for the two footnoted	21	A. That was the intention, yes. I was a little puzzled by
witnesses? One is Wong Tai-wah, who has in fact	22	the attitude of the vessel and the given depth of water.
testified	23	If it had been much deeper, I could accept that would be
THE CHAIRMAN: If Mr Wong has testified, that deals with	24	the attitude of the vessel. So it had either dug a hole
that concern. If the other witness simply says the same	25	in the mud, or somehow moved into deeper water.
		9 (Pages 33 to 36)

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Page 35

thing, then again we don't need to hear from him.

because if not, then we probably need not trouble

ourselves with reading it out.

MR SHIEH: Perhaps we could check whether or not the

statement of the other witness actually adds anything,

1 Q. Thank you. When you say "This attitude is widely

2	presented in the media" could I ask you to look at	2	noted as part of the general condition of the ship."
3	marine bundle 1, page 124.	3	But generally speaking, you would agree that
4	This is, I believe, the picture that is widely	4	aluminium would undergo corrosion when placed in contact
5	reported in the media that you have in mind?	5	with a foreign metal, a different kind of metal? As
6	A. It was certainly reproduced in a lot of newspapers in	6	a general observation?
7	Australia.	7	A. As a general observation, I must first of all comment
8	Q. Thank you, Dr Armstrong.	8	that there is almost no use whatsoever in the Marine
9	THE CHAIRMAN: Can you help me as to what time that evening	9	Department industry of aluminium per se. It should
10	the tide turned and ebbed?	10	really refer to "aluminium alloy", and it is a common
11	A. Mr Chairman, I can't be 100 per cent sure now, but the	11	I do it myself. It is a common mistake to just refer to
12	information is certainly in the file. I think it was	12	"aluminium". There are many different grades for
13	close to midnight, about 20 past midnight or something	13	aluminium alloy. This particular vessel, Lamma IV, was
14	like that.	14	built of a very common marine grade of aluminium alloy
15	THE CHAIRMAN: Thank you.	15	called 5083, and even 5083 comes in different tempers,
16	MR SHIEH: We're trying to check whatever available	16	different strengths.
17	information there is about tide that evening.	17	5083 is a very stable material which does not
18	Mr Chairman, the tide, according to our information,	18	generally corrode. However, when placed close to some
19	turned at around 22:10.	19	other materials, particularly things like copper, it
20	THE CHAIRMAN: Is that at Quarry Bay?	20	will corrode extremely quickly. In this case, it
21	MR SHIEH: Yes.	21	appeared it was under a pillar, which was of some
22	THE CHAIRMAN: Thank you.	22	unknown stainless steel material. Stainless steel also
23	MR SHIEH: Dr Armstrong, we have looked at questions	23	comes in many different grades and types. So it is
24	concerning the sinking of Lamma IV, and we have looked	24	difficult for me to say generally that there will be
25	at various charts and diagrams depicting the attitude	25	corrosion between stainless steel and aluminium.
	Page 38		Page 40
1	and also the time it took to sink.	1	If I'm pressed to say, is there corrosion between
2	Could I now turn to a different topic, concerning	2	stainless steel and aluminium, I would say yes. One of
3	the general structural condition of Lamma IV. For that,	3	the biggest problems with aluminium vessels, high-speed
4	could I ask you to turn to your first report,	4	vessels, is where they use water jets which have jets
5	paragraph 23, in the first expert bundle, page 410.	5	made from stainless steel, and we see corrosion in those
6	At paragraph 23, you start off:	6	areas.
7	"During the inspection of damage to Lamma IV, the	7	So I believe that this was very definitely because
8	opportunity was taken to make a general survey of the	8	of the quality of the stainless steel that had been
9	condition of the structure of the vessel. I found that	9	used. It was a local issue. It had been addressed.
10	it was generally of sound construction, with little	10	I don't believe it had anything to do with the sinking
11	evidence of corrosion or weakening of the plating or	11	of Lamma IV. But it was noticed by the police
12	stiffening components. Brackets were generally well	12	photographer and there are some photographs of the hole
13	aligned without obvious buckling from excessive sea	13	in the police files. I also noticed it and took some
14	loads.	14	photographs. But I don't really think it's relevant,
15	There were two locations where there had been very	15	sir.
16	localised severe corrosion in the aftermost corners of	16	THE CHAIRMAN: What are the main components of that
17	the main deck where a stainless steel pillar supported	17	aluminium alloy, 5083?
18	the deck above. The deck immediately under each pillar	18	A. I should know the exact percentages, but
19	has corroded completely through creating a small hole	19	THE CHAIRMAN: Perhaps you'd like to come back to us later
20	about 100 mm squared. However at some stage in the past		on that.
21	it has been sealed with a filling compound and the		A. They're essentially silicon, magnesium and manganese.
22	pillar put back in place to cover it. I consider the	22	But the exact percentages, given the pressure of the
23	corrosion was caused by an electrolytic action of the	23	occasion, I don't want to quote.
24	two different metals at this point, namely aluminium and	24	THE CHAIRMAN: No. Thank you.
25	the stainless steel of unknown properties. This hole	25	MR SHIEH: Now we move on to paragraph 25, when you deal
			10 (Pages 37 to 40)

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Page 39

played no part in the sinking of Lamma IV and is only

	Page 41		Page 43
1	with the question of the thickness of aluminium plating.	1	THE CHAIRMAN: Have you had access to the transcript of his
2	You say:	2	evidence?
3	"On two separate occasions the plating thickness of	3	A. I have, yes.
4	the side plating of Lamma IV has been checked by	4	MR SHIEH: Could I first of all take this witness to the
5	ultrasound. This was done at the request of Mardep as	5	Wilkinson & Grist bundle.
6	a condition of survey in June 2005 and again in May	6	THE CHAIRMAN: Yes.
7	2011. The survey results show an average thickness of	7	MR SHIEH: May I ask the witness to turn to page 1. This is
8	the side plating as 4.5 mm in July 2005, with a slight	8	the witness statement of Mr Lo, Ken Lo, from Cheoy Lee
9	decrease to 4.4 mm average in May 2011. From my	9	Shipyard. The relevant part is actually paragraph 40,
10	inspection of the plating, which is protected by paint	10	which is page 9 of this bundle. Paragraph 41, Mr Lo
11	on both sides and in good condition, I am of the opinion	11	refers to the evidence of Wong Wing-chuen, senior
12	that there was no measurable reduction of thickness over	12	surveyor of ships of Mardep, having explained in his
13	the past 6 years; rather the 0.1 mm discrepancy was more	13	witness statement that the Blue Book did not stipulate
14	likely caused by differences in the accuracy of the	14	any construction standard or guideline regarding plate
15	instrumentation and the measurement process used at the	15	thickness.
16	time.	16	" however, if the applicable rules and
17	The drawings approved by Mardep show that the side	17	regulations of the Lloyd's Register was applied, then
18	plating should have been 5.0 mm thickness. Given the	18	the plating required for a vessel of this type would
19	protective paint scheme on both the outside and inside	19	only be 3.5 mm."
20	of Lamma IV hull plates, I am of the opinion that it is	20	Dr Armstrong, you have considered the Blue Book as
21	most likely that the vessel was constructed with side	21	to whether or not it stipulated any construction
22	plating of 4.5 mm thickness, as measured in June 2005,	22	standard or guideline or particular numerical
23	despite the drawings showing 5.0 mm thickness. The	23	requirement for thickness.
24	thinner plating size on Lamma IV may have contributed to	24	A. There are no requirements in the Blue Book.
25	the extent of the damage that was experienced, as	25	Q. There are no requirements in the Blue Book. Thank you.
	Page 42		Page 44
1	plating of a greater thickness would have reduced the	1	Mr Ken Lo refers here to the relevant rules and
2	damaged hole size, which in turn might have provided	2	regulations of the Lloyd's Register in saying that "the
3	marginally more time for escape before the vessel sank."	3	plating required for a vessel of this type would only be
4	At paragraph 26, you say:	4	3.5 mm". What do you have to say about that?
5	"The hull construction for Lamma IV was	5	A. There are many different sets of rules and regulations,
6	subcontracted to Wuzhou Shipyard in Guangxi, China, and	6	and without seeing this particular set of rules, I find
7	the hull survey was conducted by China Classification	7	it hard to comment. Also, of course, it depends on what
8	Society, under an arrangement with Mardep. The survey	8	grade of aluminium is being considered. So one can't
9	report makes no specific reference to the thickness of	9	take it out of context and say, "Aluminium shall
10	materials that were used.	10	be 3.5".
11	The bottom plating thickness also appears to be	11	Q. If I can show you marine bundle 11, because that is what
12	undersized, although this played no part in the sinking.	12	Mr Ken Lo has referred to. Marine bundle 11, page 3943.
13	According to the ultrasound results at survey in 2005,	13	This is where the relevant witness, Mr Wong Wing-chuen,
14	the bottom plating thickness was 5.5 mm with some	14	at paragraph 48 of his witness statement, refers to the
15	variations in the 2011 measurements of up to 5.8 mm.	15	Lloyd's Register requirement coming down to 3.5 mm.
16	The drawings approved by Mardep show a minimum thickness	16	Are you able to offer any specific comment on that?
17	of 6 mm."	17	A. It could be an appropriate standard for this vessel,
18	Dr Armstrong, since giving your first report, the	18	yes.
19	Commission received witness statements from I believe	19	Q. Thank you. Then at paragraph 43 of his statement,
20	Cheoy Lee, producing certain documentation concerning	20	Mr Ken Lo refers to ordering the aluminium plates from
21	placing orders for the relevant aluminium alloy.	21	a company in Florida in December 1994, and he actually
22	A. I have seen that, yes.	22	produced the relevant order form or purchase order,
23	Q. You've seen that. Could I ask you to look at	23	which we can find at page 17 of this bundle. Item 4, we
24	THE CHAIRMAN: We've also had Mr Lo's evidence.	24	can see:
25	MR SHIEH: Mr Lo, giving testifying.	25	"5 mm x 72 inch x 388-inch alloy 5083"

	Page 45		Page 47
1	So that corresponds with your understanding as to	1	change in the plating, and given that the size now being
2	the grade of aluminium alloy used on the vessel?	2	provided for for the vessel is not that which is
3	A. Correct.	3	stipulated on the drawings? What should have happened,
4	Q. At paragraph 44, he says:	4	as far as the drawings are concerned?
5	"The materials were supplied with American Bureau of	5	A. I would have expected a letter stating that that was
6	Shipping certificates and these had been shown to the	6	acceptable, and the drawings may have been left as they
7	China Classification Society surveyor, a mandatory	7	were.
8	requirement."	8	MR SHIEH: Dr Armstrong, paragraph 46, Mr Lo says:
9	Then paragraph 45:	9	"It is customary practice accepted by all leading
10	"Apparently, upon receipt of the ABS certificates,	10	marine classification societies to accept tolerance for
11	it was noticed that the thickness of the 5.0 mm plates	11	plate thickness and in this particular size of aluminium
12	were supplied in the imperial management of 0.19 inches,	12	plate, 0.2 mm is the acceptable limit."
13	which was equivalent to only 4.83 mm. Cheoy Lee advised	13	Then he refers to attachment 6, which is page 29 of
14	Mardep of this discrepancy by its letter of 4 April 1995	14	this bundle. Can I ask you to look at page 29 of this
15	and received no objection from Mardep in their reply	15	bundle. You see that is Lloyd's Register Rules, the
16	letter"	16	relevant rules for Lloyd's Register. Then at the
17	Then he said:	17	bottom:
18	"It is customary practice"	18	"Dimensional tolerances.
19	THE CHAIRMAN: Could we see that letter again, please.	19	1.4.1. Underthickness tolerances for rolled
20	MR SHIEH: It's marine bundle 2, page 206. This is a letter	20	products for marine construction are given in
21	that attracted no specific comment from Mardep on this	21	table 8.1.1."
22	issue.	22	Then in the table, I think the relevant entry is the
23	THE CHAIRMAN: Well, it was ignored in the reply letter of	23	second one. The tolerance is given as 0.2 mm. What
24	about 10 days later.	24	comment do you have on this?
25	MR SHIEH: Yes. I should say the Mardep replied to the	25	A. May I first of all explain, for the understanding of the
	Page 46		Page 48
1	letter, but not commenting on this particular point.	1	Commission, that when aluminium plate is manufactured,
2	THE CHAIRMAN: No. Correct. This subject wasn't touched	2	it is rolled between two heavy rollers. In doing that,
3	upon.	3	you lose a little control of how thick it may be. So
4	MR SHIEH: Page 206. Dr Armstrong, you can look at the	4	this is a table that explains the allowable variations
5	manner in which the matter was raised with Mardep:	5	in the thickness. So when you order a 5 mm plate, it
6	"We would also like to advise of the following	6	may end up at 4.8 or even a little bit more than 5. It
7	changes:	7	is quite common practice to hope that it's slightly less
8	1. 0.19 inch (4.83 mm) plating in place of 5 mm	8	than the 5, because that way you pay less for it because
9	plating."	9	it's sold by weight.
10	So this particular point was raised with Mardep, but	10	0.2 I believe is a very common standard, and in fact
11	Mardep had not specifically commented or accepted or	11	I produced rules from another class society, Det Norske
12	rejected this point.	12	Veritas, which appear in my supplemental report on
13	A. Indeed, Mardep did produce drawings approving 5 mm.	13	page 952, which also states 0.2 mm.
14	Q. 5, yes.	14	Q. It's table A4 at page 952.
15	A. I would say I missed this particular paragraph when	15	A. Correct. For thicknesses between 4 and 8, the second
16	I was looking through the documentation, because it is	16	line down of table A4, 0.2 mm. And 0.2 mm is what would
17	headed "Fin Construction", "Bulwark Construction" and	17	expect. So I agree with Mr Lo.
18	"FO Tank". So I assumed the 5 mm comment was referring	18	Q. In fact there is also produced in Chinese the relevant
19	to one or other of those items, subsequently being drawn	19	rules for China Classification Society, in the Wilkinson
20	to my attention that none of these drawings do have 5 mm	20	& Grist bundle, page 40-51.
21	plating in them, but I did not read it that way	21	It's in Chinese, but we can see where the arrow is
22	originally.	22	pointing at. There's a translation at the back, yes.
23	THE CHAIRMAN: Before you move on.	23	Page 40-52, "Underthickness tolerances for rolled
24	What in your opinion ought to have happened, given	24	products", and you can see 0.2. It follows a similar
25	that the Marine Department are being told about this	25	format as the Lloyd's table.

	Page 49		Page 51
1	A. (Witness nods).	1	event, even though the test recorded the side and bottom
2	Although it's not specifically stated, this is	2	plate thickness to be 4.4 mm and 5.8 mm
3	understood by reading the rest of the chapter to apply	3	respectively"
4	to 5083 aluminium plate.	4	I think we can disregard 5.8, right, Dr Armstrong,
5	THE CHAIRMAN: 5083?	5	because it relates to the bottom and, as you said, the
6	A. Aluminium plate. Aluminium alloy.	6	bottom thickness has nothing to do with the sinking?
7	THE CHAIRMAN: Thank you.	7	A. Correct, yes.
8	MR SHIEH: Can we now come back to Mr Ken Lo's statement.	8	Q. So let's focus on 4.4:
9	"CCS was engaged by Cheoy Lee through Guangxi Wuzhou	9	" such reduction in thickness (about 0.4 mm and
10	Shipyard to ensure that the hull was constructed to	10	0.2 mm respectively, less than 10 per cent of original
11	drawings approved by Mardep and this procedure was	11	thickness) was regarded as the result of wear and tear
12	approved	12	in Lamma IV's 14 years of operation, and was considered
13	Upon completion of the requisite inspections of the	13	to be acceptable by Mardep.
14	completed hull, CCS surveyor signed and stamped the	14	Accordingly, Mardep is unable to agree with
15	Mardep survey items list and issued a survey report	15	Dr Armstrong's opinion that there was incompliance [he
16	confirming the hull was constructed in accordance with	16	means "non-compliance'] with the applicable requirements
17	the drawings approved by Mardep.	17	in the design and construction of the hull shell
18	Mr Wong Wing-chuen has again very clearly explained	18	plates."
19	in paragraph 51 of his statement that there would be	19	That is what Mr Wong Wing-chuen said.
20	wear and tear on the plating of a vessel that has been	20	First of all, he took issue with what you said about
21	in service for 14 years and that the reduction in	21	ultrasound, ultrasonic testing in 2011.
22	thickness of the plating, which is less than 10 per cent	22	Have you had a chance of reviewing what you noted
23	was considered acceptable."	23	and do you agree with him that it should actually be
24	Then he refers to marine bundle 11, which is the	24	2009?
25	text of Mr Wong Wing-chuen's witness statement.	25	A. Thank you for that. Could I refer you to police
	Page 50		Page 52
1	I believe you have actually dealt with the subject	1	bundle Q, I think it is, page 4870. This is hull
2	of corrosion, aluminium corrosion, in your first	2	thickness measurement record.
3	supplemental report; is that correct, Dr Armstrong?	3	Q. Yes, thank you.
4	A. Correct, yes.	4	A. The date is in the top right. It's May 2011.
5	Q. Perhaps taking it in stages, I will direct your	5	Q. Yes. That is the one that you had in mind when you
6	attention to what Mr Wong Wing-chuen said first.	6	wrote your report referring to 2011?
7	Mr Chairman, this is going to lead to a chain of	7	A. Correct. So I do not understand Mr Wong's comment.
8	looking at one document leading to another, so perhaps	8	Q. Right. But in any event, you have seen what this
9	it might be an appropriate moment.	9	perhaps you can also look at what the witness actually
10	THE CHAIRMAN: Very well, if you think that's a convenient		refers to by way of marine bundle 4, to see the two
11	break, we'll take the morning break now.	11	documents that he has referred to. Marine bundle 4,
12	Dr Armstrong, we'll take 20 minutes and therefore	12	pages 848 and 854.
13	resume at 11.45. Thank you.	13	First of all, page 848, "Inspection Record".
14	$(11.25 \text{ am}) \tag{A short hand}$	14	"Quadrennial Survey". This is the one conducted in
15	(A short break)	15	2005, you can see in the top left-hand corner.
16	(11.45 am)	16	The next one is page 854, which is the one conducted
17	MR SHIEH: Dr Armstrong, I was about to take you to the	17	in 2009.
18	evidence of Mr Wong Wing-chuen, to whom Mr Ken Lo referred. Marine bundle 11, page 3944. Paragraph 51:	18 19	So these are the two documents which the witness Mr Wong referred to as showing that there were
19 20	"Further, there was no ultrasonic testing of	20	5
20	Lamma IV's hull plating in May 2011 as alleged.	20	inspections in 2005 and 2009, but you yourself refer to that document in the police bundle as indicating that
21	According to Mardep's records, hull gauging was carried	22	there had been inspection of the hull thickness in 2011?
23	out in the periodic survey of Lamma IV on 16 June 2005	22	A. Correct. And I see no indication in 2009 on page 854 of
24	and 14 August 2009 respectively. Presumably	24	what the thicknesses were.
25	Dr Armstrong was referring to those tests. In any	25	Q. No indication, no. But in any event, the witness's main
	Er i mistong was referring to mose tests. In any	22	2. To indication, no. Dut in any event, the writess's main

13 (Pages 49 to 52)

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2 your report, such reduction was regarded as the result 7 The said: The said: 3 of wear and tear. So you see the point he's making, and 3 The said: The said: 4 Mr Ken Lo adopted that. So you see the point hey are getting at, Dr Armstrong? 5 51. I should nevertheless mention that according to the subject of normal wear and tear of a vessel. 6 A. I see the point, I don't agree with it, but I see the point. 51. I should nevertheless mention that according to the subject of normal wear and tear of a vessel. 7 Ordinance] a vessel will still be considered as easworthy even if the planting of the hull has no more than 30 per cent corrosion. It means that the hull of a vessel would only be cropped and renewed if the this so the subject of normal wears and tear of a vessel. 10 Mr Ken Lo acctually testified in this hearing. 10 11 remaining part of his witness statement to complete this witness statement. 11 12 part and transcript, so let's finish his statement 12 13 he developed the theme in this relevant part of his statement 14 14 trathe has referred to in the text of that paragraph. 14 15 THE CHAIRMAN: Let's just understand the issue? 14 16 THE CHAIRMAN: Well, yes. I take your point. One starting yoint is the drawings s	2	Page 53		Page 55
2 your report, such reduction was regarded as the result 7 3 of wear and tear. So you see the point he's making, and 7 4 Mr Ken Lo adopted that. So you see the point hey are getting at, Dr Armstrong? 5 6 A. I see the point, I don't agree with it, but I see the point. 5 7 point. 5 8 Q. Right. I think well take it step by step, because 6 9 Mr Ken Lo actably testified in this hearing. 6 10 My next step is going to be to take you to the oral evidence to see how 6 11 remaining part of his witness statement to complete this 7 12 part, and then take you to the oral evidence to see how 10 13 he developed the theme in this relevant part of his 11 14 witness statement. 12 15 A. Right. 14 16 Q. So lef's do it in stages. I don't want to jump between 16 17 statement and transcript, so let's finish his statement 17 16 THE CHAIRMAN: Lef's just understand the issue. 19 17 statement and transcript, so let's finish this staterent 10 <t< td=""><td></td><td>point is whether or not it's 4.4, as you indicated in</td><td>1</td><td>Q. Now we continue to look at what Mr Ken Lo had to say</td></t<>		point is whether or not it's 4.4, as you indicated in	1	Q. Now we continue to look at what Mr Ken Lo had to say
4 Mr Ken Lo adopted that. So you see the point they are getting at, Dr Armstrong? 5 5 1. I should nevertheless mention that according to annex M of the Code of Practice - Safety Standard R 7 point. 5.1. I should nevertheless mention that according to annex M of the Code of Practice - Safety Standard R 8 Q. Right. I think we'll take it step by step, because 6 Classes I, II and II Vessels issued under [the 9 Mr Ken Lo actually testified in this hearing. 9 Seaworthy even if the planting of the hull has no more 10 My next step is going to be to take you to the oral evidence to see how 10 11 a vessel would only be cropped and renewed if the 11 tremaining part of his witness statement. 11 a vessel would only be cropped and renewed if the plating of the hull of a vessel. 11 a vessel would only be cropped and renewed if the this relevant part of his witness statement. 12 a vessel would only be cropped and renewed if the plating of the hull of a seaworthy even if the plating of the hull and structural field would and structural field would and transcript, so let's finish his statement 14 still be considered as seaworthy even if the plating of the hull and structural Memb 14 trink cheases as how in the plate thickness 15 the ther refers to attachment 7, which is the annex 15 A. Parhaps, Mr Chairman. Or maybe it din't reduce.,	3		2	-
5 getting at, Dr Armstrong? 5 51. I should nevertheless mention that according to annex M of the Code of Practice Safety Standard for Classes I, II and III Vessels issued under (the Ordinance] a vessel will still be considered seavorthy even if the planting of the hull has no more than the scale will still be considered seavorthy even if the planting of the hull has no more than the scale will still be considered seavorthy even if the planting of the hull has no more than the scale will still be considered seavorthy even if the planting of the hull has no more than the scale will be considered as seavorthy even if the planting of the hull has no more than the scale by 30 per cent from it is original thickness. I no ther words, Lamma IV would still be considered as seaworthy even if the plating of its hull was 35 mm." 10 My next setp is going to be to take you to the oral evidence to see how your the nate scale is the dreveloped the theme in this relevant part of his 11 reduces to 4.4; is that the issue? 10 12 A. Right. 11 13 he developed the the plate thickness 11 14 tirke the all off ing and tractural Member is the circumstances in which the plate thickness 11 14 tirke the save? 12 15 A. Right. 13 16 the the refers to attachment 7, which is the annex that the hull off at 4.4. 14 16 the then refers to attachment 7, which is the annex that the issue? 14	5	of wear and tear. So you see the point he's making, and	3	"I do not believe that I need to dwell further on
5 getting at, Dr Armstrong? 5 51. İ should nevertheless mention that according to annex M of the Code of Practice Safety Standard for Practice Safety Standard for Code of Practice Safety Safety Safety Code Practice Safety Standard for Pra	4		4	the subject of normal wear and tear of a vessel.
6 A. I see the point; I don't agree with it, but I see the point. 6 annex M of the Code of Practice Safety Standard for Classes I, II and III Vessels issued under [the there reases by 30 per cent from its original thickness. In other words, Lamma IV would still be considered as seaworthy even if the plating of is the that pragraph. 16 Q. So let's do it in stages. I don't want to jump between is the the as referred to in the tat paragraph. You can see under the section "Hull". 17 THE CHAIRMAN: Let's just understand the issue? You can see under the section "Hull". 18 THE CHAIRMAN: Well, yes. I take your point. One starting point is the drawings say 5 mm. We'	5	getting at, Dr Armstrong?	5	
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25 A. (Witness nods).25 refresh your memory.	4 5 6 7 8 9 9 100 111 122 133 144 155 166 177 188 200 211 222 233	 A. Correct. THE CHAIRMAN: So if one then starts from 4.83, one issue is how does 4.83 in 1995 become 4.4 is that the right figure? in 2011? A. Correct. THE CHAIRMAN: One possibility is it started off life at 4.4. A. It's a possibility. MR SHIEH: Because if it started off life at 4.4, the question is not really one of corrosion or whatever; it would simply be a case where actually they were short-charged from day one. But if it did start off life as 4.8-something, the question of why it then diminished to 4.4 then becomes relevant. THE CHAIRMAN: Thank you. So that's the journey we're now going to embark on. MR SHIEH: Yes. Could I ask you to look at the Wilkinson & Grist bundle, page 11. This is a continuation of Mr Ken Lo's witness statement. We stopped at paragraph 49, where Mr Lo referred to Wong Wing-chuen's witness statement, which is the one we have just looked at, Dr Armstrong. 	2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24	 A. I see that, yes. Q. That is the point relied upon by Mr Ken Lo. Paragraph 52 at page 12 of the bundle: "The reduction in thickness of the plating of a vessel can also be caused by the ultrasound test conducted to check its thickness. For such a test to be performed, paint will have to be removed from various spots of the hull plating and each spot will have to be flat so as to give the touch pad of the ultrasonic device a proper contact. Otherwise, erroneous reading will be recorded. It is this paint removal and mild sanding down process that will also reduce the thickness of the plating slightly." Do you see that, Dr Armstrong? A. I see that. Q. I see you actually referred to it in a later stage in your second supplemental report, but let's pave the groundwork first. I now take you to the transcript of the evidence of Mr Lo. We travel to Day 19, which is last Monday, 21 January. The relevant part of this transcript starts at page 20. You may have actually read this already, but I think we should project that so you can actually

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	Page 57		Page 59
1	At the top of page 20. "No, definitely not" refers	1	paragraph.
2	to a previous topic, so let's disregard that.	2	Over the page at page 22, line 4. He refers to
3	Mr Beresford, my learned junior, asked him:	3	attachment 7. Attachment 7 was annex M, Dr Armstrong,
4	"Question: You then go on to say that the vessel	4	you remember; we've just seen that?
5	had been in service for 14 years, and that there may	5	A. Yes.
6	have been a reduction in thickness	6	Q. We move on to line 15:
7	Answer: Yes.	7	"Question: But is this not a guidance document for
8	Question: But isn't it right that on aluminium	8	steel hull plating?
9	plating over a period of 14 years, there wouldn't	9	
10	normally be much in the way of wear and tear?	10	Answer: It does not say whether it's steel or
11		11	aluminium, so it is assumed that all material applies.
	Answer: It depends on whether there is any		That's why I mentioned earlier, I do have other
12	corrosion, erosion. There's a lot of electrolysis	12	classification rules in my hand, one from ABS dated
13	Question: But corrosion is something you associate	13	2004, and one from ABS, 2013, plus Bureau Veritas, all
14	normally with steel	14	talking about aluminium wastage.
15	Answer: No, no, no. There is. They're a	15	Question: Perhaps we can just come to those in a
16	dissimilar metal. Aluminium is very sensitive to other	16	moment.
17	materials, like steel, for instance. If there is a	17	Answer: Yes.
18	steel in contact with aluminium, the aluminium will be	18	Question: But just while we're on annex M to the
19	wasted first.	19	code of practice, I believe Dr Armstrong will say that
20	Question: And is there any steel in contact with	20	this refers to steel-hulled plating which corrodes
21	the aluminium in this case?	21	easily and is not suitable for marine-grade aluminium.
22	Answer: Well, not when we built it."	22	He says that because steel corrodes or rusts, the
23	Then Mr Chairman interposed whether Dr Armstrong has		original thicknesses for steel material are usually
24	made some observations about that in his report.	24	calculated by classification societies with an
25	I think in your original report and also I think in	25	additional thickness to allow for corrosion, so that
	Page 58		Page 60
1	your second supplemental report, you came back to	1	even with a 30 per cent reduction in thickness over the
2	revisit this question of corrosion.	2	years, the material would still retain sufficient
3	A. Yes.	3	strength to absorb the design loads.
4	Q. As I said, I'm paving the groundwork for you to develop	4	Answer: Well, that is Dr Armstrong's view.
5	your opinion. So this is what was said:	5	Question: Do you agree or disagree with it?
6	"Answer: Must have. This is very common knowledge.	6	Answer: I have no comment"
7	Question: I think we can anticipate that	7	Line 16:
8	Dr Armstrong will say that he would not anticipate any	8	"Mr Chairman: But you interpret this guidance as
9	substantial reduction in the side plating assuming a	9	applying to aluminium?
10	5083 grade of aluminium was used.	10	Answer: Yes. Because aluminium also, you know, can
11	Answer: I can only tell you that in all	11	have corrosion.
12	classification rules, there is allowance for aluminium	12	Mr Beresford: Now, you wanted to refer to some
13	wastage. When we get to the next paragraph, I will show	13	other classification society materials, I believe?
14	you further rules from ABS and from this one is from	14	Answer: Yes."
15	Bureau Veritas, showing the same thing	15	Then there are some additional documents being
16	Question: Actually, you say"	16	mentioned, two pages from ABS and some from Bureau
17	Then he referred to the bit about annex M I won't	17	Veritas, and then the question of copying them. Then
18	read that out in full.	18	there's some discussion with Mr Pao.
19	Line 19:	19	Then further down the page, there's a reference to
20	"Question: I think you mean the 'plating of the	20	the China Classification table. Dr Armstrong, we've
21	hull', do you not?	21	looked at that. It basically dealt with the 0.2 mm
22	Answer: Yes.	22	tolerance. So we'll skip through that.
	Question: ' has no more than 30 per cent	23	At page 25:
23			
23 24	corrosion."	24	"Question: Mr Lo, you did say, I think, that there
	corrosion." Then he continues to read on until the end of that	24 25	"Question: Mr Lo, you did say, I think, that there were no materials present in the Lamma IV, at least as

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	Page 61		Page 63
1	built, that would cause the aluminium to corrode more	1	not significant.
2	easily.	2	Answer: That could be a case, yes.
3	If we look at attachment 4 to your statement, which	3	Question: And you agree
4	is the packing list, you've already drawn our attention	4	Answer: Probably not significant if you are
5	to the aluminium plate	5	careful, yes."
6	Answer: Yes.	6	Then there's a reference to the China Classification
7	Question: I'm told that Dr Armstrong will say that	7	rules, and further down the page there is the arrow.
8	this hull plate was built with some 6061-T5 and -56	8	Over the page, page 29, they move on to damage
9	stiffeners, and 5083-H321 components.	9	stability calculation, which is beyond the topic that
10	Answer: Yes.	10	we're now looking at.
11	Question: Do you agree with that?	11	So that's what Mr Ken Lo elaborated or testified to
12	Answer: Yes.	12	in the witness box on this subject of wear and tear,
13	Question: He will say that these are all acceptable	13	corrosion, and whether the stripping of paint could have
14	marine-grade aluminium materials which in combination	14	any impact on thickness. So you've seen all that.
15	should not corrode.	15	Could I now come to what you say on the topic.
16	Answer: That definitely would not corrode. This is	16	First of all, back to your first report, page 411. We
17	all aluminium.	17	have looked at paragraph 27 already. This is about
18	Question: You agree with that?	18	bottom plate thickness, and we have already touched on
19	Answer: Yes.	19	the point that this has nothing to do with the sinking.
20	Mr Chairman: The corrosion problem comes about, as	20	So we move on to your paragraph 28 of your first
21	I understand your evidence, when you have two different	21	report:
22	metals that are in contact?	22	"It is further noted that according to [what we call
23	Answer: There are other issues. No doubt seawater	23	the 1995 Instructions] the minimum thickness of side
24	there are a lot of factors affecting a ship's hull.	24	plating for a launch of less than 30 metres in length is
25	Mr Chairman: Yes, but one of them is two different	25	specified as 5.0 mm. This dimension is for a hull built
	Page 62		Page 64
1	Page 62 metals in proximity?	1	Page 64 of steel with a stiffener spacing of 600 mm."
1 2		1 2	-
	metals in proximity?		of steel with a stiffener spacing of 600 mm."
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2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22	 metals in proximity? Answer: That is the worst, yes. Mr Chairman: Yes. Answer: I mean, for instance if you have a steel nut in the bilge of your ship and nobody recognises it, they will put a hole into the hull eventually. Mr Chairman: Yes." Then the question about what Cheoy Lee was doing by way of maintenance, et cetera, was raised. We'll skip through that. At page 27 of the same transcript this is about paint. Line 20: "Then you go on in paragraph 52 of your statement to say: 'The reduction in thickness of the plating of a vessel can be caused by the ultrasound test that is conducted to check its thickness. For such a test to be performed, paint will have to be removed from various spots" This is basically reading out the last bit of the witness statement. Over the page, page 28, Mr Beresford asks: 	2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22	 of steel with a stiffener spacing of 600 mm." Would you like to take a look at the 1995 Instructions, Dr Armstrong? Can I just track down the reference for that. It's marine bundle 8, page 1820. I think the relevant part should be page 1821. Dr Armstrong, you refer to these 1995 Instructions; correct? 3.2. A. Correct. Q. Bottom of page 1820: "In no case the thickness of any part of the shell and deck plating of any steel vessel is less than the minimum standard as stipulated in the following table." So we look at the table over the page. Which of these items do you have in mind, Dr Armstrong? A. Side plate. Q. Side plate, yes. A. For a vessel with a length between 15 and 30 metres: 5 mm. Q. So it says "Minimum thickness: 5 mm". The cursor can perhaps point to that. Yes. So that's what you have in mind. This dimension is for a hull built of steel, with a stiffener spacing of

	Page 65		Page 67
1	Q. Then at page 411, you go on to say:	1	spacing, then there may well have to be a short break
2	"It is permitted to adjust the allowable thickness	2	after the completion of Dr Armstrong's evidence for us
3	for other frame spacings, and Lamma IV was designed with	3	to really gather our thoughts and make sure the
4	a frame spacing of 350 mm."	4	paperwork is in order.
5	Does it mean that you can actually do adjustments	5	THE CHAIRMAN: Yes. The only issue that we're addressing is
6	and calculate the minimum thickness on the basis of some	6	providing what should be the plating thickness for
7	other, different frame spacing as being used?	7	aluminium at 350 mm spacing.
8	A. Indeed. For a trained naval architect, it is	8	A. (Witness nods).
9	a relatively simple exercise based on a very simple	9	THE CHAIRMAN: It's as simple as that, is it not?
10	formulation.	10	A. I believe it's very simple, yes.
11	THE CHAIRMAN: So this provision is based on a frame spacing		MR SHIEH: Yes. And Dr Cheng
12	of 600 mm?		THE CHAIRMAN: How long does it make to calculate that?
13	A. The table is based on 600. It is relatively simple to		A. Well, I already have that. It took me 10 minutes.
14	change that to 350, which is the spacing on Lamma IV.		THE CHAIRMAN: Yes. And where do you have the calculations?
15	It's also possible, using the same equation, to change	15	In a computer?
16	the material to aluminium rather than steel, and I've		*
17	done that. I regret I haven't put it in evidence, but	17	the break, but I couldn't put my hands on it, sir.
18	I can do so.	18	THE CHAIRMAN: Is it in a computer?
19	MR SHIEH: Mr Chairman, at this juncture there is one point	19	A. No, it's a handwritten calculation. It's so simple
20	concerning how various what I may call loose ends may be	20	I just did it by hand.
21	tidied up. Yesterday Mr Grossman put in one expert	21	THE CHAIRMAN: So it's a 10-minute calculation?
22	report and one supplemental expert report, which	22	A. Something like that.
23	concerned the subject matter of Dr Armstrong's	23	THE CHAIRMAN: No doubt we can do it during the course of
24	testimony. Overnight other documentation has come in.	24	the day.
25	One is a supplemental report by Dr Peter Cheng, put in	25	MR SHIEH: Yes. With or without a break, or maybe for me to
	Page 66		Page 68
1	by the Department of Justice.	1	familiarise myself with it, or maybe he could be led
2	THE CHAIRMAN: Yes.	2	cold, but it may well be that it may be better for me to
3	MR SHIEH: Probably the Commission has not had the time to	3	actually understand it before leading it.
4	go through it in any great detail.	4	THE CHAIRMAN: Do you remember what the result is?
5	THE CHAIRMAN: No. If I've seen it, it is only because it's	5	A. I do indeed, sir.
6	in a bundle of material that's dumped on my desk every	6	THE CHAIRMAN: What is the result?
7	morning.	7	A. 5.22.
8	MR SHIEH: To which no particular attention has been drawn.	8	THE CHAIRMAN: So with aluminium of this grade does grade
9	THE CHAIRMAN: No, I deliberately don't give it attention	9	come into it?
10	because when things come in late, they don't deserve	10	A. It does indeed.
11	attention.	11	THE CHAIRMAN: Aluminium of this grade, with 350 mm spacing,
12	MR SHIEH: One subject matter dealt with by Dr Peter Cheng's	12	as in Lamma IV, the plating should be 5.22?
13	supplemental report and obviously Mr Mok may well	13	5 5
14	make the necessary application at some stage Dr Peter	14	MR SHIEH: And the actual numbers will come after
15	Cheng, as I understand it, performed that type of	15	Dr Armstrong has had a chance of perhaps digging out the
16	calculation that Dr Armstrong had alluded to.	16	handwriting calculation or perhaps redoing it, which
17	THE CHAIRMAN: Yes.	17	would take perhaps 10 minutes.
18	MR SHIEH: If Dr Armstrong actually said that he has in fact	18	THE CHAIRMAN: Thank you very much.
19	done some similar calculation and he would be prepared	19	So, just so I understand it, this is the required
20	to put it in writing, then obviously, subject to the	20	minimum of the thickness of the plating; is that it?
21	direction of the Commission, it may well be that if	21	A. It clearly states "required minimum shall not be less
22	Dr Cheng's report is in, or even if it is not in, if	22	than".
23	Dr Armstrong is prepared to assist the Commission by	23	THE CHAIRMAN: And we're dealing with side plating?
24 25	performing the calculation by using, first of all,	24	A. Only with side plating.
	different material, and, two, different stiffener	25	MR SHIEH: Dr Armstrong, parking the issue of producing the

	Page 69		Page 71
1	actual numbers by which you get to the figure of	1	maintained in class with the classification society,
2	5.22 mm, perhaps I'll read on your paragraph 28.	2	then the operating licence will be withdrawn and the
3	A. Please.	3	requirements of the minimum thickness in the
4	Q. You said:	4	Instructions shall be complied with in full. Lamma IV
5	"However, Lamma IV was built from aluminium, not	5	had been designed to the rules of a recognised
6	steel, and my opinion is that a stiffener spacing of	6	classification society, but it had never been classed by
7	350 mm is approximately equivalent to 600 mm	7	them, and so should have complied in full with the
8	stiffener spacing for steel, for a similar bending	8	thickness requirements given in the 1995 Instructions."
9	strength. My conclusion is that the side plating in	9	When you say "Lamma IV had been designed to the
10	aluminium should have been 5.00 mm in accordance with		rules of a recognised classification society", which one
11	the instructions"	11	do you have in mind?
12	In fact, according to what you have just told us,	12	A. Det Norske Veritas.
13	converted by reference to changing it to aluminium and	13	Q. Yes, but it has never been classed by DNV?
14	changing the spacing, you get even more than 5 mm?	14	A. Correct.
15	A. I came up with 5.22. I subtracted 0.2 for over-rolling	15	Q. Therefore, what one may call the default position,
16		16	namely the requirement of the 1995 Instructions, should
17	and came up with 5 in the report. THE CHAIRMAN: So that's the tolerance you've allowed	17	apply; correct?
18	already in that calculation?	18	A. Yes.
19	A. Correct.	19	
20	I have now actually located, or someone has located	20	Q. But that is assuming that the applicable regulations or instructions at the time were the 1995 Instructions?
20	for me, my handwritten calculation, sir. It is		
21	available.	21 22	A. It is based on that assumption, based on the evidence
			in front of me, that was my interpretation of which
23	MR SHIEH: Perhaps, if you think that it is in a form that	23	instructions applied. I will leave it to the Commission
24	you can talk us through, this can be produced for the	24	to decide which ones are the actual ones.
25	secretariat to copy and scan.	25	Q. Yes. You mentioned that the Blue Book, which is the
	Page 70		Page 72
1	A. It is handwritten, so it might be better if it's	1	version of the instructions prior to the 1995
2	Q. You may wish to do it over the lunch adjournment to make	2	Instructions, did not have specific stipulation on
3	it	3	minimum thickness.
4	THE CHAIRMAN: It's entirely up to you. Do you think we can		THE CHAIRMAN: Where is that mentioned?
5	read it?	5	MR SHIEH: I asked him orally this morning.
6	A. I believe I have excellent handwriting, Mr Chairman.	6	THE CHAIRMAN: Thank you.
7	THE CHAIRMAN: Then let's scan it now. (Handed).	7	MR SHIEH: I will actually be asking him to look at the
8	You do.	8	equivalent provision in the Blue Book, just to make good
9	A. Thank you.	9	the point that the equivalent part in the Blue Book
10	MR SHIEH: Could I read on in the meantime, Dr Armstrong.	10	concerning construction standard did not actually
11	I stopped at the word "instructions":	11	stipulate any minimum thickness.
12	" and this is reflected on the drawings approved	12	Dr Armstrong, can I ask you to look at marine
13	by Mardep. The side plating as built, in my opinion,	13	bundle 8.
14	was 0.5 mm undersized."	14	Thank you for the calculation, Dr Armstrong, but
15	This assumes the side plating as built was already	15	perhaps I will deal with this question about the absence
16	4.5 mm.	16	of stipulation in the Blue Book, about minimum
17	A. (Witness nods).	17	thickness, before moving to the calculation.
18	Q. But if, for example, side plating as built was 4.8 mm,	18	THE CHAIRMAN: Please do.
19	then there would be 0.3 mm unaccounted for?	19	MR SHIEH: Dr Armstrong, marine bundle 8, page 1768.
20	A. (Witness nods).	20	Could we first of all look at 1820, which is the
21	Q. "The Instructions for the Survey of Class I and Class II	21	1995 regulations. This is chapter II. The heading is
22	Launches and Ferry Vessels permit lesser thickness	22	"Requirements and construction of hull new vessels".
0.0	of side plating if the vessel is classed with	23	Do you see that, Dr Armstrong?
23	1 0		
23 24 25	a recognised classification society. However these instructions also make clear that if it is not	24	A. Yes.Q. Then we see various headings: "First Survey",

	Page 73		Page 75
1	"Registered or Identification Dimensions", and then we	1	of the few available at that time. Alternatively, there
2	have "Construction Standard".	2	are other regulations in other countries that are
3	Then the minimum thickness provision is contained in	3	commonly used for this type of vessel. But I do not
4	that section headed "Construction Standard". You can	4	know how Marine Department would interpret that.
5	see that, yes?	5	Q. Because on the face of it, if we simply look at it, as
6	A. I see.	6	far as construction is concerned, it simply says, "you
7	Q. Then over the page at page 1821 we have things following	7	shall not allow departure from approved plans without
8	on, like "Coamings", "Bulkheads", matters of that	8	concurrence of various people", and the only thing that
9	nature.	9	the person administering these instructions is supposed
10	When I tried to track down the existence of	10	to do is to ensure that approved plans are adhered to.
11	equivalent standards I turned to the equivalent chapter	11	A. It's left to the skills of the Marine Department, yes.
12	in the Blue Book, which is in page 1768.	12	Q. And it's left to the question of how the relevant plans
13	This is the Blue Book equivalent. You can see, Blue	13	have been approved and what standards have been adopted
14	Book, "Chapter II. Requirements and Construction of	14	when approving those plans, because once those plans
15	Hull"; you can see that?	15	have been approved, under this regulation they become
16	A. I see that.	16	the yardstick by reference to which Marine Department is
17	Q. "First Survey", "Construction", "Registered or	17	to scrutinise the question of construction.
18	Identification Dimensions", "Coamings", and then over	18	A. Yes.
19	the page, "Bulkheads".	19	Q. Can we now look at the calculation you have done, which
20	So if one were trying to locate similar stipulations	20	is now in front of us. I hope it has been scanned.
21	in the Blue Book, this would be the chapter that one	21	Yes, it has.
22	would turn to, Dr Armstrong; is that the way you would	22	In due course it will be given a page number, but
23	approach instructions of this nature?	23	for the time being, let's look at it in its present
24	A. Yes, sir.	24	form.
25	Q. So under "Construction", paragraph 9 at page 1768:	25	Could you talk us through it, Dr Armstrong.
	Page 74		Page 76
1	"In the case of new vessels, the surveyor or	1	A. I will attempt to.
2	inspector will examine the construction so as to ensure	2	The formulation relating material properties,
3	that the approved plans are adhered to in respect of the	3	material geometry and the stress or strength of the
4	vessel's dimensions, materials, scantlings, fastenings,	4	material is basically shown by equation 3, which is
5	et cetera, and no material departure from any approved	5	indicated by a circle with a "3" in it on the right-hand
6	plan will be allowed without the concurrence of the	6	side. That formulation will be extremely familiar to
7	senior surveyor"	7	anybody working in the area of mechanical engineering.
8	This would seem to be the only stipulation about	8	In fact, I'm sure you've probably all seen it
9	construction that we could find in this chapter.	9	yourselves. It basically says bending moment over
10	A. It's the only one I'm aware of, yes.	10	stress is equal to the inertia of the section divided by
11	Q. Of course we would obviously have to address what	11	the depth of the section: BM/sigma is I/Y.
12 13	instructions Mardep applied at the time, because Mardep	12	Using that formulation, we can take the stated
13 14	now says, according to its evidence, that they only began to apply the 1995 standard as from a particular	13 14	properties in the table for steel. It says that the
14 15	began to apply the 1995 standard as from a particular point in time onwards.	15	steel material thank you. If we go down. That's fine.
16	Leaving that issue to one side, simply commenting on	16	The steel material is 600 mm wide, and it is greater
17	what you can see by way of 9, what do you say about	17	than 5 mm thick. Based on the 600 mm by 500 mm we can
18	a standard or an instruction or a requirement which is	18	simply work out the inertia, which is the value of "I",
19	worded in this particular way, without any express	19	for the standard steel material in the instructions.
20	stipulation as to any kind of standard or safety or	20	"I" is given by the length of material, that is 600;
21	numerical limits?	21	times the depth of the material, 5 mm cubed; divided
22	A. I cannot obviously answer for how the Marine Department		by 12. That's in millimetres to the power of 4. And
23	may interpret that. My own personal opinion would be	23	divided by half the thickness of material, which is the
24	that I would use some standard such as a classification	24	5/2 factor: 2.5 mm.
25	society, Lloyd's Small Craft, for example, which was one	25	So I/Y for the steel material in the standard is
	second second contract, for enample, which was one		20 1, 1 101 the steel material in the standard is

	Page 77		Page 79
1	usually given by formula 5.	1	equals the I/Y value in equation 7: 350 divided by
2	Q. That is 600 times?	2	6 times "t" squared, which gives a thickness of 5.22 for
3	A. 600 times 5 cubed, divided by 12, divided by 2.5.	3	an aluminium alloy with a spacing of 350.
4	Q. Yes.	4	Q. Can I try to summarise it in extremely layman terms.
5	A. So we know the right-hand side of equation 3 for steel	5	The aim of the exercise is to find out the
6	in the standards book, in the book giving the standard.	6	equivalent of "t" in the case of aluminium?
7	If we now look at equation 3, you'll notice it has	7	A. Correct.
8	a Greek symbol sigma, which is the stress of the	8	Q. And "t" is embedded as part of the definition of "I" in
9	material. If we stroll up a little bit, according to	9	your equation 3?
10	Lloyd's Rules and Regulations for the Classifications of	10	A. Correct.
11	Yachts and Small Craft, published in 1983, the yield	11	Q. Everything else would be known, either by looking at the
12	strength for steel is 235 newtons per square millimetre.	12	books or various other sources. So once you plug
13	So we know immediately three of the unknowns in	13	everything in, "t" for aluminium follows as a matter of
14	equation 3. We can work out the bending moment, because		course?
15	we know the right-hand side of the equation and we know	15	A. Very succinctly put, yes. I should have been a lawyer.
16	the maximum allowable stress.	16	Q. So that's your calculation, Dr Armstrong, in coming up
17	I should have added that the value in equation 1,	17	to 5.22 mm for aluminium
18	the steel yield strength is equal to the maximum	18	A. Yes.
19	allowable stress that you are permitted to use.	19	Q with 350 stiffener spacing. Thank you.
20	Knowing the bending moment, that is essentially the	20	Could we now then come back to your report. We have
21	load that the structure is seeing created by the sea and	21	looked at what you have said in paragraph 28, and your
22	other loads. So I am saying that the bending moment for	22	point that although rules of a classification society
23	a steel boat would be identical to the bending moment	23	can be used instead of the stipulation in the 1995
24	for an aluminium boat or a boat of any material;	24	Instructions, that presupposes a vessel is in class with
25	basically the loads imposed on that boat by being in the	25	that classification society, which is not our case;
	Page 78		Page 80
1	-	1	-
1 2	ocean. So if we work out the bending moment for steel by	2	correct? A. Correct.
3	the method I've just explained, we can then say it's the	3	Q. Can we now then look at what you say in your second
4	same as the aluminium section.	4	supplemental expert report, expert bundle 2, page 932.
5	Are we okay so far, or am I going too quickly?	5	Paragraph 23 onwards:
6	Q. No, it's okay.	6	"During investigation of the damage to the hull of
7	A. We know the bending moment for aluminium, the left-hand		Lamma IV I noted that the thickness of the hull plating
8	side of equation 3. We know the stress for aluminium,	8	appeared to be thinner Approximate measurements with
9	which is given in equation 2, according to Lloyd's	9	a tape measure suggested that the plating was a little
10	Rules "maximum allowable aluminium alloy", that	10	over 4 mm."
11	should say. It's measured in a slightly different way,	11	So that is actually measured at a damage location,
12	so it's called 0.2 per cent proof stress. This is	12	at an opening?
		13	A. Yes.
	125 newtons per square millimetre		
13	125 newtons per square millimetre. We also know the sectional inertia in terms of the	14	
13 14	We also know the sectional inertia in terms of the	14 15	Q. That's why you can actually measure the thickness?
13 14 15	We also know the sectional inertia in terms of the width being 350 for Lamma IV. We don't, of course, know	15	Q. That's why you can actually measure the thickness?A. Yes.
13 14 15 16	We also know the sectional inertia in terms of the width being 350 for Lamma IV. We don't, of course, know the thickness. That is what we're trying to find. And		Q. That's why you can actually measure the thickness?A. Yes.Q. But that may not actually represent the thickness in
13 14 15 16 17	We also know the sectional inertia in terms of the width being 350 for Lamma IV. We don't, of course, know the thickness. That is what we're trying to find. And we don't know the depth of the section. That's also	15 16 17	Q. That's why you can actually measure the thickness?A. Yes.Q. But that may not actually represent the thickness in an undamaged location?
13 14 15 16 17 18	We also know the sectional inertia in terms of the width being 350 for Lamma IV. We don't, of course, know the thickness. That is what we're trying to find. And we don't know the depth of the section. That's also related to the thickness, what we're trying to find.	15 16	Q. That's why you can actually measure the thickness?A. Yes.Q. But that may not actually represent the thickness in an undamaged location?A. Correct.
13 14 15 16 17 18 19	We also know the sectional inertia in terms of the width being 350 for Lamma IV. We don't, of course, know the thickness. That is what we're trying to find. And we don't know the depth of the section. That's also related to the thickness, what we're trying to find. So if you scroll down a little further, there's	15 16 17 18 19	Q. That's why you can actually measure the thickness?A. Yes.Q. But that may not actually represent the thickness in an undamaged location?A. Correct.Q. How would that differ?
13 14 15 16 17 18 19 20	We also know the sectional inertia in terms of the width being 350 for Lamma IV. We don't, of course, know the thickness. That is what we're trying to find. And we don't know the depth of the section. That's also related to the thickness, what we're trying to find. So if you scroll down a little further, there's a little diagram there of the aluminium alloy being 350	15 16 17 18	Q. That's why you can actually measure the thickness?A. Yes.Q. But that may not actually represent the thickness in an undamaged location?A. Correct.
13 14 15 16 17 18 19	We also know the sectional inertia in terms of the width being 350 for Lamma IV. We don't, of course, know the thickness. That is what we're trying to find. And we don't know the depth of the section. That's also related to the thickness, what we're trying to find. So if you scroll down a little further, there's a little diagram there of the aluminium alloy being 350 wide and thickness, "t". We know the I/Y value is the	15 16 17 18 19 20	 Q. That's why you can actually measure the thickness? A. Yes. Q. But that may not actually represent the thickness in an undamaged location? A. Correct. Q. How would that differ? A. I would expect it to have been thinner if the plate had been stretched.
13 14 15 16 17 18 19 20 21	We also know the sectional inertia in terms of the width being 350 for Lamma IV. We don't, of course, know the thickness. That is what we're trying to find. And we don't know the depth of the section. That's also related to the thickness, what we're trying to find. So if you scroll down a little further, there's a little diagram there of the aluminium alloy being 350 wide and thickness, "t". We know the I/Y value is the function of "t" given in equation 7. We know the	15 16 17 18 19 20 21	 Q. That's why you can actually measure the thickness? A. Yes. Q. But that may not actually represent the thickness in an undamaged location? A. Correct. Q. How would that differ? A. I would expect it to have been thinner if the plate had been stretched. Q. Or, say, if it's next to a hole?
13 14 15 16 17 18 19 20 21 22	We also know the sectional inertia in terms of the width being 350 for Lamma IV. We don't, of course, know the thickness. That is what we're trying to find. And we don't know the depth of the section. That's also related to the thickness, what we're trying to find. So if you scroll down a little further, there's a little diagram there of the aluminium alloy being 350 wide and thickness, "t". We know the I/Y value is the function of "t" given in equation 7. We know the stress. The equation is reproduced just below	15 16 17 18 19 20 21 22 23	 Q. That's why you can actually measure the thickness? A. Yes. Q. But that may not actually represent the thickness in an undamaged location? A. Correct. Q. How would that differ? A. I would expect it to have been thinner if the plate had been stretched. Q. Or, say, if it's next to a hole? A. Yes.
13 14 15 16 17 18 19 20 21 22 23	We also know the sectional inertia in terms of the width being 350 for Lamma IV. We don't, of course, know the thickness. That is what we're trying to find. And we don't know the depth of the section. That's also related to the thickness, what we're trying to find. So if you scroll down a little further, there's a little diagram there of the aluminium alloy being 350 wide and thickness, "t". We know the I/Y value is the function of "t" given in equation 7. We know the	15 16 17 18 19 20 21 22	 Q. That's why you can actually measure the thickness? A. Yes. Q. But that may not actually represent the thickness in an undamaged location? A. Correct. Q. How would that differ? A. I would expect it to have been thinner if the plate had been stretched. Q. Or, say, if it's next to a hole?

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	Page 81		Page 83
1	in thickness, but I also examined the inside of the	1	A. Yes.
2	engine room for evidence of the general upkeep of the	2	Q. " and the remainder have related to galvanic action
3	aluminium structure and whether the thickness of the	3	caused by dissimilar metals on the vessel and/or on the
4	engine room plating may have suffered a reduction in	4	wharf. In all of these cases the corrosion has been
5	thickness owing to corrosion. I found that the hull	5	below the waterline external to the craft and involved
6	plating in the engine room and tank room were in	6	other materials.
7	generally excellent condition, as stated in my initial	7	Aluminium alloy oxidises extremely rapidly when the
8	report at paragraph 23. I then purposefully looked for	8	surface is scratched or abraded, to form aluminium
9	the results of the thickness gauging carried out during	9	oxide. Whilst aluminium might generally be considered
10	the survey process as reported in paragraph 25 of my	10	to be a soft material, in fact aluminium oxide" and
11	report.	11	you highlighted that "is one of the hardest
12	Whilst my opinion of the structural condition of	12	substances known to mankind. It is also called
13	Lamma IV in the engine room and tank room was that it	13	corundum, an extremely abrasive material, and in other
14	was in excellent condition, I did not look at the whole	14	crystalline arrangements is known as ruby and also
15	structure, only isolated parts	15	sapphire. When formed on bare aluminium it is extremely
16	I note that the generally accepted tolerances for	16	thin (about 4 nanometres), but nevertheless it forms
17	marine grade aluminium plating of this size are 0.2 mm,	17	a highly effective boundary to corrosion."
18	for example as given by the classification society	18	So you mean, usually, in a layman's eyes, oxidation
19	regulations of Det Norske Veritas."	19	is a bad thing; if iron oxidises, it rusts?
20	That's page 952 of this bundle, to which you had	20	A. Yes.
21	earlier drawn our attention.	21	Q. But here you are saying that for aluminium alloy, if it
22	A. Correct, yes.	22	oxidises it actually makes it stronger?
23	Q. That is page 952, and the table at A4 we looked at. Do	23	A. Yes. Well, I wouldn't say it made it stronger, sir. It
24	you have table A4, Dr Armstrong?	24	makes it because it is so thin, it just provides
25	A. Yes.	25	a very strong boundary against corrosion.
	Page 82		Page 84
1	Q. Returning to the text, paragraph 26:	1	THE CHAIRMAN: So it protects the underlying material?
2	"I have been involved in the design and manufacture	2	A. It protects the underlying material.
3	of aluminium craft since 1989, almost all of them using	3	A. It protects the underlying material.MR SHIEH: I'll move on. Paragraph 28:
3 4	of aluminium craft since 1989, almost all of them using 5083 grade marine aluminium plate with 6061 grade	3 4	A. It protects the underlying material.MR SHIEH: I'll move on. Paragraph 28: "Because the corrosion properties of marine grade
3 4 5	of aluminium craft since 1989, almost all of them using 5083 grade marine aluminium plate with 6061 grade extrusions."	3 4 5	 A. It protects the underlying material. MR SHIEH: I'll move on. Paragraph 28: "Because the corrosion properties of marine grade aluminium are so good, a large number of high-speed
3 4 5 6	of aluminium craft since 1989, almost all of them using 5083 grade marine aluminium plate with 6061 grade extrusions." We have seen 5083 grade marine aluminium plate in	3 4 5 6	 A. It protects the underlying material. MR SHIEH: I'll move on. Paragraph 28: "Because the corrosion properties of marine grade aluminium are so good, a large number of high-speed craft have been built in 5083 marine grade aluminium
3 4 5 6 7	of aluminium craft since 1989, almost all of them using 5083 grade marine aluminium plate with 6061 grade extrusions." We have seen 5083 grade marine aluminium plate in the order form placed with the American firm, in the	3 4 5 6 7	 A. It protects the underlying material. MR SHIEH: I'll move on. Paragraph 28: "Because the corrosion properties of marine grade aluminium are so good, a large number of high-speed craft have been built in 5083 marine grade aluminium without being painted, particularly on the interior, and
3 4 5 6 7 8	of aluminium craft since 1989, almost all of them using 5083 grade marine aluminium plate with 6061 grade extrusions." We have seen 5083 grade marine aluminium plate in the order form placed with the American firm, in the order form that we saw earlier this morning,	3 4 5 6 7 8	 A. It protects the underlying material. MR SHIEH: I'll move on. Paragraph 28: "Because the corrosion properties of marine grade aluminium are so good, a large number of high-speed craft have been built in 5083 marine grade aluminium without being painted, particularly on the interior, and on the outside of catamarans between the hulls. Paint
3 4 5 6 7 8 9	of aluminium craft since 1989, almost all of them using 5083 grade marine aluminium plate with 6061 grade extrusions." We have seen 5083 grade marine aluminium plate in the order form placed with the American firm, in the order form that we saw earlier this morning, Dr Armstrong.	3 4 5 6 7 8 9	 A. It protects the underlying material. MR SHIEH: I'll move on. Paragraph 28: "Because the corrosion properties of marine grade aluminium are so good, a large number of high-speed craft have been built in 5083 marine grade aluminium without being painted, particularly on the interior, and on the outside of catamarans between the hulls. Paint is only generally applied to these craft to provide
3 4 5 6 7 8 9	of aluminium craft since 1989, almost all of them using 5083 grade marine aluminium plate with 6061 grade extrusions." We have seen 5083 grade marine aluminium plate in the order form placed with the American firm, in the order form that we saw earlier this morning, Dr Armstrong. A. (Witness nods).	3 4 5 7 8 9 10	 A. It protects the underlying material. MR SHIEH: I'll move on. Paragraph 28: "Because the corrosion properties of marine grade aluminium are so good, a large number of high-speed craft have been built in 5083 marine grade aluminium without being painted, particularly on the interior, and on the outside of catamarans between the hulls. Paint is only generally applied to these craft to provide an identity of the owner. An example of a 2006 design
3 4 5 6 7 8 9 10 11	 of aluminium craft since 1989, almost all of them using 5083 grade marine aluminium plate with 6061 grade extrusions." We have seen 5083 grade marine aluminium plate in the order form placed with the American firm, in the order form that we saw earlier this morning, Dr Armstrong. A. (Witness nods). Q. But 6061 grade, you confirm that this was also the case 	3 4 5 6 7 8 9 10 11	 A. It protects the underlying material. MR SHIEH: I'll move on. Paragraph 28: "Because the corrosion properties of marine grade aluminium are so good, a large number of high-speed craft have been built in 5083 marine grade aluminium without being painted, particularly on the interior, and on the outside of catamarans between the hulls. Paint is only generally applied to these craft to provide an identity of the owner. An example of a 2006 design for which I was responsible and which was built in
3 4 5 6 7 8 9 10 11 12	 of aluminium craft since 1989, almost all of them using 5083 grade marine aluminium plate with 6061 grade extrusions." We have seen 5083 grade marine aluminium plate in the order form placed with the American firm, in the order form that we saw earlier this morning, Dr Armstrong. A. (Witness nods). Q. But 6061 grade, you confirm that this was also the case in Lamma IV? 	3 4 5 6 7 8 9 10 11 12	 A. It protects the underlying material. MR SHIEH: I'll move on. Paragraph 28: "Because the corrosion properties of marine grade aluminium are so good, a large number of high-speed craft have been built in 5083 marine grade aluminium without being painted, particularly on the interior, and on the outside of catamarans between the hulls. Paint is only generally applied to these craft to provide an identity of the owner. An example of a 2006 design for which I was responsible and which was built in aluminium and which has not been painted is given in
3 4 5 6 7 8 9 10 11 12 13	 of aluminium craft since 1989, almost all of them using 5083 grade marine aluminium plate with 6061 grade extrusions." We have seen 5083 grade marine aluminium plate in the order form placed with the American firm, in the order form that we saw earlier this morning, Dr Armstrong. A. (Witness nods). Q. But 6061 grade, you confirm that this was also the case in Lamma IV? A. Correct, according to the bill of materials provided by 	3 4 5 6 7 8 9 10 11 12 13	 A. It protects the underlying material. MR SHIEH: I'll move on. Paragraph 28: "Because the corrosion properties of marine grade aluminium are so good, a large number of high-speed craft have been built in 5083 marine grade aluminium without being painted, particularly on the interior, and on the outside of catamarans between the hulls. Paint is only generally applied to these craft to provide an identity of the owner. An example of a 2006 design for which I was responsible and which was built in aluminium and which has not been painted is given in appendix IV, item 22."
3 4 5 6 7 8 9 10 11 12 13 14	 of aluminium craft since 1989, almost all of them using 5083 grade marine aluminium plate with 6061 grade extrusions." We have seen 5083 grade marine aluminium plate in the order form placed with the American firm, in the order form that we saw earlier this morning, Dr Armstrong. A. (Witness nods). Q. But 6061 grade, you confirm that this was also the case in Lamma IV? A. Correct, according to the bill of materials provided by Cheoy Lee, yes. 	3 4 5 6 7 8 9 10 11 12 13 14	 A. It protects the underlying material. MR SHIEH: I'll move on. Paragraph 28: "Because the corrosion properties of marine grade aluminium are so good, a large number of high-speed craft have been built in 5083 marine grade aluminium without being painted, particularly on the interior, and on the outside of catamarans between the hulls. Paint is only generally applied to these craft to provide an identity of the owner. An example of a 2006 design for which I was responsible and which was built in aluminium and which has not been painted is given in appendix IV, item 22." That's page 953. That's the USS Independence. Is
3 4 5 6 7 8 9 10 11 12 13 14 15	 of aluminium craft since 1989, almost all of them using 5083 grade marine aluminium plate with 6061 grade extrusions." We have seen 5083 grade marine aluminium plate in the order form placed with the American firm, in the order form that we saw earlier this morning, Dr Armstrong. A. (Witness nods). Q. But 6061 grade, you confirm that this was also the case in Lamma IV? A. Correct, according to the bill of materials provided by Cheoy Lee, yes. Q. Thank you. 	3 4 5 6 7 8 9 10 11 12 13	 A. It protects the underlying material. MR SHIEH: I'll move on. Paragraph 28: "Because the corrosion properties of marine grade aluminium are so good, a large number of high-speed craft have been built in 5083 marine grade aluminium without being painted, particularly on the interior, and on the outside of catamarans between the hulls. Paint is only generally applied to these craft to provide an identity of the owner. An example of a 2006 design for which I was responsible and which was built in aluminium and which has not been painted is given in appendix IV, item 22." That's page 953. That's the USS Independence. Is that an American warship?
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	Page 85		Page 87
1	same as for the Lamma IV?	1	A. If there was corrosion. There was another thought came
2	A. Correct.	2	to mind this morning: that I have no knowledge of what
3	Q. Paragraph 29:	3	paint was applied. If the incorrect paint was applied
4	"I doubt whether the reduction in thickness of the	4	to the inside of aluminium, that could also be the
5	side plating from 4.83 mm to 4.4 mm could have been	5	source of corrosion. I have no reason to say that the
6	caused by corrosion. I also find it difficult to	6	wrong paint has been applied, but I think it's fairly
7	comprehend how this could have happened in the first	7	obvious that if, for example, a lead-based paint had
8	nine years and then there was no further significant	8	been put on, there would have been quite extensive
9	corrosion over the next six years as suggested by	9	corrosion. But I'm not suggesting for a minute that was
10	the thickness gauging reports. However, I note that	10	the case. I'm just saying that there are some potential
			5 5 6 1
11	Lamma IV has been operating in tropical areas with high	11 12	causes of corrosion of which I have no expert knowledge
12	temperatures and high humidity, and it is possible that		at this stage.
13	condensation on the inside surfaces may have been acidic	13	Q. Thank you. Paragraph 30:
14	and caused some corrosion. I have been involved in	14	"Classification society regulations do permit lesser
15	several military vessels operating in the Western	15	scantlings than the 5.0 mm minimum required by the 1995
16	Pacific, in conditions of high temperatures and high	16	Instructions. I understand that the designer has
17	humidity, and these have not exhibited corrosion of the	17	commented that the scantlings would be satisfactory even
18	plating. These craft however have not been operating in	18	at 4.4 mm thickness. However I also note that the 1995
19	areas with atmospheric pollution such as are sometimes	19	Instructions permit scantlings to be set by
20	experienced in Hong Kong."	20	classification societies, but if so then the vessel must
21	In this paragraph, Dr Armstrong, you are really	21	remain in class with that society."
22	highlighting perhaps that one peculiar feature in Hong	22	When you say, "I understand that the designer has
23	Kong that is not shared by the Western Pacific locations	23	commented that scantlings would be satisfactory even at
24	that you have referred to, and that is atmospheric	24	4.4 mm", are you referring to the evidence of
25	pollution.	25	a particular witness that you have seen?
	Page 86		Page 88
1	A. Yes, atmospheric pollution and condensation can cause	1	A. Yes, I'm referring to some particular evidence. I'm
2	acidity, and that would not be good for corrosion of	2	sorry, I don't have a note of where it is.
3	aluminium.	3	Q. Perhaps Mr Lo, who commented
4	Q. Yes, but in terms of high temperatures and high	4	A. It could well have been. But it was certainly in
5	humidity, and the potential causative effect that these	5	writing. It wasn't oral evidence.
6	may have about acidic conditions, you have mentioned	6	THE CHAIRMAN: The designer was Mr Lim. We don't have
7	that even for military vessels in the Western Pacific,	7	a written statement from Mr Lim.
8	where these conditions high humidity and high	8	MR SHIEH: Mr Lim has not been questioned on this aspect,
9	temperature existed, they have not exhibited	9	because he was only questioned about the watertight
10	corrosion of the plating.	10	bulkhead and the like. So that's why I asked, because
11	A. Correct.	11	it mentions "the designer".
12	Q. Then you went on to identify one situation peculiar to	12	THE CHAIRMAN: Yes.
13	Hong Kong that was perhaps not shared by the Western	13	MR SHIEH: But the general thrust of your point, really,
14	Pacific location	14	Dr Armstrong, is that insofar as people try to rely on
15	A. Correct.	15	classification society regulations allowing perhaps some
16	Q and that is atmospheric pollution?	16	lesser thickness, it presupposes the vessel being in
17	A. Correct.	17	class with that classification society; correct?
18	Q. So would it be fair to say that you are saying if indeed	18	A. Correct. There was
19	there was corrosion, would you say that it is possibly	19	Q. Which provides some assurance of
20	because of atmospheric pollution?	20	A. There was some documentation came in this morning,
21	A. I'm raising the possibility. It's getting a little	21	I think from Dr Cheng, quoting a number of
22	outside my knowledge area, but I'm saying it is	22	classification society calculations, all coming up with
23	a distinct scientific possibility. There was one other	23	different values.
		24	So my point is, as you say, that according to the
2.4	item that did come to	27	SU IIIV DUIII IS, as you say, mar according to the
24 25	item that did come to Q. That is to say, if indeed there was corrosion.	25	1995 Instructions, it should not have been permitted to

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	Page 89		Page 91
1	use class society calculations.	1	point to another.
2	Q. Because it was not in class	2	It's also made at the same time as the structure is
3	A. Because it was not in class.	3	being manufactured. Why is that significant? It means
4	Q with that society?	4	that you have limited control over how much glass and
5	A. (Witness nods).	5	how much plastic is actually at a particular point. It
6	Q. Thank you. That, Dr Armstrong, completes the evidence	6	is theoretically possible that you just happen to have
7	on this question about aluminium.	7	no glass somewhere and a lot of resin.
8	Perhaps I will now move on in your report to	8	Now, that depends a lot on the skill of the
9	a different topic, and that is to say the topic of seat	9	manufacturer, and the manufacturing process. And there
	failures. Please turn to page 417, paragraph 42:	10	is no question in my mind that Cheoy Lee is one of the
10			
11	"Following flooding, Lamma IV assumed a severe stern	11 12	best at making fibreglass materials. But nevertheless, it's difficult to control the mix.
12	trim. This attitude caused the failure of all of the		
13	fastenings connecting the seats to the upper deck"	13	THE CHAIRMAN: Can you just help me with this aspect of
14	I think this sets out the general outlook of the	14	things. We know that the superstructure of the vessel
15	vessel following the collision, with which we are	15	was subcontracted to a New Zealand contractor.
16	reasonably familiar.	16	A. Yes.
17	Paragraph 43, you describe the structure of the	17	THE CHAIRMAN: The hull was built in the mainland. The two
18	upper deck: 2.1 mm woven rovings, 25 mm of foam, 2.1 mm		came together in Hong Kong and appear to have been
19	of woven rovings at the bottom.	19	joined together, from a layman's point of view. Would
20	Over the page:	20	you expect the superstructure made in New Zealand to
21	"This type of construction is typical for a vessel	21	have the upper deck floor already in place or not?
22	deck, where the foam is essentially used to separate the	22	A. I'm not familiar with exactly who did what, Mr Chairman.
23	two outer skins to provide good bending strength."	23	I know High Modulus in New Zealand
24	Dr Armstrong, as I understand it, the thrust of this	24	THE CHAIRMAN: That's the company.
25	paragraph is that the woven roving may have strength in	25	A. Yes. They are recognised as about the best there are in
	Page 90		Page 92
1	certain dimensions, in two dimensions, but it has	1	the business in terms of design. I have no knowledge of
2	limited strength perpendicular to the deck and therefore	2	the capability of who built it or how they built it.
3	may not be a good material to hold the screws. That's	3	THE CHAIRMAN: So High Modulus would be designers rather
4	the general thrust of this paragraph, is it,	4	than manufacturers?
5	Dr Armstrong? Or perhaps you can develop your point	5	A. That was my understanding, but I would stand corrected.
6	first.	6	THE CHAIRMAN: But coming back to my question, would you
7	A. Could you just bear with me one second, please.	7	expect it to arrive with the upper deck floor, which is
8	The original point of the paragraph was to point out	8	the main deck ceiling, already in place or not?
9	that the combined structure that is, the woven	9	A. I would assume that, yes.
10	rovings and the foam and the woven rovings underneath	10	THE CHAIRMAN: Yes.
11	do not have good strength in the perpendicular	11	Mr Pao, are you able to help us? That's a line of
12	direction. However, you're right when you say that the	12	enquiry we raised with you yesterday. Have we got any
13	woven rovings itself also have very different properties	13	further with that?
14	in different directions. Perpendicular is weaker than	14	MR PAO: I believe I've seen some documents. They're
15	in the directions along the material.	15	collating it. Because if they produce the whole file,
16	It's a complicated answer because the material is	16	there is irrelevant material in there.
17	not homogeneous I apologise to the translators. By	17	THE CHAIRMAN: Yes.
18	"homogeneous", I mean the material is not the same, it's	18	MR PAO: They would like to just simply supply the
19	not consistent throughout. It consists of strands of	19	Commission with the relevant
20	glass, which is a very strong material, laid in	20	THE CHAIRMAN: But that's under way?
21	different directions, and it is very strong along those	21	MR PAO: It's under way.
22	strands of glass, embedded in a plastic resin, I think	22	THE CHAIRMAN: Thank you.
23	polyester in this particular case it might have been	23	I'm sorry, I interrupted you, Dr Armstrong. You
1		101	were explaining the non-homogeneous nature of the glass
24	epoxy, I can't remember but anyway, a plastic resin,	24	were explaining the non-nomogeneous nature of the glass

- 1			5
1	A. When considering a little local detail like a screw, it	1	so therefore it will be stronger embedded and therefore
2	is very hard to say whether that particular screw would	2	would be a stronger connection. But the odds of a screw
3	be embedded in lots of glass or in lots of resin. To	3	actually being on a shear web are quite small. The
4	further complicate the issue, the deck is not quite as	4	majority of the material is not shear web.
5	simple as I have described it on the previous page, on	5	MR SHIEH: Would this be an appropriate moment, Mr Chairman?
6	page 417, because it also has some internal what are	6	I'm moving on to a different topic.
7	called shear webs, which I refer to in the words	7	THE CHAIRMAN: Yes, if we're moving on, certainly.
8	MR SHIEH: Could I pause you here and draw your attention to	8	Dr Armstrong, we'll take our lunch break now and
9	your first supplemental report, page 475, when you	9	we'll resume this afternoon at 2.30.
10	commented on Dr Cheng Yuk-ki's report the shear webs,	10	A. Thank you.
11	which is what I'm actually going to refer you to.	11	(12.56 pm)
12	Page 475.	12	(The luncheon adjournment)
13	A. Thank you.	13	(2.30 pm)
14	Q. This is the 100 mm times 100 mm boxes concept.	14	MR PAO: Mr Chairman, I wish to inform the Commission that
15	A. Yes. I think the box sizes are probably smaller than	15	Dr Armstrong's impression about the New Zealand firm
16	I've quoted there.	16	being only the designer and not the manufacturer of the
17	Q. Can I ask you to explain this. This is a different	17	superstructure is correct. I've just confirmed with my
18	feature from the feature you told us earlier, about the	18	client that in fact Cheoy Lee was the manufacturer of
19	non-homogeneous nature of that top and bottom layer?	19	the superstructure in Hong Kong.
20	A. It is a different subject, yes. But considering the	20	THE CHAIRMAN: Right. Thank you for that confirmation.
21	local structure in way of a screw thread, I think you	21	Then moving to the next step, we had asked for
22	have to consider all of these issues because the	22	information relating to the contract or the order placed
23		23	with New Zealand, but also then we ought to add that we
23	material you're screwing into is just not consistent.	24	seek information as to the construction of the
24	It's non-homogeneous. Maybe I've wandered off the	24	superstructure by Cheoy Lee in Hong Kong.
23	point.	25	superstructure by Cheby Lee in Hong Kong.
	Page 94		Page 96
1	Q. You were about to talk about you said to make things	1	MR PAO: Yes. I'll see to that.
2	more complicated, there is this concept of shear webs.	2	THE CHAIRMAN: Thank you.
-	I was reminding you that this is the subject matter of	2	
3	I was reminding you that this is the subject matter of	3	MR SHIEH: Mr Chairman, before we proceed with
3 4	what you have written at page 475, at the top.	4	Dr Armstrong's evidence, there is a point about the
4	what you have written at page 475, at the top.	4	Dr Armstrong's evidence, there is a point about the
4 5	what you have written at page 475, at the top. A. Yes. I think overall I can say is, yes, there's limited	4 5	Dr Armstrong's evidence, there is a point about the remaining witnesses for these couple of days that
4 5 6	what you have written at page 475, at the top.A. Yes. I think overall I can say is, yes, there's limited strength in the perpendicular direction to the deck, but	4 5 6 7	Dr Armstrong's evidence, there is a point about the remaining witnesses for these couple of days that perhaps I should raise with the Commission, because
4 5 6 7	what you have written at page 475, at the top.A. Yes. I think overall I can say is, yes, there's limited strength in the perpendicular direction to the deck, but it can vary quite a lot depending on the local	4 5 6 7	Dr Armstrong's evidence, there is a point about the remaining witnesses for these couple of days that perhaps I should raise with the Commission, because Mr Chairman will recall raising the question about
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1	have yet to obtain a more detailed indication, but the	1	A. A variation in their strength capability.
2	initial inclination is that there are a few areas which	2	Q. Yes. Put in layman's terms, it's because of the
3	Dr Armstrong has some comments on. But we bear in mind	3	non-homogeneous make-up of the material. They may not
4	Dr Cheng's availability in the sense that he has to	4	be equally dense or the material would not be equally
5	leave on the morning of the 31st, which is Thursday.	5	packed at all places, so that a screw, if it were to be
6	THE CHAIRMAN: Yes. I'm mindful of that.	6	driven into it, could well strike into a rather loose
7	MR SHIEH: So if there is any chance of him coming in	7	area and therefore the material would be unable to
8	tomorrow and then not finishing, then obviously that is	8	firmly grip the screw. Is that the idea?
9	something to be factored in, whether we do call him	9	A. I put it slightly differently. It could go into certain
10	tomorrow or whether we leave him until after the New	10	areas where it would have additional strength rather
11	Year break. That's one consideration.	11	than say it would have less strength. But in the
12	THE CHAIRMAN: Yes.	12	majority of locations where they would be driven, I do
13	MR SHIEH: Also, there is my learned friend Mr Dominic	13	consider they would have very little strength because
14	Yeung's, acting for the China Classification Society,	14	there would be so little thread engaged with the
15	application to recall witnesses. That issue is left	15	2.1-mm-thick woven rovings.
16	outstanding.	16	Q. But in respect of the shear web point that we are
17	THE CHAIRMAN: It's certainly not urgent, is it?	17	looking at in this paragraph
18	MR SHIEH: Well, not urgent in the sense that it has to be	18	A. Then it would have additional strength if it were to
19	dealt with before we move on. But on the other hand,	19	strike a shear web.
20	the plan as we see it is that Captain Pryke may be	20	Q. If it struck a shear web. But can you help us visualise
21	available either the end of this week or early next	21	this idea of a shear web? When you say "if it goes into
22	week.	22	a shear web", what do you mean?
23	THE CHAIRMAN: It's next week that I had envisaged that he	23	THE CHAIRMAN: This is where the fibre is pointing
24	would be recalled for examination or questioning in	24	vertically, not horizontally, is it not, and the chances
25	respect of the first issue; that is, the collision.	25	of hitting it are pretty low?
	Page 98		Page 100
1	MR SHIEH: Yes. Primarily, I gather, by Mr Sussex and	1	A. Well, simply put, yes, sir. In fact, "vertically" is
2	Mr Zimmern.	2	not quite right, because the woven rovings have two
3	THE CHAIRMAN: Yes.	3	dimensions to them. They are vertical and horizontal.
4	MR SHIEH: Then it would be followed next by the crew	4	That's probably a quibble. But there is just more
5	members. Now, it may well		
~	memoers. Trow, it may wen	5	
6	THE CHAIRMAN: Well, no.	5 6	material for the screw to engage with. MR SHIEH: If it happens to strike into a shear web, do you
6 7	· · ·		material for the screw to engage with.
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7	THE CHAIRMAN: Well, no. MR SHIEH: Sorry? THE CHAIRMAN: We're getting involved in quite a discussion in the middle of Dr Armstrong's evidence. But I take on	6 7	material for the screw to engage with. MR SHIEH: If it happens to strike into a shear web, do you say?
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7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22	 THE CHAIRMAN: Well, no. MR SHIEH: Sorry? THE CHAIRMAN: We're getting involved in quite a discussion in the middle of Dr Armstrong's evidence. But I take on board what you're saying. Can we not revisit this at 4.30? MR SHIEH: Yes. The only reason I'm raising it is if there is a quick solution to whether Mr Tang Ying-kit THE CHAIRMAN: Mr Tang we can say Friday. MR SHIEH: Friday. Thank you. Dr Armstrong, welcome back. Before the lunch break I was looking at page 475 of expert bundle 1, in particular your discussion about the internal shear webs, the foam core of the structure compartmentalised into roughly 100 mm by 100 mm boxes. Let me recap. The non-homogeneous nature of the material is a separate point that you addressed earlier on in your main report 	6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22	 material for the screw to engage with. MR SHIEH: If it happens to strike into a shear web, do you say? A. I think the odds of it striking a shear web are very small, but if it did, then it would have more screw threads engaged into the glass fibre as opposed to the resin itself, and therefore it would have greater pull-out strength. Q. Could I now turn back to your main report and continue with your discussion about the seats. Page 418. The discussion as to the characteristics of the woven rovings is at paragraph 43. At paragraph 44 you discuss the actual deck construction, and you have a photograph, in fact two photographs showing the actual deck construction and also a sketch of the arrangement. Page 467. The top photograph there shows a hole. Can you explain to us the circumstances where you came across this hole? This

Page 101	Page 103
1 pointed out to me by Senior Inspector Tang of the Marine	
2 Police. It was where a ventilation fitting had passed	2 20.9 mm of the screws were embedded in the soft foam
³ through the deck, and it was a hole that was	3 core and the vinyl floor tiles, which provided no
4 manufactured during the construction of the vessel and	4 strength to the self-tapping screws."
5 would have had a circular vent fitting running through	5 I'm sure it's entirely my fault. Could you work out
6 it, which has been displaced as a result of the	6 the math with me. Woven rovings of 2.1 mm thickness
7 accident.	7 so it's 2.1 on top?
8 In order to help understand it, there is a cable	8 A. Yes. One has to allow for the thickness of the seat
9 outside, a steel cable by the look of it, running	9 foundation as well in the mathematics
10 outside, and there's also a red hose, which are	10 Q. Yes.
11 irrelevant. What we're looking at is a circular section	11 A which are 2 mm thick, approximately.
12 through the deck, and you can see some green colour,	12 Q. Right. Thank you.
13 which is the foam, and some vertical white partitions	13 THE CHAIRMAN: That's with the vinyl?
14 which are in fact the shear webs. Then above and below	14 A. I believe so, yes, sir.
15 that are the upper and lower surfaces of the deck, made	15 THE CHAIRMAN: Thank you.
16 out of 2.1-mm-thick woven rovings.	16 MR SHIEH: Thickness of the support?
17 Q. So the white things we see are actually the shear webs?	17 A. No, that is not with the vinyl, Mr Chairman, I'm sorry.
18 A. Correct.	18 Because I say 20.9 were embedded in the soft foam core
19 Q. The bottom sketch on the same page shows the layers of	
20 the wafer, if I can put it this way, viewed sideways?	20 Q. Thank you.
21 A. Correct. Those screws are actually taken from the deck	21 "It is an engineering 'rule of thumb' that
22 of Lamma IV, with the permission of the police. What	22 self-tapping screws in metal should be sized such that
²³ I've not shown in the sketch is that there are some	 the thickness of material equals at least two-and-a-half threads of a screw. The majority of screws used on
 24 vinyl tiles sitting on the floor of 25 O. Above the woven rovings? 	
Page 102	Page 104
1 A. Above the woven rovings, between the seat support and	1 engaged with the woven rovings, which would have needed
2 the woven rovings. But I had allowed for those in the	2 to be at least 5 mm thick to comply with the 2.5 times
3 thickness of the base plate of the seat support.	3 'rule of thumb'."
4 I don't know how thick they are, but I would guess about	4 Because each thread was about, what, 2 mm?
5 1.2mm, 1.3 mm. So I think the amount of thread of the	5 A. If I can refer you to the sketch on page 467, at the
6 screws inside the plastic foam is very close to reality.	6 bottom.
7 Q. Thank you.	7 Q. Yes.
8 A. The plastic foam itself is quite hard to describe. I'm	8 A. The thickness of the black line is approximately one
9 not sure of the material of this particular one. It's	9 thread.
10 probably a polyurethane foam or some other chemical	10 Q. Right.
11 composition. Typically well, on this particular	11 A. So, yes, you're correct: about 2 mm would be one thread.
12 boat, I did have a sample and it is easily crushed in	12 The thickness, the black line, being the woven rovings,
13 your hand and made into a powder. I would describe it	13 is engaging with about one thread.
 in layman's terms as having the strength of toast, and about similar strength characteristics when it has 	 14 Q. "In any case, fibreglass construction cannot take 15 a large screw load because it is not a homogeneous
8	 a large screw load because it is not a homogeneous material and resin will not hold for a large load.
1	17 Furthermore, screw holes in a fibreglass deck permit
Q. Not very suitable for holding screws, or having a grip,having a firm grip?	18 water on the deck to penetrate to the foam at the core
19 A. In my opinion, no. But I did note the comment by Mr Lo	1
20 that their practice was to put some bedding compound in,	20 have further contributed in a small way to the seat
und mon provide was to put some bedaning compound in.	21 foundation failure."
21 and if this was an epoxy type of material, that would	
 and if this was an epoxy type of material, that would have strengthened the hole where the screw was. 	22 When you say "causes it to deteriorate", you mean 23 the foam?
and if this was an epoxy type of material, that would	22 When you say "causes it to deteriorate", you mean

	Page 105		Page 107
1	in.	1	in the middle of the open area deck, where I think it
2	Q. Maybe epoxy?	2	was the port aft fitting had lifted from the deck.
3	A. Yes, maybe epoxy.	3	A. Yes.
4	Q. "The seat connections on the upper deck should have been	4	THE CHAIRMAN: As had, I think, the middle of the
5	through-bolted, meaning a bolt should have been used	5	attachments.
6	that had a nut under the deck with a washer sufficiently	6	A. They are the seats I was referring to, yes.
7	large to spread the load so as not to crush the foam.	7	THE CHAIRMAN: They remained attached in some places but not
8	The seat foundations on the lower deck did not fail,	8	in all, is the point I'm making. Perhaps we could see
9	because all of them were screwed through the aluminium	9	those photographs.
10	metal deck, with about 2.5 threads engaged. Viewed from	10	MR SHIEH: Yes. Could I just have a moment to locate them.
11	below, as shown in appendix IV, item 12, the screws have	11	THE CHAIRMAN: Yes, of course.
12	remained undisturbed."		MR SHIEH: Page 398-2, produced by Dr Cheng during the
13	That is page 468.	13	course of his evidence.
14	This shows the seat foundation screws in the	14	The pictures at the top left-hand corner and the
15	aluminium main deck, but this picture is taken from	15	bottom right-hand corner show two mountings which have
16	below the main deck, so from one of the compartments?	16	become detached. They form part of that pair of long
17	A. It's taken from below the main deck, and there were many	17	white benches on the weather deck. Is that the
18	such pairs of screws, as you might anticipate, under	18	mountings that you observed, in the picture?
19	each of the seats. I looked at all of them and I could	19	
20	not tell that anything had happened up above. The paint	20	are the benches I was referring to. They are not shown
21	was intact, there were no cracks or any other evidence	21	on the General Arrangement plan in that location, so
22	of strain.	22	I presume they were moved at some stage. I notice that
23	Q. But this is not an example of them being bolted; this is	23	at least one of the foundations, and it could have been
24	simply an example where the screws were driven in	24	the one shown in the right-hand photograph on the
25	through a metal deck with 2.5 threads engaged?	25	left-hand side, had bolts, through-deck bolts on it, and
	Page 106		Page 108
1	A. Yes, although oddly there were occasions where there	1	were still intact. Although it appears to have lifted
2	were bolts through and I just assumed at some stage the	2	in that picture.
3	seats had either been taken out or changed or moved.	3	I do have the photographs with me, and maybe at
4	There were some nuts underneath as well. But I think it	4	a suitable interval I can try and find those.
5	was just, as I say, because of some later change.	5	Q. You do not have it now nearby, but you can locate them?
6	THE CHAIRMAN: Do you have a photograph of that, of the	6	A. It is on a computer.
7	through-bolt going through the main deck aluminium	7	Q. Right. But let's address this question of the screws
8	floor?	8	and the bolts in a bit greater detail, because you
9	A. I think not, Mr Chairman. I did take many pictures down	9	mentioned first of all, you produced the photographs
10	below, so there may be a picture somewhere I can look	10	at page 468 as being an example where screws were
11	for just in case I captured it.	11	screwed through aluminium metal deck with 2.5 threads
12	THE CHAIRMAN: Thank you.	12	engaged, which did not fail. Now, this mechanism did
13	MR SHIEH: There is a picture of a bolted arrangement taken	13	not involve the using of bolts; this simply utilises the
14	by Dr Cheng, but with the bolt being visible, viewed	14	thickness of the metal through which the screw was
15	from the top, which may be one type of arrangement which	15	driven. Correct?
16	would have ensured a firmer attachment. Could I ask you	16	A. Correct.
17	to look at page 390. Do you see that, Dr Armstrong?	17	Q. And because the surface that the screw was driven
18	A. I see that. I also saw that the seat which ran forward	18	through is not the structure that we have seen with foam
19	and aft on the centreline on the open deck, which	19	in the middle, but is actually metal
20 21	remained attached or perhaps had been reattached, I'm	20 21	A. Correct.
21	not sure, but when I inspected the vessel, those five seats were attached to the deck and had remained, in my	21	Q that's the 2.5-thread point, this enabled a firm grip on the screw?
22	opinion, intact and had bolts fitted. I do have	22	A. Correct.
23	a picture of that.	23	A. Correct. THE CHAIRMAN: What is the thickness of the metal deck that
24	THE CHAIRMAN: We had some evidence in relation to the seats		we're looking at there?
	THE CHAINMAIN. WE HAU SOME EVIDENCE IN TETATION TO THE SEALS	20	we to tooking at more!

	Page 109		Page 111
1	A. I believe it's 4 mm, Mr Chairman.	1	Q. Either with a bolt, or being tapped in, or being
2	MR SHIEH: Now, that is the metal let me see. That is	2	penetrated with at least 2.5 threads.
3	what deck? That is the lower deck?	3	A. Correct.
4	A. That is the lower deck, yes. The main deck.	4	Q. Thank you.
5	Q. Which is called the main deck?	5	Paragraph 47, you refer to the 1995 Instructions
6	A. Yes.	6	which said:
7	Q. Right. And the screws penetrated the metal and you had	7	"Where seats are provided for passengers, their
8	to go to one of the compartments to take a picture	8	form, design and attachments should be adequate"
9	looking upwards?	9	Then you make the point that it's all up to the
10	A. Correct. That was inside the tank room, I think.	10	experience of the individual inspector or surveyor.
11	Q. Right. Dr Cheng's photograph of the bolt at page 390	11	Paragraph 48, you say:
12	shows another way whereby seats could be securely	12	"It is noted from the annual survey items that the
13	mounted. You saw some examples of this manner of	13	seats generally appear to have performed adequately
14	securing the seats during your visit?	14	since 1995. There is evidence that some of the seat
15	A. I saw one.	15	foundations became loose in service, and photographs
16	Q. You saw one?	16	taken after the accident of one seat foundation suggest
17	A. I saw one.	17	that at one stage some of the seat screws have pulled
18	Q. According to Dr Cheng, this was taken on the main deck		out and could not be replaced, and consequently a small
19	cabin. But I think you have different terminologies,	19	steel plate was connected to the deck with four new
20	because what Dr Cheng referred to as the main deck	20	screws and to which the seat was then attached."
21	I believe means the upper deck; right?	21	Could I ask you to look at police album VIII,
22	THE CHAIRMAN: No, I think this is the floor of the main	22	page 421, to see whether or not that is what you have in
23	deck, is what Dr Cheng was telling us. So he was	23	mind.
24	looking down onto the floor of the main deck.	24	Is that what you have in mind, Dr Armstrong?
25	MR SHIEH: Yes.	25	A. I cannot say that with certainty because I noticed the
	Page 110		Page 112
1	THE CHAIRMAN: The photograph we've just looked at was	1	four holes and I cannot say that that was the same four
2	a photograph from underneath, looking up.	2	holes that is shown in this particular drawing.
3	MR SHIEH: Yes.	3	I understand from what I've heard recently and read in
4	THE CHAIRMAN: If we call it the floor, perhaps that might	4	the transcripts that this may have been the plate in
5	work.	5	which some pop rivets were used.
6	MR SHIEH: Yes, but I thought there was a point Dr Cheng	6	THE CHAIRMAN: That's what Dr Cheng told us.
7	mentioned, that he perhaps might have used rather	7	A. I only saw the four holes in the deck. I think it's
8	different terminology in describing this deck.	8	quite an interesting photograph, because this actually
9	But this way of attaching the seats would require	9	uses four screws which are generally associated with
10	driving in the screw from below the deck and putting the	10	roofing and are a much finer thread. It's possible that
11	bolt from above?	11	if this type of screw had been used in fibreglass, then
12	A. I think it will be more likely to be done the other way:	12	there would have been 2.5 threads in contact. But of
13	putting the bolt in from the top and the nut underneath.	13	course, these screws were not generally used. So
14	Q. Oh, right.	14	I cannot say with certainty it's the same four holes.
15	THE CHAIRMAN: So this is the bolt head that we're looking	15	MR SHIEH: But further down at the same paragraph, you
16	at?	16	mention:
17	A. Yes.	17	"In other examples the screws appear to have pulled
18	THE CHAIRMAN: The nut and washer would be down beneath?	18	out at some stage and have been put back very close to
19	A. Underneath, yes.	19	the previous hole."
20	MR SHIEH: Right. Thank you.	20	Could I have police album VII, page 357. Is that
21	So that is the other way of ensuring a firm grip?	21	the feature?
22	A. (Witness nods).	22	A. That's the exact photograph I had in mind, yes.
23	Q. But the detached seats, in your opinion, would not have	23	Q. Thank you. Now, there have been suggestions that the
24	been secured by either of these methods?	24	detachment of the seats on the Lamma IV could well have
25	A. When you say "either of these methods"	25	been related to the deceleration of the vessel. What

	Page 113		Page 115
1	would you say about that suggestion?	1	my opinion could not be considered as adequate."
2	A. The deceleration during the collision?	2	So that still represents your conclusion? You've
3	Q. Yes.	3	heard Dr Cheng give evidence, and you have seen
4	A. I did do a quick calculation when that was raised, and	4	A. I still stand by that.
5	according to my calculation, the deceleration averaged	5	Q the result of his test about the amount of force that
6	something around about 0.2 G. Of course it would have	6	was needed. Could I remind you of your first
7	been variable. I think there would have been an initial	7	supplemental report, where you dealt with that. The
8	higher impact deceleration. But it would have been	8	same bundle, page 475. This is where you discussed the
9	Q. Sorry, when you say "0.2 G", "G" would be	9	shear webs. It is in the wider context of commenting on
10	A. Acceleration due to gravity.	10	Dr Cheng's experiment. So you would confirm that view?
11	Q. 9.8?	11	A. I'm still of the same view as I was when I wrote the
12	A. 9.8065, yes.	12	first report.
13	Q. Gravitational acceleration?	13	Q. We now move on to deal with the question of the
14	A. Yes. 0.2 G. There would have been an impact load for		applicable regulations at the time of construction of
15	a very short duration higher than that, but it would not	15	Lamma IV. In a way, one can say it's either a question
16	have affected the seats.	16	of law, whether or not the statute, properly understood,
17	Q. You mentioned that you actually made a calculation at	17	applied to the Lamma IV; or it could well be a matter of
18	the time when the matter was raised.	18	fact, namely which set of rules Mardep chose in fact to
19	A. (Witness nods).	19	apply.
20	Q. I believe it was actually raised during the questioning,	20	A. (Witness nods).
21	I believe, of Dr Cheng.	21	Q. But I would simply wish to get your opinion as an expert
22	A. You may well be right, yes.	22	shipbuilder to look at the text of the relevant
23	Q. Is it possible for you to write out the calculation for	23	regulations and see what would have been your reaction
24	us?	24	upon seeing the wording of those texts, which may be of
25	A. Yes, of course it is possible.	25	assistance to the Commission.
20	E.		
	Page 11/		Page 116
1	Page 114	1	Page 116
1	Q. Will it take a long time, or is it possible that you	1	A. Right.
2	Q. Will it take a long time, or is it possible that you actually write it out	2	A. Right. Q. Paragraph 49:
2 3	Q. Will it take a long time, or is it possible that you actually write it outA. I've got the original somewhere.	2 3	A. Right.Q. Paragraph 49: "Lamma IV was constructed in 1995. According to the
2 3 4	 Q. Will it take a long time, or is it possible that you actually write it out A. I've got the original somewhere. Q. Right. I suppose those at the back may well help dig 	2 3 4	 A. Right. Q. Paragraph 49: "Lamma IV was constructed in 1995. According to the evidence available to me, the keel was laid on 30 June
2 3 4 5	 Q. Will it take a long time, or is it possible that you actually write it out A. I've got the original somewhere. Q. Right. I suppose those at the back may well help dig out the piece of paper. 	2 3 4 5	 A. Right. Q. Paragraph 49: "Lamma IV was constructed in 1995. According to the evidence available to me, the keel was laid on 30 June 1995, and it is the date of keel-laying that is used in
2 3 4 5 6	 Q. Will it take a long time, or is it possible that you actually write it out A. I've got the original somewhere. Q. Right. I suppose those at the back may well help dig out the piece of paper. A. It may well be at Lo & Lo. I also calculated the 	2 3 4 5 6	 A. Right. Q. Paragraph 49: "Lamma IV was constructed in 1995. According to the evidence available to me, the keel was laid on 30 June 1995, and it is the date of keel-laying that is used in Hong Kong, as elsewhere, for the purposes of defining
2 3 4 5 6 7	 Q. Will it take a long time, or is it possible that you actually write it out A. I've got the original somewhere. Q. Right. I suppose those at the back may well help dig out the piece of paper. A. It may well be at Lo & Lo. I also calculated the accelerations owing to operation in a seaway, and noted 	2 3 4 5 6 7	 A. Right. Q. Paragraph 49: "Lamma IV was constructed in 1995. According to the evidence available to me, the keel was laid on 30 June 1995, and it is the date of keel-laying that is used in Hong Kong, as elsewhere, for the purposes of defining the application of regulations."
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	Page 117		Page 119
1	evidence, yes.	1	There is now produced and shown to me marked 'WCW-1'
2	THE CHAIRMAN: Could we have that definition on the screen.	2	copy of Marine Department Notice No. 7 of 1996 issued on
3	Page 1817.	3	19 January 1996, which announced the coming into effect
4	MR SHIEH: Yes. It's marine bundle 8.	4	of the 1995 Instructions. See also the exchange between
5	"'New vessel' means	5	the shipbuilder, Cheoy Lee and Mardep and Mardep's
6	(a) a vessel the keel of which is laid, or which is	6	file note which show that the Blue Book as opposed
7	at a similar stage of construction on or after	7	to the 1995 Instructions applied to the approval and
8	1 January 1995."	8	initial survey of Lamma IV."
9	That's the definition you had in mind, Dr Armstrong?	9	Marine Department Notice No. 7 is at WCW-1, which is
10	A. Yes.	10	in the same bundle, page 3947.
11	Q. Thank you. Then in the next paragraph, you pointed out:	11	"Owners, operators and shipbuilders of launches and
12	"Prior to 1995, there were guidance documents titled	12	ferry vessels are hereby informed that certain chapters
13	'Instructions for the Survey of Launches"	13	of the existing Instructions have been amended and
14	That's the Blue Book; correct?	14	updated separate standard for vessels carrying not
15	A. Correct.	15	more than 60 passengers now termed as class II
16	Q. You say:	16	vessels"
17	"At the time of construction of Lamma IV there	17	It sets out the various chapters.
18	appears to be some confusion as to which of the two	18	"The contents of chapter V 'Fire-Fighting
19	books of Instructions were applicable, probably because	19	Appliances' and chapter VI have not been changed but
20	the surveyors and inspectors were familiar with the Blue	20	are presented in table form.
21	Book, but the new Instructions were less familiar. At	21	3. Chapter X 'Local Certificate of Competency' is
22	the time there would also have been craft building to	22	amended"
23	both sets of instructions because their respective dates	23	Chapter X, certificate of competency, and then it
24	of keel-laying fell either side of 1 January 1995."	24	goes on.
25	Could I show you the stance taken by the Marine	25	Paragraph 6:
	Page 118		Page 120
1	Department. I think it is actually covered by a host of	1	"The amended Instructions, endorsed by the
2	different Mardep witnesses, but the witness statement	2	Provisional Local Vessel Advisory Committee, will
3	I am going to show you comes from Mr Wong Wing-chuen,		supersede the existing Instructions and will come into
4	who actually has not testified, but it just comes in	4	effect from the date of issue of this Notice."
5	handy because I don't believe there is any material	5	Being January 1996.
6	difference between Mr Wong's explanation and other	6	So this is what Mardep says to the way it handled
7	Mardep witnesses. It is marine bundle 11, page 3932.	7	things. It issued a notice in January, and they say the
8	The bottom of the page, paragraph 16:	8	1995 Instructions came into effect in the sense of
9	"At that time there were statutory requirements to	9	Mardep beginning to apply them, as from January 1996.
10	regulate the construction and survey of ocean-going	10	A. (Witness nods).
11	vessels set out in (Cap 369AM), but no statutory	11	Q. That's the way Mardep puts it. Now, as an expert
12	requirements had been prescribed for the construction	12	shipbuilder, obviously you have to deal with
13	and survey of local vessels.	13	interpretation of regulations. In an ordinary court of
$13 \\ 14$	Instead, guidelines as to Mardep's practice	14	law, this may or may not be material, but since we are
$14 \\ 15$	concerning local vessels were set out in a booklet	15	an inquiry I simply wish to have your opinion on this
16	called 'Instructions for the Survey of Launches and	16	point. The text of the 1995 Instructions in terms says
17	Ferry Vessels' (which were updated from time to time),	17	it applies to vessels keel laid you know, "new
18	commonly referred to as the 'Blue Book' and its	18	vessel" definition after 30 June 1995. Do you
19	subsequent replacement [being the 1995	19	remember that definition?
20	Instructions]"	20	A. Yes, sir.
20 21	Then paragraph 18:	20	
21 22			Q. So in terms, the applicability depends on the keel-laid
	"The survey of Lamma IV was conducted by reference to the Plue Pool's since the 1005 Instructions only came	22 23	date; correct?
23	to the Blue Book, since the 1995 Instructions only came		A. Correct.
24 25	into effect on 19 January 1996, by which lime Lamma IV had already been keel laid (in June 1995).	24	Q. So what do you say, what is your comment about what
20	Lamma IV nau aneady been keel laid (in june 1995).	25	I would call a conundrum? Mardep says 1 January 1996,

	Page 121		Page 123
1 2	come into operation; but somebody who looks at the rule book in, let's say, January 1996 would see the	1 2	many people would do, yes, and certainly something that I would look very closely at if I was involved in
3	definition of "new vessel" being keel laid after	3	designing a vessel.
4	30 June.	4	Q. But in any event, you make the point at paragraph 53:
5	If you were the person administering these rules,	5	"Essentially it does not matter too much as to which
6	how would you have dealt with a vessel like the	6 7	were the correct regulations, because it is clear that
7 8	Lamma IV, keel laid after 30 June 1995 but before what's called the date of this notice, where under Mardep's	8	both sets of Instructions were guidance documents for the surveyor and were not mandatory, with much being
9	understanding the instructions came into effect?	9	left up to the discretion of the surveyor or
10	A. I understand your dilemma, Mr Shieh. It's not clear.	10	inspector Also, both sets of instructions are
11	Nevertheless, no matter what date the letter was issued	11	reasonably similar."
12	saying that these new instructions are in force, the new	12	Of course, we are seen specific aspects where the
13	instructions do make it quite clear that a new vessel,	13	1995 Instructions were more specific, in particular the
14	for which there are regulations under the chapter of	14	bit about construction, with the minimum requirement of
15	"new vessel", is one that is built after 1 January 1995.	15	5 mm.
16	So my initial reaction would be, this is somewhat	16	But in the table below, in paragraph 54, you set out
17	retrospective legislation that requires me to comply	17	the main requirements by way of comparison; correct?
18	with something that was written previously. By and	18	A. Correct.
19	large IMO do not grandfather their clauses so that they	19	Q. 3.2, for example that's the point we have just
20	bring in regulations for existing ships or ones for	20	touched on "Minimum thickness of shell plating,
21	which the keel had been laid previously. It does	21	5 mm"; whereas under the Blue Book, "No requirement".
22 23	happen, but it's a little unusual.	22 23	But in terms of watertight bulkhead, collision bulkhead
23 24	I think the reaction would normally be to make contact with the Marine Department for clarification.	23 24	forward, both sets of rules required that; correct? A. Correct.
24	But the way that I read this when I first saw it, and	25	Q. "Watertight bulkheads at each end of engine room", both
	Page 122		Page 124
1	before the statement from Mr Wang was that it's quite	1	_
1	before the statement from Mr Wong, was that it's quite clear in my mind that even though it had come into	1 2	sets of rules required that; correct?
2	clear in my mind that even though it had come into	2	sets of rules required that; correct? A. Correct.
2 3	clear in my mind that even though it had come into effect on 19 January 1996, the definition was still that		sets of rules required that; correct? A. Correct. Q. "Peak bulkheads at both ends", maximum distance
2 3 4	clear in my mind that even though it had come into effect on 19 January 1996, the definition was still that a new vessel was one built after 1 January 1995. So	2 3	sets of rules required that; correct?A. Correct.Q. "Peak bulkheads at both ends", maximum distance 40 per cent ship length; both sets have that?
2 3	clear in my mind that even though it had come into effect on 19 January 1996, the definition was still that a new vessel was one built after 1 January 1995. So I would have to comply with that.	2 3 4	sets of rules required that; correct? A. Correct. Q. "Peak bulkheads at both ends", maximum distance
2 3 4 5	clear in my mind that even though it had come into effect on 19 January 1996, the definition was still that a new vessel was one built after 1 January 1995. So	2 3 4 5	sets of rules required that; correct?A. Correct.Q. "Peak bulkheads at both ends", maximum distance 40 per cent ship length; both sets have that?A. Yes.
2 3 4 5 6	clear in my mind that even though it had come into effect on 19 January 1996, the definition was still that a new vessel was one built after 1 January 1995. So I would have to comply with that.Q. Could I put it this way. You mention retroactive	2 3 4 5 6	sets of rules required that; correct?A. Correct.Q. "Peak bulkheads at both ends", maximum distance 40 per cent ship length; both sets have that?A. Yes.Q. "Any access opening in a watertight bulkhead is to have
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	Page 125		Page 127
	should be adequate" on the one hand, and "properly	1	We now come to openings of the aft peak bulkhead,
	2 secured" on the other?	2	page 425 of the expert bundle.
	³ A. No, I see no material difference.	3	You have expressed your view that the vessel sank in
	4 Q. Thank you. Then further down this section, you began	4	the way it did because of a combination of various
	5 discussing this question of 0.1L, schedule 3 and all	5	things, first of all the hole, the gash and the hole in
	6 that, which we touched on yesterday, which I will not	6	the engine room and the hole in the tank room, but more
	7 revisit for the time being.	7	importantly the absence of a watertight door between the
	⁸ I now come to the next main heading, "Openings in	8	tank room and the steering gear compartment.
	9 the aft peak bulkhead".	9	A. Yes, all of those were factors.
1	-	10	Q. Had there been a watertight door at frame $1/2$, the
1	1 in fact it probably emanates from you setting out the	11	vessel would not have sunk in the way it did; it would
1	2 result of your calculation which those at Lo & Lo have	12	actually have remained afloat in the manner that you
1	3 identified. In fact I was looking at a copy myself,	13	have depicted, I think in your first supplemental
1	4 except that it actually refers to your calculation.	14	report. I'm sorry, I've lost the reference. Could you
1		15	just bear with me, Dr Armstrong.
1	6 your subsequent description of the result of your	16	Page 463. This shows the effect of the watertight
1	7 calculation is depicted in this note which you have	17	door between the tank room and the steering gear
1	8 typed up?	18	compartment in the middle of that page.
1	9 A. Correct.	19	A. Correct. It would have stayed afloat, but fairly
2		20	marginal.
2	11	21	Q. Yes. This section, page 425 of your first report,
2		22	addresses the issue of the openings in the aft peak
	3 that you have done.	23	bulkhead.
2	8	24	"The drawings provided by the shipbuilder showing
2	5 deceleration on the detachment of the seats,	25	the ships structure for Lamma IV were originally
	Page 126		Page 128
	1 Mr Chairman.	1	submitted to the Hong Kong Marine Department by letter
4	2 THE CHAIRMAN: Yes.		
		2	of 5 January 1995. There were four structural drawings,
	MR SHIEH: Perhaps, Dr Armstrong, you can talk us through		of 5 January 1995. There were four structural drawings, which have dates in December 1994 Two of these
4	MR SHIEH: Perhaps, Dr Armstrong, you can talk us through this, about this being a simple calculation based on		of 5 January 1995. There were four structural drawings, which have dates in December 1994 Two of these drawings were relevant to the aft peak bulkhead
	 MR SHIEH: Perhaps, Dr Armstrong, you can talk us through this, about this being a simple calculation based on velocity before and velocity afterwards? 	3	of 5 January 1995. There were four structural drawings, which have dates in December 1994 Two of these drawings were relevant to the aft peak bulkhead (frame 1/2)."
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	Page 129		Page 131
1	The top view (side shell profile) shows the words	1	A. Correct, yes.
2	'WT BHD' The second view (centreline profile) shows	2	Q. That one has a handwritten notation of "superseded".
3	the words 'Corrugated WT BHD' the bottom view (bottom		But the one that we have looked at at page 205 has
4	plan) shows 'WT BHD' at frame 1/2. The appropriate line	4	a Marine Department "approval" chop, 3 May.
5	representing the bulkhead is also shown on all four	5	A. Correct. There is also one other occurrence on this
6	views. The term WT is generally understood to mean	6	drawing which I should draw your attention to, which is
7	'Water Tight'. It is obvious that the bulkhead at	7	in the top right-hand corner, where it also refers to
8	frame 1/2 was intended to be watertight, as was required	8	watertight bulkhead.
9	by the Regulations and Instructions"	9	Q. Section B-B.
10	So you place emphasis on the reference to "WT";	10	A. Section B-B.
11	correct?	11	Q. Yes. Which expressly refers to "WT Bulkhead"?
12	A. Correct.	12	A. Correct.
13	Q. You say:	13	Q. Thank you. Then at paragraph 63:
14	"The appropriate line representing the bulkhead is	14	"On 10 March 1995, the shipbuilder sent a letter to
15	also shown on all four views."	15	Mardep seeking expedited approval of the drawings sent
16	In your experience, solid lines denote a watertight	16	on 5 January 1995, and in an effort to speed up approval
17	bulkhead?	17	also enclosed copies of the drawings for a sister ship
18	A. Generally, yes. Sometimes it may be shown as in the	18	which had been built in China some 3 years previously."
19	upper view, the profile, as a more solid dotted line.	19	That letter that you referred to is marine bundle 2,
20	Q. Yes.	20	page 195, which is the sister ship letter, enclosing
21	A. Indeed there is a convention with a solid dotted line	21	some drawings of the sister ship. 10 March 1995.
22	with two with a dotted line with two solid lines on	22	I think for present purposes, in this paragraph,
23	either side, but that is not shown here.	23	I don't think I need to actually take you to those parts
24	Q. Yes. We have looked at these drawings at some length,	24	of the sister ship drawing which are the same as the
25	so I'm not going to ask you to identify the individual	25	drawings for Lamma IV, but you have identified one part
	Page 130		Page 132
1	lines representing the bulkheads. We are reasonably	1	where they are not the same, and that is the fifth line
2	familiar with that.	2	from the bottom of this paragraph:
3			
	Over the page, you refer to drawing 391-5. I think	I .≾	
	Over the page, you refer to drawing 391-5. I think that's Sections and Bulkheads, which is page 205	3 4	"The sectional view at frame 1/2, shown on the
4	that's Sections and Bulkheads, which is page 205.	4	"The sectional view at frame 1/2, shown on the drawing called Sections and Bulkheads shows the same
4 5	that's Sections and Bulkheads, which is page 205. The relevant one is the one at the bottom left-hand	4 5	"The sectional view at frame 1/2, shown on the drawing called Sections and Bulkheads shows the same opening details as the previous submitted drawing but
4 5 6	that's Sections and Bulkheads, which is page 205. The relevant one is the one at the bottom left-hand corner. You say:	4 5 6	"The sectional view at frame 1/2, shown on the drawing called Sections and Bulkheads shows the same opening details as the previous submitted drawing but the words 'Access Opening' have been replaced with the
4 5	that's Sections and Bulkheads, which is page 205.The relevant one is the one at the bottom left-hand corner. You say:"It is a solid corrugated bulkhead with an opening	4 5 6 7	"The sectional view at frame 1/2, shown on the drawing called Sections and Bulkheads shows the same opening details as the previous submitted drawing but the words 'Access Opening' have been replaced with the words "WT Door'. All of the drawings for the sister
4 5 6 7	 that's Sections and Bulkheads, which is page 205. The relevant one is the one at the bottom left-hand corner. You say: "It is a solid corrugated bulkhead with an opening located and marked 'Access Opening 1,200 x 600 W/50R 	4 5 6 7 8	"The sectional view at frame 1/2, shown on the drawing called Sections and Bulkheads shows the same opening details as the previous submitted drawing but the words 'Access Opening' have been replaced with the words "WT Door'. All of the drawings for the sister ship have been marked as 'For record purposes only' and
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	Page 133		Page 135
1	that I've asked you to look at earlier, because I've	1	A. Yes. It has not been moved.
2	skipped over the earlier set of drawings that you	2	Q. Thank you.
3	referred to. But I think for material purposes, the	3	Coming back to paragraph 64, you drew attention to
4	point sought to be illustrated is the same, namely the	4	several drawings, but the notations there are the same
5	consistent references to "watertight bulkheads".	5	as the drawings that you had alluded to at paragraph 62
6	A. Mr Shieh, could I draw your attention to the drawing of	6	and therefore I'm not going to compare these various
7	the sister ship that we've just had?	7	drawings. In fact, I have asked you to look at this set
8	Q. Yes. Page 198. Which particular	8	of approved drawings when I took you to the underlying
9	A. The bottom left diagram. It actually says "Bulkhead at	9	documents.
10	frame 1.5", rather than frame $1/2$.	10	But in the middle of page 427, you say:
11	Q. Yes.	11	"The use of the words 'Access Opening' is not
12	A. However, when I read that I assumed that was	12	helpful, as it does not signify the presence or absence
13	a typographical error because in the Profile and Deck,	13	of a watertight door. It is noted that the Instructions
14	it's still shown as frame $1/2$.	14	for Survey states 'where any access opening is fitted in
15	Q. Profile and Deck on the previous page at 197?	15	a watertight bulkhead, it is to have an efficient
16	A. 197, perhaps.	16	closing appliance'."
17	Q. Yes.	17	In fact this feature is common between the Blue Book
18	A. I believe the reason for this is that the frame	18	and the 1995 Instructions?
19	numbering system was different; that instead of starting	19	A. It is, yes.
20	with zero partway forward, they actually started with	20	Q. So for this, it doesn't actually matter which is the
21	zero behind the boat. So also the boat was the same,	21	applicable set of instructions; correct?
22	the frame numbering system was different.	22	A. Correct.
23	I think you can see on that drawing there's a zero	23	THE CHAIRMAN: And what is that provision in the 1995 rules?
24	on the very left-hand side of the drawing.	24	MR SHIEH: Mr Chairman, it is at page 421 of the expert
25	Q. Are you referring to the Profile and Deck?	25	bundle, where Dr Armstrong helpfully set out the
	Page 134		Page 136
1	Page 134 A I'm referring to the Profile and Deck and we're looking	1	Page 136
1	A. I'm referring to the Profile and Deck, and we're looking	1	paragraph number in the comparative table.
2	A. I'm referring to the Profile and Deck, and we're looking at the deck on the screen at the moment. There is	2	paragraph number in the comparative table. A. Chapter II, 5.4.
2 3	A. I'm referring to the Profile and Deck, and we're looking at the deck on the screen at the moment. There is a zero on the very left-hand side.	2 3	paragraph number in the comparative table. A. Chapter II, 5.4. Q. In 1995, it's chapter II, 5.4; in the Blue Book, it's
2 3 4	A. I'm referring to the Profile and Deck, and we're looking at the deck on the screen at the moment. There is a zero on the very left-hand side.A. Yes. On Lamma IV, the zero is about 1 metre further	2 3 4	paragraph number in the comparative table.A. Chapter II, 5.4.Q. In 1995, it's chapter II, 5.4; in the Blue Book, it's chapter 12(v).
2 3 4 5	A. I'm referring to the Profile and Deck, and we're looking at the deck on the screen at the moment. There is a zero on the very left-hand side.A. Yes. On Lamma IV, the zero is about 1 metre further forward than that, or a bit more than 1 metre. So	2 3 4 5	paragraph number in the comparative table.A. Chapter II, 5.4.Q. In 1995, it's chapter II, 5.4; in the Blue Book, it's chapter 12(v).THE CHAIRMAN: Thank you.
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and yet, on the other hand, be watertight, if you want

1	and yet, on the other hand, be watertight, if you want	⊥	information put in front of me.
2	it to be watertight?	2	THE CHAIRMAN: But if it had been determined to proceed
3	A. That is correct. All the information I had available to	3	without a door, should any revised drawing have been
4	me suggested it should have been watertight. All of the	4	sought or the drawing amended to show it had been
5	structural drawings, backed up by the damage stability	5	changed?
6	book, which is a de facto watertight subdivision	6	A. It is standard practice in the industry in which I'm
7	approach requiring or showing that there were watertight	7	involved to produce what are called as-built drawings,
8	bulkheads there, as well as the specification which	8	but maybe not for a small vessel that was being used
9	talked about five watertight bulkheads at six	9	locally. But certainly in all the contracts I've been
10	compartments, all of the information I had available to	10	involved in, they've required as-built drawings so that
11	me indicated that those bulkheads would be watertight.	11	the owner knows exactly what he has or has not got.
12	The fact that there was an access opening was,	12	It's usually specified in the contract, and I'm unaware
13	I thought, satisfactory because of the clause in the	13	of this contract giving such detail.
14	instructions which said that access openings had to have	14	MR SHIEH: We have heard evidence that the cost of actually
15	a watertight door.	15	adding a door is only going to be in the region of a few
16		16	
	Q. Thank you. At paragraph 65, you refer to the actual		thousand dollars. You are aware of that evidence?
17	access opening. I don't think it is controversial,	17	A. Yes, I was aware of that.
18	because you describe in some detail what you have seen.	18	Q. I'm not sure whether we have evidence about the cost
19	I think it is now accepted on all fronts that in fact	19	implications of various things, or whether or not that
20	the access opening had no efficient closing appliance;	20	has actually been taken into account, but what would
21	there simply was no door. You say over the page at	21	have been your estimate as to the relative cost of
22	paragraph 66:	22	actually amending the drawings or producing a set of
23	"It is possible that the access opening and door	23	as-built drawings showing actually no door? Would you
24	could have been moved at some stage, although there is	24	be able to comment on that?
25	no obvious evidence of this."	25	A. I cannot comment on the cost of buying in a door.
	Page 138		Page 140
	2		5
1	Det De American Ithink beening the method in		X 111 (1 1) (1) 11 (1)
1	But, Dr Armstrong, I think hearing the matter in	1	I would have thought that was a reasonably priced item,
2	this hearing, you have not heard any evidence that there	2	and I've no reason to disagree with the figure put
2 3	this hearing, you have not heard any evidence that there ever was affixed any door to that opening?	2 3	and I've no reason to disagree with the figure put forward by Mr Lo.
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information put in front of me.

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	Page 141		Page 143
1	Lamma IV was being constructed, inspections and surveys	1	examining the shipyard's submission of its calculation
2	were done stage by stage. You were here or at least you	2	of floodable length or damage stability.
3	have seen the transcript of the various Mardep	3	In the present case, I understand that Cheoy Lee did
4	inspectors testifying.	4	not install a watertight door at the access opening in
5	A. Yes.	5	frame $1/2$. This was a departure from the approved
6	Q. We have heard that for various reasons, the fact that	6	plans. If I had been involved in the decision whether
7	there was no watertight door at frame 1/2 has not been	7	or not to issue a certificate of survey, I would
8	spotted and correlated with the various drawings that we	8	certainly have examined the 'Damage Stability
9	have seen, which would have prompted the hypothetical	9	Information' booklet submitted initially by Cheoy Lee on
10	question of, what if the point had indeed been spotted	10	6 March 1996. If, after examining such calculation,
11	at the material time during one of the several	11	I came to the view that the safety of the vessel would
12	opportunities when the lack of a watertight door might	12	not be jeopardised, I would consider issuing such
13	or could have been spotted? What ought Mardep to have	13	certificate notwithstanding the departure from the
14	done or what would Mardep have done?	14	approved plans.
15	A. I'm not sure I can answer that question on behalf of	15	At around the time when the booklet was submitted by
16	Mardep, Mr Shieh.	16	Cheoy Lee, I was being transferred out of Section to the
17	Q. I know. But could I ask you to comment on certain	17	Government New Construction Section located at the
18	evidence that has been given by Mardep. Could I ask you	18	Government Dockyard. The responsibility for examining
19	to look at the evidence of Wong Chi-kin. Marine	19	the booklet therefore lay with my successor,
20	bundle 11, page 3880.	20	Mr Leung Wai-hok, who was also a surveyor of ships.
21	THE CHAIRMAN: You're looking at the witness statement, are		I now have an opportunity to examine the calculation
22	you?	22	set out in the booklet. As stated in paragraph 47
23	MR SHIEH: The witness statement, yes.	23	above, I agree with Dr Armstrong both the steering gear
24	"Effect of the Approved Plans".	24	compartment and the tank room should be investigated as
25	This is Wong Chi-kin, Marine Department inspector,	25	being flooded. In other words, the calculation should
	Page 142		Page 144
			Idge IH
1	who actually approved the Profile and Deck and the	1	-
1 2	who actually approved the Profile and Deck and the Sections and Bulkheads drawings. Paragraph 49 explains	1	have been undertaken on the basis that the steering gear
2	Sections and Bulkheads drawings. Paragraph 49 explains	2	have been undertaken on the basis that the steering gear and the tank room in fact constituted one compartment
2 3	Sections and Bulkheads drawings. Paragraph 49 explains his thinking as a result of what he now knows to be the	2 3	have been undertaken on the basis that the steering gear and the tank room in fact constituted one compartment instead of two. This is because, as I have explained
2 3 4	Sections and Bulkheads drawings. Paragraph 49 explains his thinking as a result of what he now knows to be the case:	2 3 4	have been undertaken on the basis that the steering gear and the tank room in fact constituted one compartment instead of two. This is because, as I have explained above, since the length of the former was less than
2 3 4 5	Sections and Bulkheads drawings. Paragraph 49 explains his thinking as a result of what he now knows to be the case: "In respect of Lamma IV, I approved the plans	2 3	have been undertaken on the basis that the steering gear and the tank room in fact constituted one compartment instead of two. This is because, as I have explained above, since the length of the former was less than 0.1L, the bulkhead between the two compartments at
2 3 4	Sections and Bulkheads drawings. Paragraph 49 explains his thinking as a result of what he now knows to be the case: "In respect of Lamma IV, I approved the plans entitled 'Profile & Deck', 'Sections & Bulkheads' on	2 3 4 5	have been undertaken on the basis that the steering gear and the tank room in fact constituted one compartment instead of two. This is because, as I have explained above, since the length of the former was less than
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2 3 4 5 6 7 8	Sections and Bulkheads drawings. Paragraph 49 explains his thinking as a result of what he now knows to be the case: "In respect of Lamma IV, I approved the plans entitled 'Profile & Deck', 'Sections & Bulkheads' on 3 May 1995" Dr Armstrong, we've seen those drawings and we've	2 3 4 5 6 7 8	have been undertaken on the basis that the steering gear and the tank room in fact constituted one compartment instead of two. This is because, as I have explained above, since the length of the former was less than 0.1L, the bulkhead between the two compartments at frame 1/2 should not be regarded as forming part of the subdivision of Lamma IV. However, as a matter of fact, the booklet did not
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2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23	 Sections and Bulkheads drawings. Paragraph 49 explains his thinking as a result of what he now knows to be the case: "In respect of Lamma IV, I approved the plans entitled 'Profile & Deck', 'Sections & Bulkheads' on 3 May 1995" Dr Armstrong, we've seen those drawings and we've actually seen the chop, "3 May 1995". " and the plans entitled 'Shell Expansion' and 'Midship Section' on 17 May 1995 The owner/builder of vessel is expected to build the vessel in accordance with the approved plans. However, this does not mean that if there is any aspect of the vessel which departs from the approved plans, a certificate of survey must necessarily be denied." Whether any departure from the approved plans would be accepted by the Section would depend on the importance of the particular aspect of the vessel which does not adhere to the plans. For example, if a bulkhead which is shown to be watertight on the approved plans turns out not to be watertight, such alteration will be disallowed unless the absence of the watertight 	2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23	have been undertaken on the basis that the steering gear and the tank room in fact constituted one compartment instead of two. This is because, as I have explained above, since the length of the former was less than 0.1L, the bulkhead between the two compartments at frame 1/2 should not be regarded as forming part of the subdivision of Lamma IV. However, as a matter of fact, the booklet did not contain such calculation. Faced with such a situation, a surveyor of ships could respond in a number of ways. He could have asked the shipbuilder to resubmit a revised booklet Alternatively, he could instruct a ship inspector working under him to perform such calculation, or he might make a professional judgment on the basis of the information already contained in the booklet to determine whether it was likely that the calculation of damage stability based on a flooding of both compartments would or would not meet the criteria for attaining damage stability. I can illustrate the last point in this way. In respect of Lamma IV, it is possible to accurately estimate the effect of flooding of both the steering gear compartment and the tank room without performing
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	Page 145		Page 147
1	volume of the steering gear compartment and tank room,	1	MR SHIEH: That's the reason I'm reading it to Dr Armstrong.
2	I would find that the combined volume is smaller than	2	THE CHAIRMAN: Yes.
3	the volume of the engine room. As the booklet shows,	3	MR SHIEH: Dr Armstrong, you have seen this witness. He was
4	the criteria for attaining damage stability would be	4	responsible for approving the plans. He was not
5	complied with if the engine room were flooded. It	5	responsible for ultimately signing off the ship, if
6	could, based on the surveyor's professional judgment and	6	I can put it this way, because Mr Leung Wai-hok was
7	experiences, be reasonably concluded that such criteria	7	responsible for doing that. He gave his explanation as
8	would likewise be complied with if the steering gear	8	to what he might well have done had he noticed that the
9	compartment and tank room were both flooded.	9	actual ship as built departed from the drawings that he
10	Accordingly, if I had been remained in the position	10	had approved. Particularly at paragraph 56, he referred
11	of surveyor of ships I might well have decided to	11	to this thinking, that because the combined volume of
12	issue a certificate of survey for this vessel even	12	steering gear compartment and tank compartment, which is
13	though the booklet did not contain the calculation based	13	very near the aft, was smaller than the volume of the
14	on the combined volume in accordance with the	14	engine room. So he reasoned, if the vessel could pass
15	one-compartment flooding standard as I explained above."	15	the test for engine room flooding, which is of a larger
16	Dr Armstrong, have you seen this evidence before?	16	volume, the vessel should pass whatever test is
17	A. I have read this before, yes.	17	prescribed for tank room plus steering gear flooding,
18	Q. You have read this before. But now your memory has been	18	which totally took up less volume than the engine room.
19	refreshed.	19	That's the purport of his paragraph 56. Do you have
20	A. Yes. Thank you.	20	any comment on that mode of thinking?
21	Q. I understand that during the hearing, a point has arisen	21	A. I have a difficulty with the paragraphs you've just
22	as to whether or not this which is effectively	22	explained in terms of timeline, which let me explain.
23	an ex post facto explanation of how this witness would	23	Q. Yes, please.
24	have dealt with the matter had it been the subject of a	24	A. The vessel got approved plans on roughly mid-May 1995.
25	discussion	25	If the builder then went ahead and built the vessels in
	Page 146		Page 148
1	THE CHAIRMAN: That was established in his oral testimony.	1	accordance with the approved plans, everything would
2	This is his pre-oral testimony statement, but this was	2	have progressed along and eventually the damage
3	expanded in oral testimony.	3	stability information would have been brought together
4	MR SHIEH: Yes.	л	
5		4	and seen, and a certificate issued. Now, the damage
	Yes, because I understand that there has been	4 5	and seen, and a certificate issued. Now, the damage stability information cannot be completed until the
6	a certain exchange during the course of this witness's		stability information cannot be completed until the vessel is complete and an inclining experiment is
6 7		5	stability information cannot be completed until the vessel is complete and an inclining experiment is conducted, in order to ascertain the weight of the
7 8	a certain exchange during the course of this witness's testimony as to whether or not this evidence is to be received. But be that as it may, because the purpose of	5 6 7 8	stability information cannot be completed until the vessel is complete and an inclining experiment is
7 8 9	a certain exchange during the course of this witness's testimony as to whether or not this evidence is to be received. But be that as it may, because the purpose of my reading it out is actually for Dr Armstrong to	5 6 7 8 9	stability information cannot be completed until the vessel is complete and an inclining experiment is conducted, in order to ascertain the weight of the vessel, and also its drafts and trim. However, if the builder at some stage decides that
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1	The second comment I'd like to make is in regards to	1	resulting moment would not be the same because of the
2	paragraph 56, suggesting that some surveyors'	2	location.
3	professional judgment and experience be used when you're	3	A. I think that's rather a sad approach, to expect
4	dealing with the safety of 200-300 people I find to be	4	a professional person just to add two volumes together
5	quite extraordinary. I would expect an inspector or	5	and say it will be satisfactory. As you've just
6	surveyor to want to do a full calculation. It's not	6	alluded, if he had taken the volume and the lever to
7	difficult to do, especially with software. Indeed, it	7	create a moment, he would have got a better indication.
8	was one for the purposes of producing the Damage	8	But even so, it would have been a crude approximation,
9	Stability Book. So we know such software existed and	9	even taking a moment. I would have wanted to have done
10	was relatively easy to use. So I cannot see how you	10	it much more accurately than that.
11	could use professional judgment. I wouldn't want to do	11	There are a number of factors in play. To do it in
12	that, with so many people's lives at risk.	12	accordance, for example, with schedule 3, it's not clear
13	We're not talking about a situation where someone	13	to me what would happen to the margin line with heel on
14	may be injured: we're talking about risk to 300 people's	14	the vessel, and that can't be done simply. That would
15	lives here. So I would have thought "professional	15	have to be done using the software that they had
16	judgment" was not satisfactory.	16	available to them. The moment method would give you
17	I would have thought that if they decided not to go	17	a crude indication of schedule 1 requirements, but would
18	ahead with approved plans, that they would discuss it	18	give you no indication at all, in my opinion, of
19	with the surveyor. The surveyor should have then	19	schedule 3 requirements.
20	documented it and if necessary, talked to his manager,	20	THE CHAIRMAN: So we understand your evidence, you regard it
21	his superior back at Mardep, and the decision then be	21	as quite extraordinary that this should have been done
22	made as to whether to approve it or not. And those	22	on the basis of experience being prayed in aid rather
23	sorts of decisions go on in shipbuilding all the time.	23	than doing calculations?
24	It's quite correct to say that sometimes, for whatever	24	A. I do, yes.
25	reason, you cannot build in accordance with the approved	25	THE CHAIRMAN: Thank you.
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1	plans. It happens on every contract I've been involved	1	MR SHIEH: Dr Armstrong, allow me to perhaps test you a bit,
2	in.	2	playing devil's advocate.
3	In that case you go back to the surveyor, you	3	You have since conducted calculations on the basis
4	explain why, you produce the calculations, if necessary,	4	of Lamma IV as built in 1996?
5	to show that what you are proposing is equally if not	5	A. Yes.
6	stronger, and it is then agreed, you usually get	6	Q. In particular, seeing whether or not the margin line
7	a letter saying, "Yes, this is allowed"; you don't	7	test would have been passed, based on various
8	necessarily change the drawings but you have	8	compartment flooding scenarios; correct? I think that
9	documentation. Then you proceed to build a ship and it	9	we can see in expert bundle 2. That's your latest
10	becomes certified at the end of the day. Then it's	10	expert report. Can I ask you to look at expert evidence
11	a matter of the contract as to whether you produce	11	bundle 2, page 928.
12	as-built drawings or not.	12 13	The relevant standards required testing of flooding of one compartment only at the time; correct,
13 14	Q. How about this line of reasoning which this inspector adopted ex post facto by he didn't even actually	14	of one compartment only at the time; correct, Dr Armstrong?
14 15	perform the calculation, he simply took the view that	14	A. Yes.
16	the combined volume of tank and steering room	16	Q. One compartment. We could perhaps leave to one side the
17	compartment was actually smaller than the engine room,	17	flooding scenario of engine room only, because I think
18	for which calculations had been done. So he took the	18	flooding of engine room only passed the margin line
19	view, "Ah, should be fine", and it would have passed any	19	test
20	test, so he did not actually perform any calculation.	20	A. Yes.
21	On that front, what comments do you have? Because	21	Q and we have no issue with that.
22	during the course of the evidence, in examining the	22	A. Correct.
23	Mardep witnesses, they actually accepted that even	23	Q. Here you deal with "tank room only" flooding; correct,
24	though the volume might be similar, or even the combined		Dr Armstrong?
			-
25	volume may be even smaller than the engine room, the	23	A. Yes.

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1	Q. Page 928: condition as of 1998 as constructed.	1	that a vessel with no watertight door would still pass
2	A. 1996?	2	the test?
3	Q. 1996, as constructed. "With watertight door". In other	3	A. At that time, yes. However, it left a trail through the
4	words, "With watertight door", that is "tank room only"	4	Damage Stability Book which indicated that it had
5	does mean "tank room only?	5	certain characteristics which it did not, because the
6	A. Correct.	6	bulkhead was not watertight. That may have had
7	Q. Satisfactory. Margin line not submerged. Yes?	7	an impact further down the track.
8	A. Yes.	8	Q. In 1998 and 2005?
9	Q. "No watertight door", that is to say, you assume that if	9	A. Correct.
10	tank room is flooded, steering gets flooded as well?	10	Q. I will explore that in a bit more detail when we come to
11	A. Correct.	11	2005 and 1998, when actually the margin line test would
12	Q. Which incidentally would have been the requisite	12	have failed after the adding of ballast.
13 14	approach if you were to look at steering compartment,	13 14	Perhaps still staying at 1996. Irrespective of this
15	because steering compartment can't be reviewed as one compartment because it is less than 0.1L.	15	idea about damage stability calculation, submersion of margin line, would a hypothetical Marine inspector have
16	A. Exactly.	16	taken into account things apart from these numerical
17	Q. So you have to test one-compartment flooding by looking	17	matters? Do you remember we've discussed this concept
18	at tank room plus steering; correct?	18	of the aft peak bulkhead, of the requirement in the Blue
19	A. Correct.	19	Book that the ship should have peak bulkheads at both
20	Q. Which would be similar to a case whereby tank room	20	ends?
21	flooded without watertight door; correct?	21	A. (Witness nods).
22	A. Correct, yes.	22	Q. So would this hypothetical Marine inspector say to
23	Q. Let's say a hypothetical Marine inspector were to say to	23	himself, "Irrespective of the satisfaction of these
24	himself, "Let me do the calculations. I am aware of	24	calculations, where is the aft peak bulkhead?", and, if
25	this 0.1L concept, so I won't look at steering	25	so, what would have been the response of this
	Page 154		Page 156
1	compartment flooding on its own, because that is less	1	hypothetical Marine inspector asking himself, "Was the
2	than 0.1L. I will have to think of a compartment which	2	Blue Book complied with insofar as a peak bulkhead at
3	is longer than 0.1L", which in the case of Lamma IV	3	the aft end is concerned?"
4	would be steering compartment plus tank room; correct?		A. The hypothetical Inspector, I would have thought, would
5	A. Correct.	5	have documented all of this information. If he had made
6	Q. That would have yielded a "pass" result, because that	6	a decision that it did not need a watertight aft peak
7	would be no watertight door: passed. So this	7	bulkhead, he should have documented that, left a trail
8	hypothetical Marine inspector, had he done the requisite	8	behind.
9 10	calculation, would still have reached a "pass" result. So he might well have said to himself, "Right. Although	9	Q. Let's say this hypothetical Marine inspector left a note behind and said, "I have taken the view that frame 1/2
11	I now know there is no watertight door, having done the	11	need not be watertight because I don't take that as the
12	calculation, treating the two as one, I'll pass it."	12	aft peak bulkhead. The aft peak bulkhead, or the peak
13	What do you say to this suggested approach of the	13	bulkhead on the aft required by the Blue Book, the role
14	hypothetical Marine inspector who has actually done the		of that is played by the watertight bulkhead as between
15	calculation and come up with the result that we can see	15	the engine room and the tank room."
16	as built in 1996?	16	Now, what would you say to that sort of approach?
17	A. Then the vessel could proceed with certification,	17	A. I think the Director of Marine I'm sorry, I don't
18	because it met the requirements of schedule 1 in this	18	understand the effect of legislation in this area, but
19	particular case.	19	I hypothesise myself that the Director of Marine had the
20	Q. Could it then have been suggested that the non-spotting		power for his inspectors to make such decisions that
21	of the absence of the watertight door had no impact on	21	they did not want to comply with certain parts of what
22	let's say the satisfaction of the margin line test, and	22	we've heard are non-mandatory instructions, but even so
23	therefore it made no difference to whether or not the	23	I would expect him to give reasons for it and make the
24	vessel could have been passed, in the sense that even if	24	office aware of his decisions.
25	it had been spotted, the calculations would still show	25	Q. Coming back to the point in question, in your opinion,

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1	ought this hypothetical Marine inspector regard	1	Q. As I said, it may be a difficult question. But how
2	frame $1/2$ with an access opening as the requisite aft	2	close to the stern would you say a bulkhead needs to be?
3	peak bulkhead?	3	A. Within 10 per cent of the length, I would have said.
4	A. My personal opinion is, no, it wasn't a satisfactory	4	That is based on the fact that collision bulkhead should
5	approach. All of the indications were there should be	5	be between 5 per cent and 7 per cent.
6	an aft peak bulkhead and it should be watertight. So	6	Q. Collision bulkhead, that would be at the fore?
7	personally, if I had been approving the vessel, I would	7	A. At the forward end, yes.
8	not have accepted that. But that's my personal opinion.	8	Q. In fact, within the definition of regulation 7 it
9	Q. Yesterday you talked about SOLAS, the SOLAS	9	actually says:
10	requirements, and you mentioned that SOLAS actually	10	"An after peak bulkhead, and bulkheads dividing the
11	required an aft peak bulkhead.	11	machinery space shall also be fitted"
12	A. It does.	12	It seems to suggest that an after peak bulkhead is
13	Q. I think we have since located the relevant page of	13	something separate and distinct from a bulkhead which
14	SOLAS. I hope it has now been inserted in expert	14	separates machinery space. What do you say about that
15	bundle 2.	15	suggestion?
16	Item 12D, page 956-5. Regulation 10:	16	A. Could you give me that quote again, please?
17	"A fore peak or collision bulkhead shall be fitted	17	Q. It's within the definition of regulation 7:
18	which shall be watertight up to the bulkhead deck."	18	"An after peak bulkhead, and bulkheads dividing the
19	A. It's subregulation 7, Mr Shieh, under Regulation 10.	19	machinery space"
20	Q. So we'll move on to the next page. Yes, of course.	20	In other words, it could well be argued or suggested
21	"An after peak bulkhead, and bulkheads dividing the	21	that an aft peak bulkhead is something separate and
22	machinery space, as defined in regulation 2, from the	22	distinct from, you know, the type of bulkheads which
23	cargo and passenger spaces forward and aft, shall also	23	separate machinery space, such as the bulkhead between
24	be fitted and made watertight up to the bulkhead deck.	24	tank and engine.
25	The after peak bulkhead may, however, be stepped below	25	A. I understand. In fact, the bulkheads dividing the
	Page 158		Page 160
1	the bulkhead deck, provided the degree of safety of the	1	machinery space from the cargo or the machinery space
2	ship as regards subdivision is not thereby diminished."	2	from the passengers is also a requirement in the
3	So that is the SOLAS stipulation	3	Instructions, which says, "There shall be bulkheads at
4	A. Correct.	4	the forward and after end of the machinery space".
5	Q as to the need for a watertight after peak bulkhead.	5	So those bulkheads are there not necessarily for
6	A. Correct.	6	watertight subdivision, as you are indicating, but also
7	Q. Of course, this does not actually tell you in numerical	7	to prevent all sorts of other events, such as the spread
8	terms how far away the requisite aft peak bulkhead is	8	of fire or to avoid flooding of the machinery space, or
9	required to be from the stern. But yesterday I think	9	to stop noxious gases and the like escaping from the
10	you gave some evidence on the positioning of the aft	10	machinery space.
11	peak bulkhead.	11	The same sort of argument could be applied to the
12	A. Yes, sir, and there is no definition in SOLAS of what	12	aft peak bulkhead, although I wouldn't suggest that's
13	an aft peak bulkhead is, and I believe that is because	13	a source of fire. But as I mentioned yesterday, there
14	it is a very commonly used and accepted term in the	14	is a source of water leakage through something like the
15	industry.	15	shafting for the propeller or the shafting for the
16	Q. I know it may be a rather difficult question. You have	16	rudders.
17	made a comment that a bulkhead which is halfway between		So both of them in the same paragraph, I believe,
18	midship and the transom could not qualify as an aft peak	18	are there because there is a need to delineate between
19	bulkhead because it is too far away from the aft. You	19	the use of the space and the risk of the space from the
20	made a comment on that, because that was Mr Beresford's	20	cargo spaces and the passenger spaces.
21	question of Mr Lo, that a bulkhead which is 57 per cent	21	Q. Thank you. And in the case of the Lamma IV, you
22	of the space between midship and transom could not be	22	mentioned yesterday, in terms of breaches of the ship's
23	regarded as the relevant aft peak bulkhead, and Mr Lo	23	structure, even though the propeller doesn't actually go
24	gave his opinion, and I think you disagreed with him.	24	into the steering gear compartment I think you said
25	A. I disagreed with him, yes.	25	it went into the engine room.

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1	A. Comes through the engine room floor, yes.	1	A. These are the results of a calculation rather than the
2	Q. The rudder does come through the steering gear	2	calculation itself.
3	compartment?	3	Q. Yes, these are the results of a calculation.
4	A. There are two rudders and they both come through, yes.	4	As of 1998 we know that ballast had been added. In
		5	
5	Q. Steering gear compartment?		such a case
6	A. Yes.	6	THE CHAIRMAN: And I think there's a separate factor that
7	THE CHAIRMAN: It's the rudder stock that comes through?	7	you reminded us of earlier: that the weight of the
8	A. It's the rudder stock that comes through.	8	vessel has been increased as well, in addition to the
9	MR SHIEH: So this question about potential breaching of the	9	ballast?
10	structure is not an immaterial one; it is the one that	10	A. Correct, yes, by about 6.25 tonnes, if I remember
11	applies to Lamma IV because the rudder certainly	11	rightly.
12	A. It is a risk because it depends on a mechanical seal,	12	MR SHIEH: But then this calculation well, the result of
13	and mechanical seals can fail, and do fail.	13	the calculation here took that into account as well?
14	Q. But can it be said again, I'm playing the devil's	14	A. Yes.
15	advocate that, "Oh, it doesn't matter because even if	15	č – – – – – – – – – – – – – – – – – – –
16	the rudder pokes a hole in the steering gear	16	door, in other words tank room flooding does mean tank
17	compartment let's say the whole steering gear	17	room flooding only, would have passed the margin line
18	compartment is flooded, it doesn't matter because there	18	submersion test?
19	is this damage stability calculation requirement which	19	A. Correct.
20	actually requires you to assume steering gear	20	Q. But without watertight door, it would have failed the
21	compartment and tank room to be both flooded. So as	21	margin line test?
22	long as that is passed, margin line not immersed, so	22	A. Correct.
23	it's okay. No point making that frame 1/2 watertight."	23	Q. But this is where, again, I would like to test you
24	A. Yes, you're correct.	24	a bit. Passing or non-passing of the margin line test
25	Q. What would you say about that sort of argument, which	25	depends on the result of conducting the relevant
	Page 162		Page 164
1	more or less eliminates the need for an aft peak	1	calculations, one-compartment flooding, and then
2	bulkhead?	2	proceeding on the basis of which is the relevant
3	A. Well, the aft peak bulkheads I suggested should be at	3	compartment; correct?
4	least 10 per cent away because of that extent of damage.	4	A. (Witness nods).
5	However, it's a different criteria. The 10 per cent	5	Q. Again, could it be said, "Oh, it doesn't matter
6	only refers to the situation of a collision. If you put	6	because" now, this is perhaps a little bit long and
7	an aft peak bulkhead at, say, 5 per cent, then it still	7	if you want some time to consider it, perhaps tell us
8	provides that separation of water flooding in through	8	because we're near 4.30. Could it be said, "Oh, it
9	rudder stocks. It's not unusual for vessels to	9	doesn't matter whether or not in fact the absence or
10	accidentally touch the bottom, and in touching the	10	presence of a door in frame 1/2 was spotted or not",
11	bottom, bending the rudder. Many vessels have lost	11	because in 1998, let's say the hypothetical
12	their rudder; water comes in through the hole. It does	12	conscientious Marine inspector realised the 0.1L
13	matter then where the aft peak bulkhead is. It's	13	problem, in other words he realises that the steering
14	immaterial whether it's 10 per cent or 2 per cent; it	14	gear compartment cannot be treated as an individual
15	still protects the rest of the boat from flooding. The	15	compartment for the purpose of calculation of
16	10 per cent only applies in case of accident.	16	one-compartment flooding. This conscientious Marine
17	THE CHAIRMAN: In case of collision?	17	inspector would then say to himself, "Ah, for the
18	A. In case of collision. Sorry, yes. I understand. In	18	purpose of one-compartment flooding, I should treat
19	case of collision.	19	steering gear compartment and tank room merged as one
20	MR SHIEH: Could I then move on to the situation in 1998,	20	and I will calculate the relevant margin line test, and
21	because this, as you said, could be where the	21	it would have failed the margin line test." But that
22	carried-over effect of the failure to spot the error in	22	would have been the case whether or not there is or is
23	1996 would be felt. Could I ask you to look at your	23	not a watertight door, because for the purpose of
24	calculation in expert bundle 2. I think it is the same	24	calculating the one-compartment flooding scenario, door
25	table, page 928.	25	or no door, you just merge the two as one, because this

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1	would be the way people do the one-compartment flooding	1	MR YEUNG: Yes, Mr Chairman.
2	calculation.	2	THE CHAIRMAN: The matter I think we can deal with at this
3	And the Marine inspector, the hypothetical	3	stage is your request for the provision of documentation
4	conscientious Marine inspector, upon spotting the	4	from Cheoy Lee. What is it that you are seeking?
5	failure of the margin line test in 1998, would have sent	5	MR YEUNG: Yes, sir. As indicated in the letter submitted
6	Cheoy Lee or Hongkong Electric back and said, "You	6	yesterday, we ask for all communication between Cheoy
7	failed. Can you sort it out, try to find a way out?"	7	Lee and the Wuzhou Shipyard in respect of the
8	Upon being asked to do this, the problem about	8	construction survey inspection of Lamma IV; the covering
9	failing the margin line test would not and could not	9	letter from Cheoy Lee to the Hong Kong Marine Department
10	have been solved by adding a door.	10	enclosing the survey items list; the survey report
11	A. Adding a door, mm'hm.	11	signed by our client; and lastly, the certificates of
12	Q. So could it then be said that door or no door has no	12	the hull plates for construction of Lamma IV issued by
13	bearing on the passing or failure of the margin line	13	the American Bureau of Shipping.
14	test in 1998, even if a conscientious Marine inspector	14	THE CHAIRMAN: Yes.
15	had spotted the need to merge steering compartment and	15	MR YEUNG: Of course, I'm fully aware of the reply made by
16	tank compartment for the purpose of one-compartment	16	Wilkinson & Grist, saying in effect that there are only
17	flooding? Do you follow the line I'm getting at?	17	two items that are still in their custody, and that is
18	A. I follow exactly your line of argument, yes. And	18	a fax dated 7 April from Vanzon, which was the agent of
19	I believe you are right, that certainly if this	19	the Wuzhou Shipyard, to their client, and there's
20	conscientious Marine inspector had indeed seen that	20	another fax dated 5 September from Vanzon again to their
21	there was a problem with the two compartments flooded,	21	client, enclosing the CCS survey report dated
22	or, if you like, the steering gear compartment flooded	22	6 September 1995.
23	and therefore the space forward also flooded, fitting	23	THE CHAIRMAN: Yes. So in the upshot, what is it you seek?
24	a door would not have solved the problem. So there	24	MR YEUNG: At least the two documents that are listed in the
25	would have needed to have been another solution. In	25	letter of 28 January by Wilkinson & Grist.
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1	that regard, the door is immaterial.	1	THE CHAIRMAN: Yes. We have the CCS survey report, do we
2	THE CHAIRMAN: The problem at this stage is the added lead.	2	not, Mr Pao?
3	A. The problem at this stage is the added weight of the	3	MR PAO: Yes, we do.
4	vessel.	4	THE CHAIRMAN: So what's missing is the fax enclosing it; is
5	THE CHAIRMAN: Yes. Lead plus the extra weight of the	5	that right?
6	vessel.	6	MR PAO: Yes.
7	A. Correct.		THE CHAIRMAN: And that's in your possession?
8	THE CHAIRMAN: And it appears, does it not, that the trail	8	MR PAO: I believe so, yes.
9	not having been left as perhaps it ought to have been,	9	THE CHAIRMAN: That can be provided to the Commission, can
10	as you said earlier, formed the basis of the	10	it not?
11	miscalculations?	11	MR PAO: Yes.
12	A. I believe so.	12	THE CHAIRMAN: What's the other matter, Mr Yeung?
13 14	MR SHIEH: I wonder whether that would be an appropriate	13 14	MR YEUNG: The first fax, dated 7 April 1995, from Vanzon enclosing a draft contract.
14	moment, because I will go on to test the same line by reference to 2005.	15	THE CHAIRMAN: Yes. And you've got that, Mr Pao?
16	THE CHAIRMAN: Yes, certainly.	16	MR PAO: Yes, we do.
17	It's been a long day for you already, Dr Armstrong.	17	THE CHAIRMAN: And you can provide that to the Commission?
18	For your purposes, we'll call it the end of the day.	18	MR PAO: Yes, we can.
19	But we have some other things I want to deal with now.	19	THE CHAIRMAN: Thank you.
20	We will resume with your evidence tomorrow at	20	Now, Mr Yeung, is there anything else we can deal
21	10 o'clock, but you're free to leave the witness box	21	with at this stage?
22	now.	22	MR YEUNG: Yes. We apply, as I indicated yesterday, for the
23	A. Yes, sir.	23	recall of two witnesses.
24	(The witness stood down)	24	THE CHAIRMAN: That's a separate issue. We don't need to
25	THE CHAIRMAN: Mr Yeung, your matter.	25	deal with that now. We don't have anything from you

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1	yet, do we?	1	I N D E X
2	MR YEUNG: Actually, we have provided a witness statement,	2	INDEX
3	but it's in Chinese, to all parties. The English		DR NEVILLE ANTHONY ARMSTRONG (on former oath)1
4	translation is being finalised, and those instructing me	3	
5	are aiming to send the translation out later today or		Examination by MR SHIEH (continued)1
6	tonight.	4	
7	THE CHAIRMAN: Right. When was this material provided?	-	(The witness stood down)166
8	MR YEUNG: Just after lunch.	5 6	
9	THE CHAIRMAN: Right. It certainly hasn't reached me.	7	
10	MR YEUNG: Mr Secretary has a copy, but it's in Chinese.	8	
11	THE CHAIRMAN: Yes. I have a Chinese-reading	9	
12	co-Commissioner; this is not a problem. But it hasn't	10	
13	reached us.	11	
14	So we'll deal with your application when we've got	12	
15	your material.	13	
16	MR YEUNG: Thank you. I'm grateful.	14 15	
17	THE CHAIRMAN: Mr Zimmern, Mr Sussex intimated yesterday	16	
18	that you would be in the final stages, as I understood	17	
19	it, of dealing with an expert report that would be	18	
20	provided to the Commission which is relevant to the	19	
21	questioning of Captain Pryke. Where are we on that?	20	
22	MR ZIMMERN: My understanding, Chairman, is that that report	21	
23	we anticipate will be ready during the course of	22	
24	tomorrow.	23	
25	THE CHAIRMAN: Tomorrow?	24 25	
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1	MR ZIMMERN: Yes.		
2	THE CHAIRMAN: Thank you. Any other matters arising?		
3	MR GROSSMAN: I'm sorry, perhaps something I should ask my		
4	learned friend, but we really would like to know who the		
5	next witnesses are. I think you still have to make		
6	a decision on whether or not Dr Peter Cheng is to be		
7	called.		
8	THE CHAIRMAN: Well, that's going to be partly in the hands		
9	of counsel. I've no idea how long it is such questions		
10	as you might be permitted to ask will take.		
11	All of you, not just you, Mr Grossman.		
12	MR GROSSMAN: Well, I can tell you immediately: no time at		
13 14	all. THE CHAIRMAN: Well that is a matter for sourced and		
	THE CHAIRMAN: Well, that is a matter for counsel, and I leave it to you to discuss it amongst yourselves.		
15 16	10 o'clock.		
17	(4.38 pm)		
18	(The hearing adjourned until 10 am on the following day)		
19	(The nearing adjourned until 10 and on the following day)		
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