SUPPLEMENTAL
EXPERT REPORT

PREPARED BY

DR. NEVILLE ANTHONY ARMSTRONG

Expert Witness appointed by the Commission of Inquiry
into the Collision of Vessels
near Lamma Island on 1 October 2012

16 January 2013

Commission of Inquiry into the Collision of Vessels
near Lamma Island on 01.10.2012

Dr. Neville Anthony Armstrong
Naval Architect of Fastships (Australia) Pty Ltd, Coogee, Western Australia

Introduction

1. Subsequent to the submission of my Report dated 3 January 2013, .further documents and witness statements have become available to me which have led me to add some clarifying opinions in this supplementary Report.

2. Also subsequent to the submission of my Report dated 3 January 2013, I have had obtained further technical clarification and additional information and have reason to amend the diagram in Appendix IV representing the time line for the vessel to sink. This amendment adds a further 16 seconds to the time from the initial collision until *Lamma IV* assumed an approximately vertical position on the sea bed.

Estimate of time to sink, *Lamma IV*

3. I originally estimated the displacement, draughts and trim of *Lamma IV* at the time of the collision during my first visit to Hong Kong on 11th December 2012. This was based upon the vessel characteristics contained within the "approved" vessel Stability Booklet[1]. There were several stability books and damage stability books for the vessel, and I used what I believed to be the latest one for *Lamma IV*, which was approved in 1998 and represented the vessel with additional ballast. On the 15th December 2012 I discovered a later "approved" stability book[2] in a new format which represented the vessel condition after some modifications had been made to the aluminium framework containing the ballast in the Tank Compartment in 2005. This booklet was based on different computer software and included an entirely new set of hull characteristics, known as the Hydrostatic Tables, even though the hull had not been changed in any way. I chose to ignore the added complication of the re-

[1] Stability Booklet for *Lamma IV* with Lead Ballast, 1998
[2] Stability Booklet for *Lamma IV* with relocated lead Ballast, 2005

calculated Hydrostatic tables, particularly as they indicated that the vessel had reduced in weight by over 3.3 tonnes when the ballast framework was added. In my experience, the lightship weight of a craft never decreases unless some substantial modification is made (the weight of a boat always seems to grow with age) and I believed that the cause of the change lay with the use of a different software. Since that time I have calculated the Hydrostatic Tables using my own software, which indicates broad agreement with the 2005 stability booklet, and as a result of that calculation I have chosen to update the calculation of the "time to sink" for *Lamma IV*, and to bring it in line with the lightship values in the 2005 "approved" Stability Booklet. The Hydrostatic Tables in the 2005 book give generally lower values of every coefficient that was used in the calculations compared to those in the 1998 Stability Booklet. The calculated condition of *Lamma IV* at the time of the collision, using the lightship particulars in the 2005 Stability Booklet, is given in Appendix IV, Item 14.

4. In making this change I have also taken the opportunity to improve the algorithm representing the flow of water into the engine room through the diagonal slot that was chocked with debris. The flow through a tall and thin vertical slot is difficult to estimate, and further investigation led me to make a revision.

5. The above modifications make no difference to the vessel sinking, or the impact of the omission of a watertight door in the Aft Peak bulkhead. They only change the shape of the plot of the vessel angle against time, and add some seconds to the estimated time to resting on the sea bed.

6. The revised timeline is given in Appendix IV, Item 15. The time to sink, given in my original Report at Paragraph 38-3 of about 87 seconds from initial contact to the deck at the stern going below the water, has extended to 96 seconds. The time of 102 seconds from the initial contact to assuming a position of 70° to the horizontal, given in my original Report at Paragraph 40, is amended to 118 seconds.

7. As the calculation of the timeline is dependent upon the arbitrarily-chosen "choke factors" which represent the effects of debris from *Sea Smooth* remaining within the holes in the hull, I have also included a second timeline in Appendix IV Item 16 which indicates the effect of choosing other choke factors. In this case the vessel is at

70° to the horizontal and resting on the sea bed in about 111 seconds, indicating a possible range error owing to the amount of debris in the holes of about 7 seconds.

Final attitude of Lamma IV

8. There are various representations of the final attitude of *Lamma IV* after sinking and before salvage, and an explanation of these attitudes is offered to avoid possible confusion.

Phase 1: Consequent to the flooding, *Lamma IV* sank by the stern until the deck edge on the transom went below the waterline. When this happened there was no further reserve of buoyancy and the vessel could only sink further. The trim angle at this point was a little more than 6½°, and this occurred at about 97 seconds after the collision.

Phase 2: The vessel continued to rotate by the stern until the transom hit the sea bed at approximately 118 seconds at an angle of 62°. There are two witnesses[3] [4] who comment about a heel to starboard during the descent. This may have been the result of hydrodynamic forces generated around the hull whilst sinking, or from the rudders which were most likely positioned to one side, or even from the initial contact with the soft mud.

Phase 2a: The vessel settled in the mud to some unknown extent, but I have estimated this as initially 70° based on the depth of water and an assumption as to the depth of mud, supported by the attitude of the vessel illustrated in a photograph owned by the South China Morning Post[5], which shows the initial stages of the rescue by the Fire Services Department.

Phase 3: The vessel further settled in the mud, assisted by the effects of the current and the incoming tide, and assumed an attitude of 90°, as illustrated by the Fire Services Department[6] during the rescue.

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[3] Translation of Statement of Wong Tai Wah, Police Ref L.48 Item 36a,
[4] Translation of Statement of Leung Yuk Chuen, Item 55b
[5] [http://www.scmp.com/news/hong-kong/article/1052603/passengers-aboard-hkkf-catamaran-tell-panic-and-confusion] on 3 January 2013
[6] Exhibit 3 to Witness Statement of Yau Wai Keung (31.12.2012)

Phase 4: Pushed by the current and with a receding tide, the vessel was trapped at an angle of greater than 90°, estimated from photographs as approximately 110°~115°. This attitude is widely presented in the media, but by this time I believe that all practical rescues of passengers had been completed. It is not known how much of the vessel was supported by the mud at this time, as the inside of the cabin has little obvious mud within it when it was inspected and there was little damage in the cabin area and upper deck from lying at the bottom. I can only assume that the vessel had dug a hole in the mud during the previous hours whilst it lay at lesser angles.

Illustrations of these attitudes are given in Appendix IV, Item 17.

Comment on the Report by the Government Forensic Scientist

9. Subsequent to completion of my Report, I have read the Statement of Dr Cheng Yuk Ki, Forensic Scientist at the Hong Kong Government Laboratory[7]. There are no obvious disagreements between the findings contained in the report of Dr Cheng and my own report, and some of the issues raised by Dr Cheng have helped to clarify some items in my Report, specifically:

a) The stainless steel forefoot on the port bow was reported to be missing in my report Paragraph 20. Dr Cheng has annotated his report, paragraph 3.2.5, to state that "*according to Police Information, the metal plating on the port hull of Sea Smooth was reportedly dismantled for maintenance and no substitute was reportedly installed at the time of the accident*".

b) The blue paint smear referred to in paragraph 3.4.4 of Dr Cheng's report, and illustrated in his photograph 20, provides excellent correlation with the sketch included in my Report in Appendix IV on Page 64, being the plan view of the two collided craft at an elapsed time of 2.0 seconds and showing the calculated maximum extent of penetration of *Sea Smooth* into *Lamma IV*. This sketch is reproduced in Appendix IV Item 18, showing the location of the blue paint smear from *Sea Smooth* within the cabin of *Lamma IV*, and thus representing the maximum penetration of one craft into the other

[7] Statement of Witness, Dr Cheng Yuk Ki, Expert Bundle, Item 4

c) Dr. Cheng measured the forces necessary to break the remaining seat in the upper deck cabin from the deck, as indicated in his report paragraph 3.10. I would like to highlight that this may have been the only remaining chair because it had the strongest attachment to the deck, and therefore all the other chairs broke off at a possibly much lower value than the 190 Kg that was measured. A factor that must be considered is that the deck material had varying consistency and physical properties; specifically it was made with internal "shear webs", meaning the foam core of the structure was compartmentalised into roughly 100mm x 100 mm "boxes" by internal vertical sheets of fibreglass. There is no visual indication by looking at the deck where the internal shear webs may be located, and if a seat foundation screw was to be fitted close to or into a shear web it would be able to hold a much larger load. This may be the reason why the single chair foundation was undamaged.

d) In paragraph 5.2 and in his summary at paragraph 6.1 of his report, Dr. Cheng comments that the two boats met at an angle of approximately 30°. I would like to clarify that the measured angle of 30° is not the angle at which the two craft met, because a geometric correction needs to be applied to allow for the relative speed of the two craft. According to my measurements, the angle of the gash in the deck in *Lamma IV* was 30° when taken down the centre of the gash, and at the inboard edge of the gash the angle was 28°. These angles, when considered with the relative speed of the two craft, show that the two boats met at a difference in true heading angle of approximately 41.6°, as discussed in my report in paragraph 15, and not at 30°. The vector diagram is illustrated in Appendix IV Item 19, with *Lamma IV* moving at 11 knots "up the page' and *Sea Smooth* moving at 22 knots from the top left towards the bottom right at an angle of 41.6°. In this case they meet at a combined speed of 31.1 knots and an apparent relative angle of 28°, but the true heading difference was 41.6°.

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Expert's Declaration

I, DR NEVILLE ANTHONY ARMSTRONG, DECLARE THAT:

1. I declare and confirm that I have read the Code of Conduct for Expert Witnesses as set out in Appendix D to the Rules of High Court, Cap. 4A and agree to be bound by it. I understand that my duty in providing this written report and giving evidence is to assist the Commission. I confirm that I have complied and will continue to comply with my duty.

2. I know of no conflict of interests of any kind, other than any which I have disclosed in my report.

3. I do not consider that any interest which I have disclosed affects my suitability as an expert witness on any issues on which I have given evidence.

4. I will advise the Commission if, between the date of my report and the hearing of the Commission, there is any change in circumstances which affect my opinion above.

5. I have exercised reasonable care and skill in order to be accurate and complete in preparing this report.

6. I have endeavoured to include in my report those matters, of which I have knowledge or of which I have been made aware, that might adversely affect the validity of my opinion. I have clearly stated any qualifications to my opinion.

7. I have not, without forming an independent view, included or excluded anything which has been suggested to me by others, including my instructing solicitors.

8. I will notify those instructing me immediately and confirm in writing if, for any reason, my existing report requires any correction or qualification.

9. I understand that:

(a) my report will form the evidence to be given under oath or affirmation;

(b) questions may be put to me in writing for the purposes of clarifying my report and that my answers shall be treated as part of my report and covered by my statement of truth;

(c) the Commission may at any stage direct a discussion to take place between the experts for the purpose of identifying and discussing the issues to be investigated under the Terms of Reference, where possible reaching an agreed opinion on those issues and identifying what action, if any, may be taken to resolve any of the outstanding issues between the parties;

(d) the Commission may direct that following a discussion between the experts that a statement should be prepared showing those issues which are agreed, and those issues which are not agreed, together with a summary of the reasons for disagreeing;

(e) I may be required to attend the hearing of the Commission to be cross-examined on my report by Counsel of other party/parties;

(f) I am likely to be the subject of public adverse criticism by the Chairman and Commissioners of the Commission if the Commission concludes that I have not taken reasonable care in trying to meet the standards set out above.

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Statement of Truth

I confirm that I have made clear which facts and matters referred to in this report are within my own knowledge and which are not. Those that are within my own knowledge I confirm to be true. I believe that the opinions expressed in this report are honestly held.

Dr Neville A Armstrong
16 January 2013

APPENDIX III

Commission of Inquiry into the Collision of Vessels near Lamma Island on 01.10.2012

Documents referred to in this Report

Footnote		Bundle Reference
1.	Stability Booklet for *Lamma IV* with Lead Ballast, 1998	Police P Item 28 pp.4917+
2.	Stability Booklet for *Lamma IV* with relocated lead Ballast, 2005	Marine Bundle 4, pp.667+
3.	Translation of Statement of Wong Tai Wah	Police Ref L.48 Item 36a, pp.352-1+
4.	Translation of Statement of Leung Yuk Chuen, Item 55b	Police Ref L.70 Item 55b, pp.507-1+
5.	Photograph of foundering *Lamma IV* at http://www.scmp.com/news/hong-kong/article/1052603/passengers-aboard-hkkf-catamaran-tell-panic-and-confusion	
6.	Exhibit 3 to Witness Statement of Yau Wai Keung (31.12.2012)	FSD, Bundle 3, Item 2, Exhibit 3, p.652
7.	Statement of Witness, Dr Cheng Yuk Ki	Expert Bundle, Item 4, pp.362+

APPENDIX IV

Commission of Inquiry into the Collision of Vessels
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Diagrams and sketches by Dr NEVILLE A ARMSTRONG, and referenced in this Report

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Appendix IV, Item 14. Condition of *Lamma IV* immediately prior to the collision.

USING 2005 STABILITY BOOK

Assumed pax weight = 70 Kg

Item		Weight	KG		From Fr 0 LCG	
Fuel oil	assume 75%	3.35	1.43	4.791	3.75	12.563
Fresh Water	assume 75%	0.75	1.2	0.900	1.425	1.069
OW tank 1		0.096	0.873	0.084	5.775	0.554
OW tank 2		0.043	0.85	0.037	6.9	0.297
Pax in main cabin	60	4.20	3.642	15.296	9.495	39.879
Pax in upper cabin	30	2.10	6.05	12.705	13.195	27.710
Pax on aft upper deck	37	2.59	6.05	15.670	7.495	19.412
Stores		0.5	1.8	0.900	14.445	7.223
Crew & Effects		0.3	6.0	1.800	11.445	3.434
Deadweight		13.93	3.75	52.182	8.05	112.139
Lightship		60.36	2.273	137.198	8.397	506.843
TOTAL		74.29	2.55	189.380	8.332	618.982

LEVEL TRIM ONLY

Hydrostatic Table data

Draught	Displ	LCB	LCF	TPCm	MCT1cm
1.1	73.555	8.466	9.116	1.17	1.797
1.125	76.49	8.492	9.16	1.18	1.823
Draught to USK	1.106	74.289	8.473	9.127	1.173	1.804

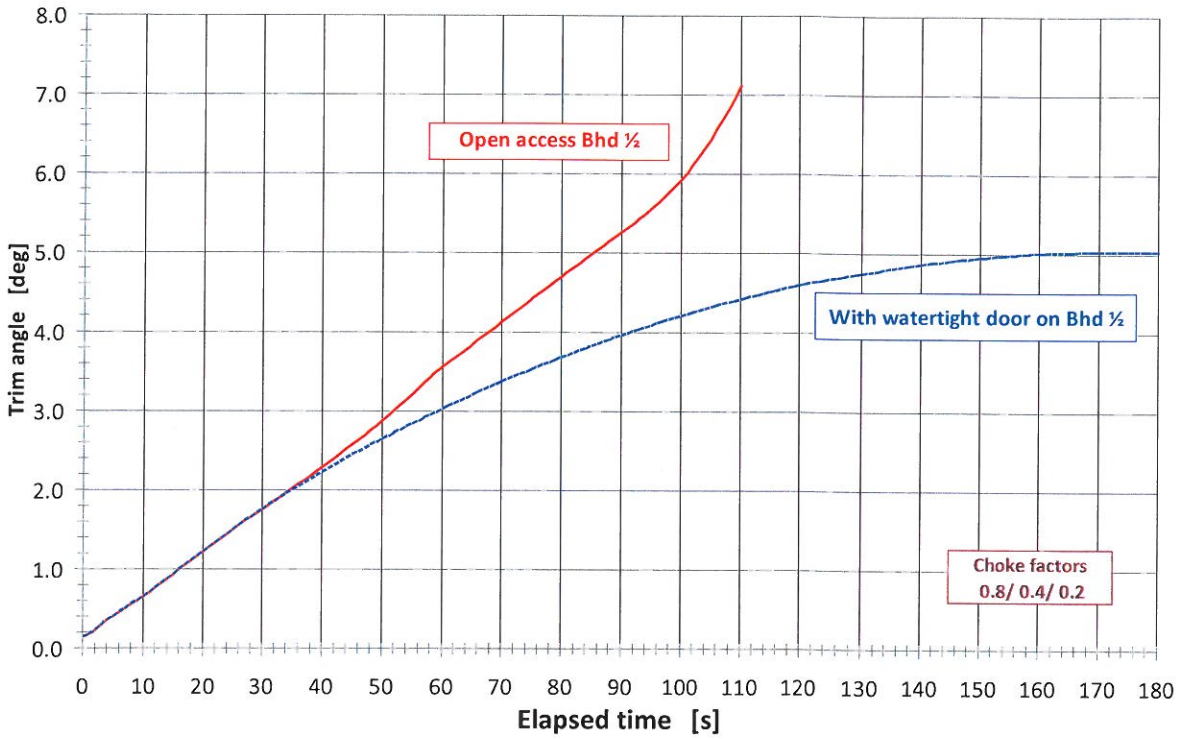
Trim lever	0.140	m
Trim	5.78	cm
Assumed length for hydrostatics	24.89	m

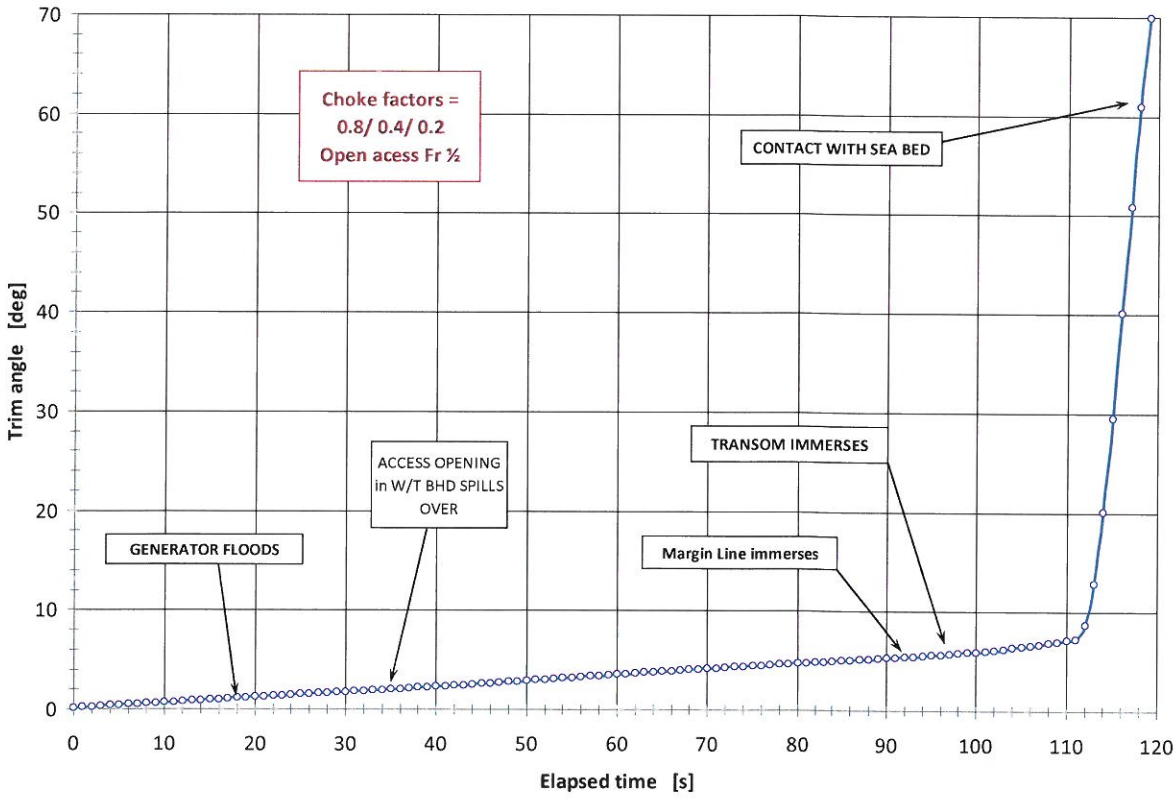
Gives draughts above USK

Fr 19	0.055	1.051	m
Fr 6.0	0.017	1.089	m
Fr 4.50	0.013	1.093	m
Fr 3.25	0.009	1.097	m
Fr 0	0.000	1.106	m

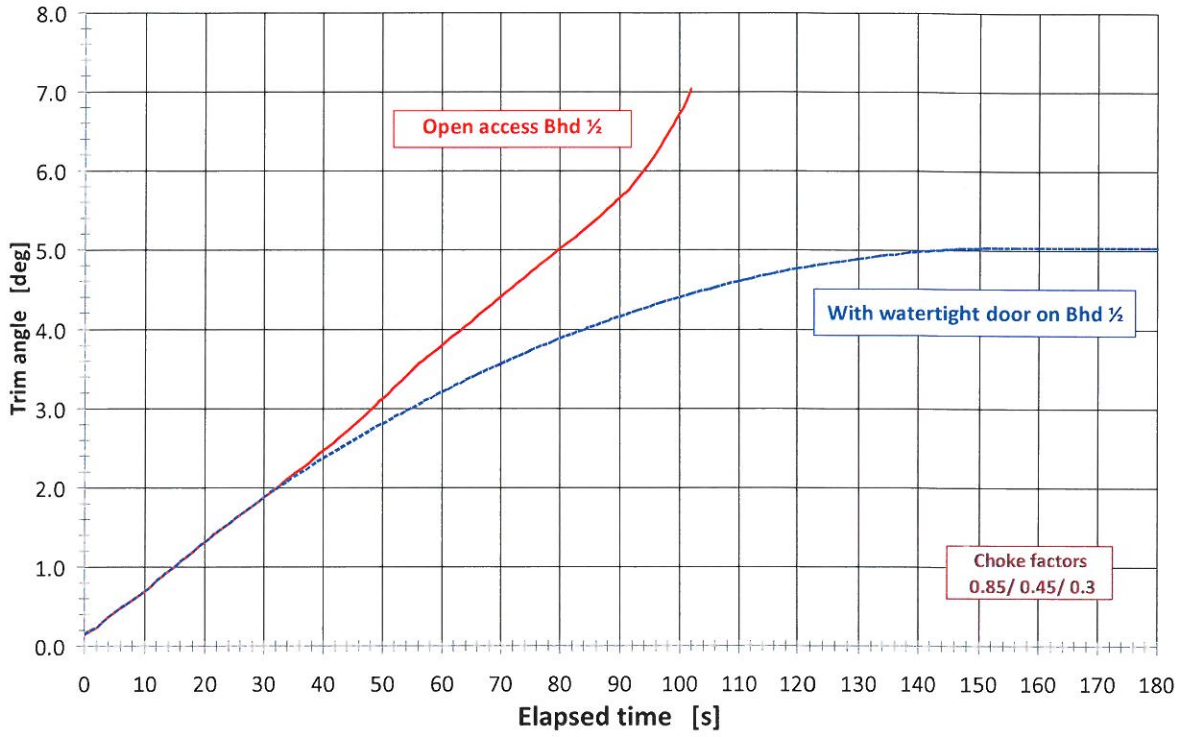
Longitudinal reference is frame 0

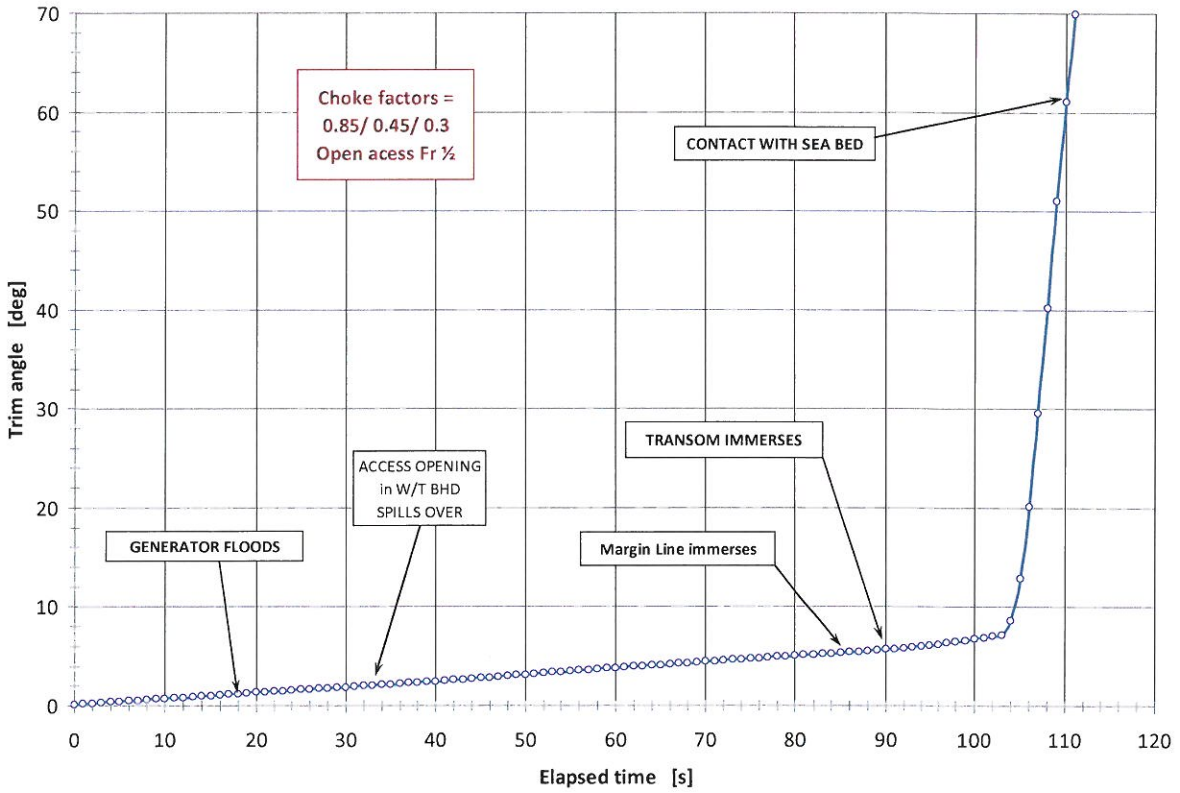
Appendix IV, Item 15. Elapsed time and trim angle, estimated choke factors



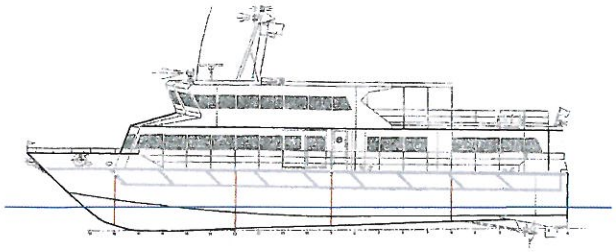


Appendix IV, Item 16. Elapsed time and trim angle, alternative choke factors (higher flow rate)

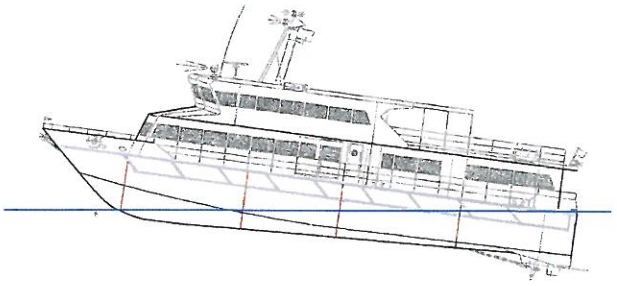




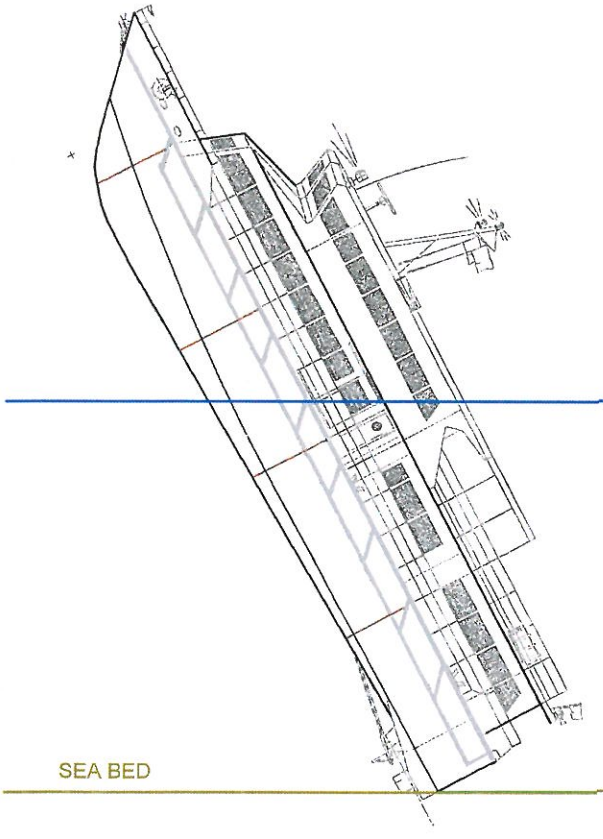
Appendix IV, Item 17. Angles assumed by *Lamma IV* after sinking



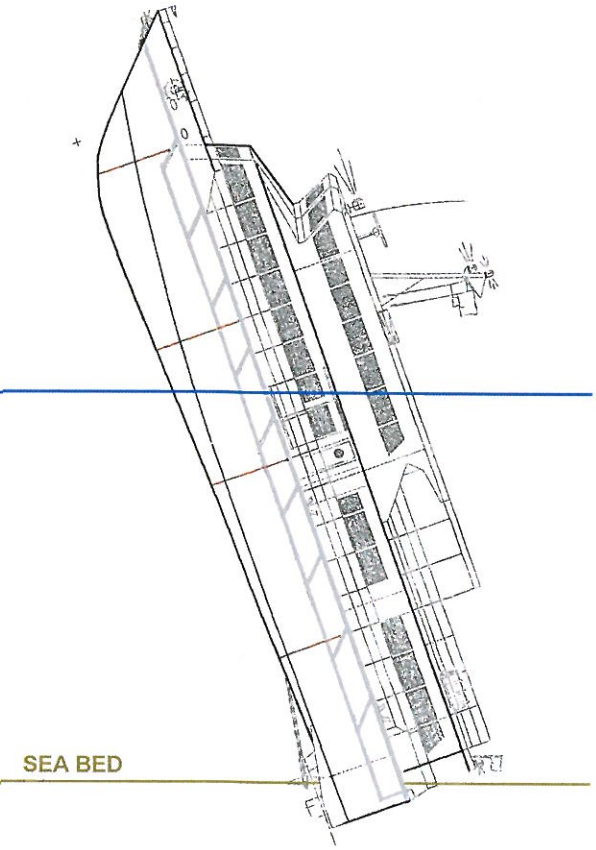
Level trim



End of Phase 1: Transom immersed at 6.5°

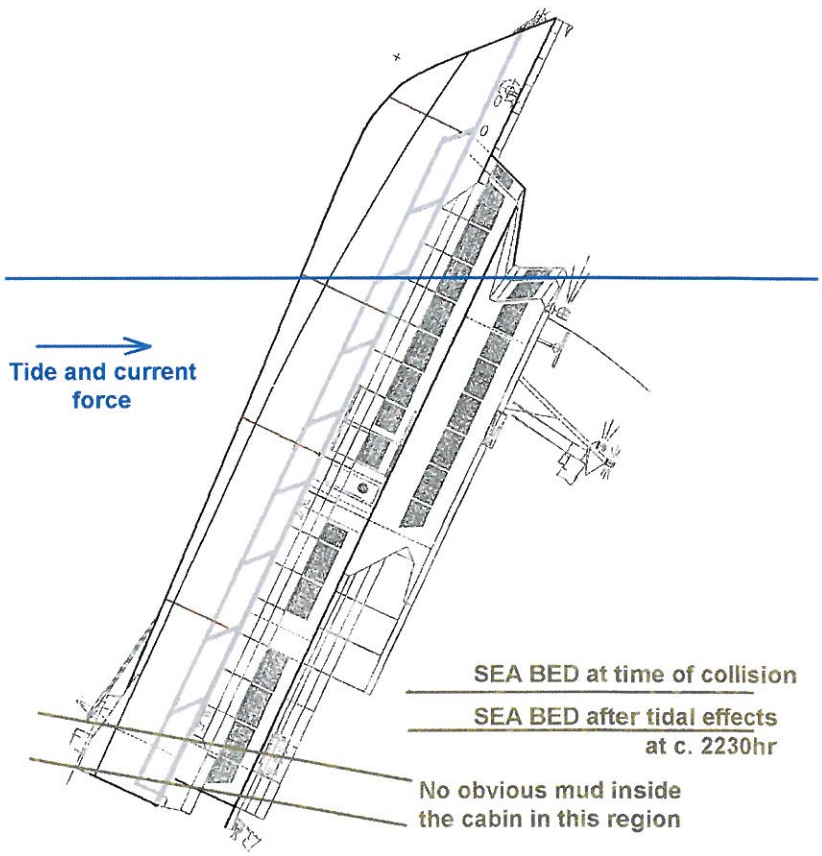


End of Phase 2: Transom in contact with sea bed.



End of Phase 2a: Vessel settles into the mud on the sea bed.

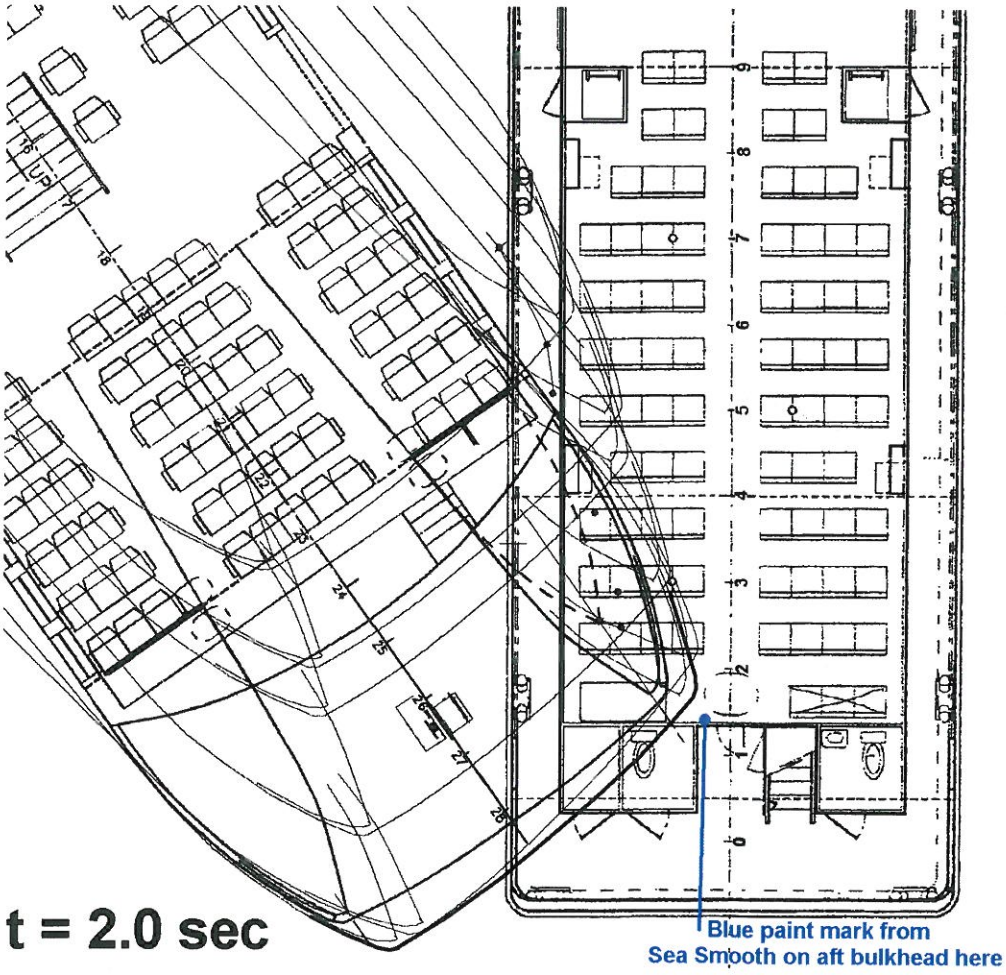
Phase 3 is similar to the first diagram illustrated Exhibit 3, Witness Satement of Yau Wai Keung (31.12.2012).



Final Phase 4.

Appendix IV, Item 18. Forensic evidence of length of penetration of *Sea Smooth* into *Lamma IV*

The following diagram is taken from my initial report, Appendix IV Item 5 after a time of 2.0 seconds from the initial contact. I have superimposed the location where the Forensic Scientist noted a mark matching the paint of *Sea Smooth*, which shows good correlation with the extent of hypothesized penetration.



Appendix IV, Item 19. Difference in true heading angles of the two craft at the moment of the collision

The following diagram is based on a speed of 11 knots for *Lamma IV* and a speed of 22 knots for *Sea Smooth*, and results in a difference in true heading of 41.6°. Other speeds can be solved using simple geometry to give alternative heading angles as listed in my Report of 3 January 2013.