

## **Bourbon Dolphin: Public Hearings Process**

### **Public Hearings of October 24, 2007 in Oslo**

- **Witness No. 1 took the stand:**

Name: Harald Møller  
Date of birth: 2 October 1953  
Address: 6060 Hareid  
Stilling: Deputy CEO, Ulstein Verft

Møller testified that he had been employed in Ulstein since 1980. He had started as a designer and since worked on planning and projects until 1999, when he became sales manager. In 2006 he became deputy CEO, which involves responsibility for sales and project implementation. Møller testified further that they had a small project department whose project manager reported to him. The participants in the projects are appointed to the line, with management for each individual project.

Asked what was the concept behind the A102 design, he replied that it was to build an anchor-handling vessel with good cargo capacity, envisaged for use in operations world-wide. Asked which characteristics were focused on in the design, he testified that there was nothing innovative in the design, but a conventional anchor-handling vessel. At the same time worked out the design X-Bow and built the anchor-handling vessel "Bourbon Orca" in this design, which was a much more innovative design than the A102. He testified further that the calculations done were performed by the design office, and that experience from previous construction projects was also utilised. Geometric models and calculations were prepared before the contract was signed. He testified further that experiential data were also used for weight calculations via the program ShipWeight. They also had a database that inter alia concerned weight follow-up.

Asked about the characteristics of the winch package, he replied that there was nothing special about this winch package as compared with similar designs. Møller testified further that they had a dialogue with Bourbon Offshore at an early stage, but the shipping company/owner did not participate in the development of the design, which was a design they had from before. The contact with Bourbon went via the operations division, inter alia the director of operations. From the Bourbon side the participants were primarily Bjørn Remøy and then Bjørn Bergsnes to follow up. Asked when Bergsnes had left Ulstein, Møller replied that he was uncertain. Møller testified further that the owner was focused on capacities, crew comforts, safety on deck and so forth. The owner wanted the winch package to be the same on the "Orca" and the "Dolphin", with a pulling power of 400 tonnes. The winch they ended up with was slightly different from the A102 design.

There were no changes in the design in consequence of the order from Bourbon Offshore. Hull shape, engines, cargo tank capacity etc. were more or less unchanged, and generally the vessel was an entirely conventional anchor-handling vessel. Asked whether he was aware of design changes along the way, he replied that there were some changes in the chain arrangement, but only minimal ones. Asked further whether they used the database program for weight calculations, Møller replied that there were two areas they fill up, namely weight of steel and equipment weights. This is a tool with a database that follows the vessel throughout the phase. They had good control of the weight of steel, but the equipment was rather harder to keep track of.

Møller testified further that stability calculations were done in the phase before the vessel was launched, so as to achieve an overview of both weight of steel and the fact that the equipment had become rather heavier, but weights were also followed up throughout the construction phase. In May the provisional stability calculations were performed. Asked about when they became aware that the vessel had become heavier than planned, he replied that they became aware of it along the way, but not until the launching did they realise how heavy the vessel was, heavier than the provisional calculations. Møller also testified that no adjustments of the vessel were made in consequence of the increase in weight. The Commission stated that at one point the cover over the winch package was removed, but Møller replied that it had to have been removed at an earlier stage and not in consequence of the weight increases. Asked whether there were other factors they discovered along the way, Møller replied that there was nothing special that he could recall. Møller thought he remembered that the winch package on the "Dolphin" was rather different from the basic concept in the A102 design, which Møller assumed could be related to the weight, and that is why the winch was heavier. Møller stated that the weight increase was communicated to the affected parties (the authorities and the owner).

Asked about the date of delivery of the vessel, Møller replied that the original delivery date was 7 July 2007, but that this was postponed. The reason for that was a late hull delivery, about a month, and in addition the main engines were eight weeks delayed. In addition, that was the summer holiday season. Asked when it was decided that delivery should take place in the autumn, Møller replied that they decided that delivery should take place some time after the holiday, and he think they scheduled the delivery for the end of September or the beginning of October.

The Commission stated that the roll test was on 20 August, and asked whether the vessel was then complete. He answered in the affirmative and testified further that it was not unusual for up to six weeks to elapse from the roll test to delivery of this type of vessel. He thought he remembered that only 1.3 % of the weights were not on board during the roll test. These were by and large only mattresses, furniture and pictures on the wall. Asked what routines they have for follow-up of the lightship weight, he replied that all divisions and subcontractors supply weights that are then included in the computer program (ShipWeight). For the weights that are not present for the roll test they include estimates. Møller also stated that it is the Norwegian Maritime Directorate that decides whether a roll test can be taken.

The Commission noted that there are tank sensors and asked whether they were placed pursuant to the drawings, but Møller was not certain how this ended up, and replied that he had to check it and come back to it. Asked whether the sensor readings were checked against manual readings, Møller replied that would have to check that and get back to it.

The Commission then asked questions as to why the vessel became 250 tonnes heavier between May and August. To this Møller replied that it was due to errors in calculation of the preliminary weights for the equipment, and not that any extra weights were inserted subsequently. He testified also that weights could be located anywhere in the vessel. Asked whether the stability characteristics were addressed in the light of this weight increase, Møller replied that he assumed so, but did not recall. The weight of steel they had under control, but the equipment weights were more uncertain.

The Commission showed Møller a table of three Ulstein designs in which data were obtained from stability books, and GM was set up in lightship weight. The Commission explained that there were some discrepancies for the "Dolphin" with regard to both fuel, transverse centre of gravity and safe workload for the winch. Møller testified that he was not familiar with the Commission's calculations.

Møller testified further that there was a yard trial on 16 September, a technical trial on 19 September, and a test of the bollard pull on 30 September. The FMEA test was on 29 September. Asked whether the vessel had a high degree of roll, about 20 degrees, under the turning test, he replied that they test in extreme conditions and that such a roll is not unusual. As far as Møller knew, no measures were considered in consequence of these tests.

The Commission also noted that the vessel had her capacity reduced, inter alia the deadweight was reduced by 300-400 tonnes, and that deck cargo was reduced by 200-300 tonnes. Asked when these discrepancies were discovered, Møller replied that it was not until after the roll test that the final figures came up. He could not recall stability characteristics being a topic of discussion at meetings with the owner. Asked what compensation applied under the contract, he testified that it was standard conditions that included deadweight and bollard pull, but not deck cargo. There is also a clause on delivery date. The owner was compensated for reduced deadweight and delayed delivery.

The Commission referred to the fact that the shipyard's homepage still states a deadweight of 2500 tonnes, he replied that they would correct the information. Asked whether the deck cargo capacity of the "Dolphin" deviated from that of similar vessels, Møller replied that in the Nineties they build two similar vessels that had about the same deck cargo capacity as the "Dolphin". He also stated that no more vessels of the A102 design had been sold, but Møller considered that there was nothing wrong with the design as such. He testified that there were no big claims from the owner, and that they seemed content. Asked whether there was documentation of the project, he replied that they had all the documentation at the office, and that the Commission can have access to it.

There was a break in the testimony.

After the witnesses Strand and Hareide had testified again, Møller was called back for follow-up questions. Asked by the Commission whether Ulstein was ISO-certified, he replied that they had a quality assurance system, but that it was not ISO-certified. Asked then how the quality assurance system handles stability calculations, Møller replied that he did not know. Nor did he know whether there were quality assurance procedures that dealt with stability calculations over and above the minimum requirement in the regulations.

Attorney Lund Mathisen enquired whether Møller had been involved in evaluation of the design and stability after the accident. To this Møller replied that there had been an evaluation by Ulstein Verft and Ulstein Design, but that he himself had not been involved. He testified that a group had been appointed that was to undertake an evaluation, but that he had not seen any report from them. He did not know who was in the group, nor whether any report had been prepared.

Attorney Lise Siverts referred to his previous testimony regarding claims in connection with settlement of the vessel, and asked whether the originally agreed price had been reduced. Møller answered in the affirmative, that they were compensated for inter alia deadweight and delivery time. He testified also that there were no material residuals at delivery.

Attorney Lesley Gray noted that the A102 design was based on the A101 design and that there was a difference in beam [respectively 17 and 20 metres] and he was asked whether this difference was taken into account in the development of the A102. He replied that the A102 design was a separate design, but that it was a clearly smaller vessel and that to begin with the design was meant for a customer other than Bourbon. This other customer was Farstad Shipping, which they hoped to get a contract with, and it was a project for a vessel that was to go to the Orient. Farstad wanted a vessel to perform anchor-handling operations, but which also had to have good cargo capacity. The latter was necessary because she was to be used for PSV too, but the design was for world wide operations. Asked whether the

PSV function affected the anchor-handling function, he answered that this was not the case, other than that there was more equipment under deck and a bigger cargo system than if she had been a pure anchor-handling vessel. Nevertheless, this was not at the expense of the anchor-handling capacities. Asked by Gray whether it was difficult to find a balance between the two functions, he replied that it did not offer any problems, but that it offered certain challenges. Asked by Attorney Gray what were the consequences of the differences between the two designs and the change of criteria, for example the winches, and whether this put restrictions on the use the vessel, Møller replied that there were big differences between vessels with beams of 17 and 20 metres, and that this was taken into account in design and construction of the vessel. Asked how it affected the stability, he replied that stability would have been different if the vessel had been broader.

Attorney Lund Mathisen asked why the design was not delivered to Farstad, and Møller replied that it was because Ulstein was NOK 3 million too expensive.

By way of conclusion the Commission asked about dry bulk tanks. Møller testified that the A102 had these, but that none of the four vessels delivered to the A101 design had. Asked whether ballast capacity was materially different between the two designs, Møller replied that did not know.

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After Møller had read through the record, he wanted to make the following addition:

Page 3 second paragraph, first sentence:

This is wrong. The specifications say 800 tonnes. The final capacity was 740 tonnes. That is, a reduction of 60 tonnes in deck cargo.

▪ **Witness No. 2 took the stand:**

Name: Tor-Kåre Hareide  
Date of birth: 9 July 1962  
Address: Ulsteinvik  
Post: Senior Engineer, Ulstein Design

Hareide testified that he had worked for Ulstein Verft from 1987 to 2004, and at he then started work in Ulstein Design. Ulstein Design and Ulstein Verft are two different companies in Ulstein Group. Hareide stated that he had been working mostly with stability calculations since 1995. He testified that in the initial phase of a project they draw a general design, and his job is to do the stability calculations on that basis. There are three persons in the company who work on stability, and Hareide was only involved in the design in the phase before Bourbon Offshore ordered the "Dolphin".

He testified further that he acted as a team leader for those working with stability in Ulstein Design. Asked whether they follow a template when setting up stability calculations, he testified that they had their own template, and that there are no requirements for conditions for anchor-handling in the regulations. They first create initial arrival and departure conditions with a little forward trim, in which they have 10% fuel and freshwater in the arrival condition. They then put a load on the stern roller so that the vessel gets a stern trim and a list. Then they check intact and damage stability and the weather criterion for every load condition against relevant criteria. The GM for every condition is then checked against the limit curves they have calculated. The template they use means that they have a load they lay vertically. The centre of gravity for the vertical force does not follow a standard. He testified that some choose to put in on top of the stern roller, and others prefer to lay it rather lower. He himself usually puts the centre of gravity on top of the stern roller, and the transverse point he usually puts at the end of the stern roller, depending on the location of the towing pins.

Asked whether the conditions he uses depend on extreme or limit conditions, Hareide replied that they usually ask how much wire is to be used on the anchor winches when they take account of the loading on the stern roller. If wire is placed on other drums, it affects the loading they can get on the stern. It is not realistic to have maximum wire on all drums at the same time as maximum load on the stern roller. The conditions are advisory, and it is difficult to draw up exact conditions since they depend on how much wire is on the various drums. He testified also that there no requirements in the regulations for preparation of conditions for anchor-handling, nor are these conditions approved by the Directorate. It is ballast conditions, maximum deck load and tow conditions that are approved by the Directorate. It is therefore more of an operability assessment that is employed when he calculates conditions and that conditions for anchor-handling are examples of how they can be, and that they must insert into the load calculator the weight of the wire on the winches and the content of ballast tanks before they can calculate how much load they can have on the stern. Asked whether they have communication with the crew regarding anchor-handling conditions, he testified that they did not usually get any feedback from the crew on the anchor-handling conditions. Hareide testified further that certain customers wanted a certain wire capacity and they adjust conditions pursuant to this. Often, too, they check conditions after delivery. Hareide testified further that after the roll test they prepare final conditions. Asked whether the method they use to put conditions together was a shipyard standard, Hareide testified that he thought so, and that they ran the load conditions in the same way as they did before the previous Ulstein group was acquired by Vickers and later Rolls-Royce. When they run calculations for a new vessel, they compare with previous conditions for other vessels.

Asked what characteristics are often focused on by the customer, Hareide replied that it was bollard pull and winch pulling-power. Bollard pull would not affect the stability calculations,

but the winch pulling power would have significance. Asked which challenges a vessel faces if it is to be a supply vessel (PSV) or an anchor-handling vessel, he testified that on anchor-handling vessels there is a great weight up in and on the anchor-handling winch, and that a PSV without a winch is therefore a stiffer boat. Hareide testified that a PSV will often be too stable, so that they must use roll reduction tanks when they have little deck cargo. He testified further that water ballast tanks are usually located midships, and also forward and aft so that they have three possibilities for changing trim or draught of the vessel and also a possibility if she rolls a little sideways. Hareide also testified that the quantity of water ballast was in conformity with the need for volume for cargo.

Asked what was the purpose of that part of the stability book called "Instructions for Masters", he testified that it was the instructions to the master about what he should pay attention to, and that they have inserted applicable stability criteria and information about roll reduction tanks and deck cargo. They have a standard template for a stability book to which additions can be made as required. Hareide stated that it is the same general description/template that is used for all designs. The Commission showed Hareide the Regulations of no. 695 15 September 1992 (the Building Regulations) Section 8, 13<sup>th</sup> paragraph, which state that "stability information shall be prepared that in a rapid and simple manner enables the ship's master to have precise guidance about the ship's trim and stability under differing sailing conditions". Asked how he interpreted this provision of the Regulations, Hareide testified that it means that the master must have all necessary information in order to use the manual. He noted also that there were several chapters in stability manual that concern instructions to the master, including Chapter 11 (limit curves) and Chapter 13 (roll reduction tank) that are specific to the vessel, but that "Instructions for Master" are general. The manual has a total of 16 chapters, in which reference is also made to the regulations.

Hareide was then shown the Regulations' Section 13 sixth paragraph, which makes requirements about the preparation of instructions on the use of roll reduction tanks. Hareide testified that these are described in Section 3.7 and Chapter 13. There is nothing in the manual to suggest that the roll reduction tanks ought not to be used in anchor-handling operations, since there is no requirement for anchor-handling conditions, but they never put the use of roll reduction tanks into the anchor-handling conditions. Free liquid surface, however, and that one will have a reduction of GM and the calculation of this, are discussed in the manual. Asked whether they had amended the template after the accident, he testified that the same template was used, but that they have complied with the emergency measures taken by the Norwegian Maritime Directorate just after the accident.

Asked what situations he would regard as most stability-critical for the vessel, Hareide replied that those who use the vessel would be able to answer that, and that he did not want to speculate about it.

Hareide testified further that he had no role related to quality assurance (QA/QC) along the way in the construction process. They divide the projects among themselves and he was then working on other projects. In the shipyard they had routines for quality assurance in relation to weight via a programme called ShipWeight. Both this programme and launching allows them to control both displacement and weight. The shipyard does not, however, have a routine for the calculations undertaken by the case officer being checked by someone else, since the Directorate and DNV will check the calculations.

He testified that in the conceptual part the project manager will get input from various disciplines, for example electrical and mechanical engineering, stability etc. Hareide himself had no direct contact with the owner in this job, but the project manager did. Asked whether deck cargo capacity and deadweight for the "Dolphin" were the same as for equivalent vessels, Hareide replied that they did not have a basis for comparison from other projects in

Ulstein, and that he had no opinion about whether the capacity of the “Dolphin” different from that of vessels with similar main dimensions.

The Commission noted that the weight was 250 tonnes higher than in the preliminary stability calculations, and asked whether the stability characteristics were subject to evaluation in consequence of this, but Hareide was not involved in this phase and did not know what was done after the roll test. The only thing he was aware of was that the vessel became heavier.

The Commission showed Hareide a table from three Ulstein designs in which data were obtained from stability books, and GM was set up in lightship weight. The Commission explained that there were some discrepancies for the “Dolphin” both with regard to fuel, transverse centre of gravity and safe workload for the winch. Hareide testified that he was not aware of the calculations, but testified that Dolphin was 17 metres wide, whereas the “Orca” was 18.5 metres and ULSTEIN A101 20 metres. He himself had only done calculations for ULSTEIN A101. Asked whether he had any comments on the fact that the transverse centre of gravity for the inner towing pin was 0.5 meter and that the shark-jaw was outside this restriction, Hareide replied that he had no comments, since he had not performed the calculations. Nor could he answer as to whether the shark-jaw could be used in a safe manner when it was outside the limit.

The Commission noted that First Officer Bjarte Grimstad visited the shipyard in March 2007, but Hareide did not then meet him. He was aware that Grimstad wanted a review of the stability book, but Hareide did not know why Grimstad wanted such a review. It is, however, not unusual for officers to visit the shipyard in order to undertake a review of the stability manual.

Asked whether Ulstein had made a review of the stability of the A102 design, Hareide replied that he was not aware of it.

There was a break in the testimony.

After the witness Strand had testified, Hareide was called back for follow-up questions. Attorney Morten Lund Mathisen asked whether Hareide had been involved in checking the roll test report. Hareide replied that he could not recall having made such a check. Lund Mathisen also asked whether he had been involved in follow-up after the accident, and Hareide then replied that he had looked at the calculations that Strand had prepared, inter alia control conditions. Hareide did not remember there being any problem areas.

The Commission then asked what quality assurance Hareide had as leader of the stability team. He testified that they prepare conditions that must meet the criteria in the regulations. Asked by the Commission whether they look at the operational conditions under which the vessel will be used, Hareide replied that they focus on the stability satisfying the requirements of the regulations. The Commission asked whether the stability was sufficiently addressed when one has to restrict work within the inner towing pins, given that the vessel has a stern roller with a broader attack point. Hareide had no comment on this condition, but testified that the crew had a load calculator that they had to use to check conditions and the loadings. If the quantity of wire is reduced, they can also have greater weight aft on the stern roller. Asked whether operability was addressed if the capacity of the winch cannot be used over the supposed working area on the vessel, Hareide replied that the person using the vessel must ensure that the vessel is used within the restrictions.

Attorney Horneland noted that only one vessel had been built in the A102 design and asked on what previous concepts the design was based. This, however, Hareide could not answer. Nor could he say whether it was based on previous designs at all, but they did not have equivalent designs from Ulstein. Asked how long he had worked in Ulstein, he replied that he

had worked for 20 years for Ulstein Verft and Ulstein Design taken together. He had also been working in Ulstein when parts of the activity were sold to Vickers. Asked by Horneland whether restrictions were laid on development of the design, he replied that Ulstein could not sell its design until a period of five years had elapsed. Hareide testified further that they could develop new designs and build vessels to them, but could not sell designs to others until the five years had passed.

The deputy group president in the Ulstein Group, Tore Ulstein, was present and testified that the A102 design was based on four AHV designs and that the A102 concept was more or less the same. To the second question about sale to Vickers, Ulstein testified that it is correct that they had a limitation period of five years in which they could only build their own designs. After five years they could build designs from anywhere. They could develop designs and build to their own designs, and after five years they could sell the designs to others.

Attorney Lise Siverts referred to the table that the Commission had prepared and showed to Hareide previously, and asked what Hareide could say about the expected stability of the "Dolphin" in relation to the two other vessel types. He did not know how much wire was on the winches, and the Commission stated that it was 130 tonnes. Asked by Attorney Siverts what the main difference was between the designs that involved these differences, Hareide replied that the A101 was three metres wider and thereby could manage greater loads. He also noted that the "Dolphin" was a smaller vessel with less capacity, and this was something that the crew had to related to, so that they did not exceed the limit curves. Asked by Siverts why they made such a small vessel as the A101 design, Hareide replied that it depended on what the owner wanted, and there are anchor-handling vessels that are smaller than the "Bourbon Dolphin".

Attorney Lesley Gray asked what restrictions there might be for a vessel that was 17 metres in the beam as opposed to one that was 20 metres. Hareide replied that in order to answer that question he could have do calculations and compare them. He noted also that the people at the shipyard had load conditions for the A101 design. He also testified that the owner had to determine how the vessel was to be used in relation to forces and so on. Asked about what Bourbon informed Ulstein with regard to use of the vessel, Hareide replied that he assumed that the owner was given information about the vessel's capacity. He testified also that it was the owner who orders capacity for the vessel and that the people on board had to use the load calculator to see what limits are applicable. H also replied that project concepts are developed that owners can evaluate. Asked who was involved in the development of the A102, Hareide replied that he did not know, but that he could check.

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After Hareide had read through the record, he wanted to make the following additions:

Page 2 second paragraph, second sentence.

Bollard pull will not affect the stability calculations for anchor-handling conditions, but for towing conditions it will have an effect pursuant to the towing criteria. The winch pulling power will also have significance.

Page 3, fifth paragraph.

The question was misunderstood by Hareide. After the accident the stability manual for the ULSTEIN A102 design and the calculations therein were reviewed.

▪ **Witness No. 3 took the stand:**

Name: Per Gullik Strand  
Date of birth: 30 January 1976  
Address: P.O. Box 179 Ulsteinvik  
Post: Ship's engineer, Ulstein Design

Strand testified that he had been employed in Ulstein since 1997. His job is to perform stability calculations, and the company has a group of three persons who are working on it. The two others are Hareide and Gasparovic. In this work with the "Bourbon Dolphin" he reported to project manager Roar Riise. Strand testified that he was involved with calculations and follow-up from when the contract was signed to the roll test, and that he inter alia prepared provisional stability calculations. He also prepared final stability calculations and documentation after the roll test. Weight calculations are not performed by him, but by other individuals at the shipyard, but he has the follow-up of these in relation to the roll test.

Asked what were the biggest stability challenges for a vessel that is to be a combined platform supply vessel (PSV) and anchor-handling vessel, for example in relation to capacities such as cargo, fuel, winch of a certain size, etc., Strand testified that they receive a specification of what the customer wants that they try to satisfy, but that it is difficult to give a general answer to the question, as it will depend on what kind of boat it is. Asked whether there were any particular stability challenges with the "Bourbon Dolphin", Strand answered that the only thing was that the roll test showed a different vertical factor than the provisional calculations, but that the stability nevertheless satisfied regulations. He testified further that the cargo mark was determined by freeboard standards.

Asked with whom he collaborated in the shipping company/the owner during the construction process, Strand answered that it was the project manager who had the contact, and as far as he remembers it was particularly deadweight that was discussed with the owner. There were no changes that were discussed with the owner, as far as Strand was aware. Asked whether the cover over the winch was removed at a certain point, Strand answered that he could not recall it.

Asked whether anyone checked his calculations, he replied that control was exercised by the authorities and classification society at a later date, but that in this case he had Hareide go through the roll test report.

Strand testified further that they made departure/arrival conditions in order to cover a spectrum of among other things fuel and freshwater on board, and that chainboxes were to be calculated with 98 % water ballast during anchor-handling conditions. This is because the deck hatches will be open during the operation and be filled with water. Asked about the capacity of the winch, he testified that they enter the vessel's maximum capacity permitted within the regulations.

Strand was then asked what challenges they saw in the preparation of the anchor-handling conditions that were set up. To this Strand testified that the challenge in all such boats is to get as much cargo/loading on the boat as possible while at the same time satisfying the regulations. He testified also that if one is to increase pulling power one must take away something else, either by reducing the quantity of wire on winches, reducing deck loading, and that this is an interplay between forces. Asked what anchor-handling operations he would regard as the most stability-critical, for example deployment of anchors, recover of anchors etc., Strand answered that it depended on the operation, but that they add a vertical

loading on the stern roller with a certain attack point in relation to the boat and they add what they can manage within the regulations.

Asked whether deadweight and deck cargo capacities were different on the "Dolphin" than on other similar vessels, Strand answered that he had not calculated for similar vessels of the same size, nor did he know the capacities of competing designs. He was then shown the preliminary stability books from 31 May 2006, and was asked when they are normally prepared. He testified that they are prepared when the most relevant data are complete, for example the tank arrangement, what loads they can be exposed to, and estimated lightship weight and centre of gravity. They count on provisional stability conditions before the preliminary stability book is prepared, and if they get great discrepancies from the information received from the shipyard, new conditions are prepared. New conditions were made for the "Dolphin" in consequence of updated weight calculations. He testified further that they get weights reported from departments at the shipyard, for example steel, electrical engineering, mechanical engineering, equipment etc. The weights he used in the preliminary stability book were not based on reported weights, but were a provisional estimate that was prepared in the program Ship Weight and was based on certain factors such as weigh coefficients, volume calculations and experiential data. As the component weights are verified, the information is entered in a more and more reliable weight report.

At launching one gets the real provisional lightship weight, and the last report from the shipyard prior to launching showed 3,000 instead of 2,950 tonnes, which was not dramatic. At the launching in June/July the figure was 3,130, as far as he recalls.

Asked whether the weight increase that emerged from the roll test led to their making new evaluations in relation to stability, he replied that when one has obtained an approved result on the roll test, this is the formula for the final lightship weight upon which the stability book is based. Strand testified further that there was no discussion about the stability characteristics. They were still within the regulations. He stated that the final stability manual was prepared after the roll test.

Strand testified further that it was he who had drawn up the "Instructions to Master" in the stability manual, and that this was made in conformity with the template that the company employs. The instructions in this manual were the same as for other vessels. It was not vessel-specific, which is not required by the regulations either. The manual itself was moreover in accordance with the regulations.

The Commission showed Strand a table of three Ulstein boats in which data was obtained from stability books, and GM set up in lightship condition. The Commission explained that there were a number of discrepancies for the "Dolphin", as regards fuel, transverse centre of gravity and safe working load for the winch. Strand pointed out that these vessels were not similar, as regards neither displacement nor beam, but the Commission noted that it was not the figures in themselves that were interesting, but the principles for them. Strand testified further that safe working load (SWL) of 400 tonnes on the winch was something they managed to achieve on the provisional calculations, but when the lightship was found to have a less favourable weight and centre of gravity on the roll test, they had to reduce the winch power. As regards TCG he testified that it corresponded to the wire being between the two inner towing pins and would be stopped against the top flange of the towing pin. He referred to a letter he sent to the Directorate in which he asked for approval for such a solution. Asked whether this was a deviation for normal practice for set-up of conditions, Strand answered that it was something he felt he had to do if the vessel was to achieve the capacities the owner wanted, and that the TCG values applicable were variable from boat to boat. Asked what was the basis for the fuel quantities for arrival and departure, he replied that the conditions should have 10 % on arrival in relation to departure. He also testified that anchor-handling conditions were not subject to approval and that, in order to achieve a GM

he thought was good enough, in this case he had a little more fuel than what was normal in relation to regulations as regards the conditions that were subject for approval. What he set up were example conditions. The reason for this was that he filled up fuel oil (FO) in the centre tanks up into the vent pipe, so that there was no free liquid surface. This is why there was more fuel on board in these example conditions. Asked whether fuel consumption was in line with what is normal for an anchor-handling vessel, Strand answered that he also prepared conditions where one has 10 % FO, which satisfied the regulatory requirement, but he wanted, as he said, a better GM.

He would send over the conditions showing 10 % FO to the Commission. He did not, however, have the conditions showing safe working load of 400 tonnes on the outer towing pin. According to Strand, there were no conditions showing safe working load of 400 tonnes on the inner towing pin either, if the wire quantity etc was to be realistic.

Asked whether he had an opinion about why there are regulations on stability, he replied that it is so that the vessel can have a satisfactory stability and in order to address safety for cargo and crew. The Commission noted that in this case stability had been calculated vis-à-vis the inner towing pin, and asked whether Strand knew where the shark-jaw was placed. To this Strand testified that the shark-jaw was placed a little further out on the side, and that with a load of 300 tonnes on the stern roller the shark-jaw cannot be used, as the loading is calculated vis-à-vis the inner towing pins, but again said that this was an example condition.

Asked further by the Commission whether he thought that it was an element for those using the vessel that the equipment fitted, including the shark-jaw, could be used, Strand answered that a vessel is exposed to many conditions and that all of them should be tested against the loading in question and the GM value, which is done by using the stability manual and the load calculator. Strand was accustomed to prepare conditions that were real for the operations for which the vessel was to be used. Asked whether there was reason to believe that in an anchor-handling operation there can only be vertical forces lying 0.5 metres from the centreline, Strand answered that there was not, but that there is no requirement in the regulations for preparation of anchor-handling conditions. He also testified that given the condition in question that he prepared, the vessel was safe and within the requirements of the regulations. Strand did not know what was GM with 10 % fuel and 400 tonnes on the winch, but thought that the GM was within the limit curve.

The Commission showed Strand the Regulations No. 695 of 15 September 1992 (the Building Regulations) Section 8, 13<sup>th</sup> paragraph, which stated that "stability information shall be prepared that in a rapid and simple manner enables the ship's master to have precise guidance about the ship's trim and stability under differing sailing conditions". Strand was then asked to what degree restrictions on anchor-handling operations, such as use of towing pins, need for fuel and load on the winch, were addressed in the stability book, and whether this information could rapidly be obtained. Strand testified that one must familiarise oneself with the ship's stability by checking the relevant condition against the limit curve, and they have the load calculator which means that they easily acquire information about stability, and that the load calculator is a simple and quick way of checking the individual condition. The load calculator is connected to a tank sounding system, and it is easy to lay in weights on deck and the loading on the boat. The Commission noted that "Instructions for Master" did not contain information about anchor-handling operations, ballast routines, or instruction in the use of roll reduction tanks, and asked whether this was satisfactory. Strand agreed that such information ought to be contained in the stability manual, but said that the design of the manual is based on a template used by all the big consultancies, and that the manual has been approved by the Directorate and DNV for many years. Asked whether Ulstein had changed its standards for the stability book after the accident, Strand answered that they had taken account of the emergency measures from the Norwegian Maritime Directorate and that they were now engaged in preparing extended instructions for roll reduction tanks and ballast

water. They will also be writing more generally about use of for example cranes and anchor-handling.

The Commission noted that First Officer Bjarte Grimstad was at Ulstein and had talked to Strand about the "Bourbon Dolphin", and asked him to amplify what was discussed. Strand testified that Grimstad, on his own initiative, had phoned him and asked whether he could have information about the load calculator and the stability manual. Grimstad did not raise any problems about the vessel, but was more interested in further information about the vessel. Questions of fuel, deck cargo or deadweight were not discussed, but they talked a little about liquid surface effect.

Asked whether he heard from Grimstad during the visit regarding the vessel's characteristics, Strand answered that Grimstad said that the vessel had good characteristics and was a "good workhorse" and that there were no problems with the vessel. The ability to take on board deck cargo was not mentioned, nor was the incident off Mongstad. He remembered that Grimstad had mentioned that on one occasion the vessel had heeled over on her side because a pump had not been shut off.

Asked whether they had a review of the A102 design after the accident, Strand answered that they held a review of factors they might have overlooked, the stability manual etc., but that they had not found anything that could have been done differently. Strand testified that they could have asked for a lighter boat with a lower centre of gravity, and that it would have been nice to have had a smaller winch, but that it was thus the vessel had been specified and bought for the purpose. Strand regarded the vessel as good enough in relation to the regulations.

The Commission referred to the roll test that was performed on 20 August. Strand testified that the sum of uncertain weights, including both weights that were on board and weights that were not to be on board after the roll test, should not exceed 2 % of the lightship weight, and they took their point of departure in a lightship weight of 3,150 tonnes, and 2 % of that is about 60 tonnes. They then saw that there were 1.3% weights that were not taken on board, which was within the requirements.

Asked whether they performed any assessments when the roll test showed a GM of 0.29 in lightship condition, Strand answered that there was of course the basis for the final stability calculations. This was not an abnormal GM, and Strand also referred to the fact that the vessel had negative GM in lightship condition. He also referred to the fact that there were other anchor-handling vessels with a lower GM, and that the GM was lower because of heavy deck cargo, for example winches. Asked whether the content of tanks was measured and calculated, Strand answered that they empty in advance tanks containing water that ought not to do so, but that they had filled up the water ballast tank for the roll test, which was checked by putting a hose down into the vent pipe on deck, and it was checked throughout the roll test, so that they did not get any contribution from free liquid surface. They measured fuel with a riser and found out its precise volume and weight. Draught was measured by means of a pole lowered into the water, and they measured draught around the entire vessel. Freeboard measurements were also undertaken. Asked whether the tank sensors were checked on installation, Strand testified that a drawing had been made for their placement, and that people had been sent in who measured precisely how they were located after the building, before sounding tables were prepared. It was measured manually, and they checked that different systems showed the same.

The Commission noted that there appeared to be a detailed list of deductions and additions of weights from the roll test, and Strand said that the list could easily be obtained. Asked how weights that were to be taken on board were checked, Strand answered that he followed

them up. He was also the smoke-diver on the project with the "Bourbon Dolphin" and accompanied the sea trials. He himself saw which weights were taken on board.

Asked whether he perceived it as being the case that the Norwegian Maritime Directorate approved the entire stability manual, including the "Instructions for Master", Strand answered in the affirmative.

He was also asked about the roll of 20 degrees they experienced during the sea trial, but stated that as far as he knew the roll was 17.2 degrees. He explained this in terms of the fact that they performed extreme tests during sea trials, and such rolls can then arise. On that occasion there was a load condition of 5 metres and a GM of 0.98. That was the highest GM achievable with that draught (it was 5 metres that had been specified in the contract for speed measurement) and with the FO available on board at the time of this trial. Asked whether the roll could be explained, he replied that they had not expected such a roll. It was a rather low GM, but approved by the Directorate.

Asked whether he discussed inner and outer towing pins with Grimstad, Strand answered in the negative. He also testified that if the outer towing pins had been used, they would have had to reduce the deck cargo or the towing power. Strand testified that everyone who uses anchor-handling vessels knows that if you exert a stronger force on the boat in one field, you must reduce somewhere else. It is an interplay between forces. Strand testified further that they can lay in an initial roll on the vessel, and the load calculator will be tested against all IMO requirements and load conditions, and are the same requirements that they have in the stability manual. Strand also testified that the load calculator would light up red or green. There are three indicators that in principle light green: a VCG margin, a margin in relation to bending moments and shear forces. The load calculator also performs a check with regard to reduced GZ area.

Asked whether he had any opinion about why the vessel capsized, Strand answered that he did not, and that this was what the Commission was to find out. When the Commission insisted that it would be interesting to hear Strand's opinion, Strand said that the vessel had been exposed to something for which she had not been designed.

There was a pause in the testimony.

Attorney Lund Mathisen asked Strand who had supplied the load calculator that was on board. To this Strand testified that it was a firm called Coast Design, which had supplied a program called Autoload, based on Autoship. Lund Mathisen referred to load conditions 16 and 17, and these parts of the stability manual were shown to Strand. On page 195 it says stern roller 300 tonnes SWL, and a ZM of 6.47, and Strand was asked how this figure was calculated. He testified that it was a pure vertical force that had to be calculated from the point at which the wire leaves the ship, and in this case this point is 6.47 m over the baseline. That is some way down the roller. The Commission asked whether they had considered laying the centre of gravity closer to the pendulum centre, but Strand noted that this was a standard method of making conditions. Attorney Lund Mathisen asked also about towing conditions (L20 and L21) where 10 and 20 % were used, but this is not done for anchor-handling conditions. Strand did not understand what these percentages related to. He guessed, however, that they related to 10 % fuel. According to Strand, 20 % fuel was never mentioned.

Strand testified that he could have included this in the stability manual also for anchor-handling conditions, but that he wanted to show conditions with a higher GM instead, which he felt he could do, as these conditions are not subject to approval. Lund Mathisen also referred to what Strand had testified earlier, that the vessel was good enough with regard to the regulations, and he was asked whether he regarded the "Bourbon Dolphin" as a good

vessel. To this Strand testified that Ulstein built vessels in conformity with the regulations, and that a good vessel is in principle one that is conformity with regulatory requirements. Lund Mathisen referred to Strand's earlier testimony that in calculation of conditions 16 and 17 on transverse ship forces they used the inner towing pins, and that he then put more fuel in order to get a better (higher) GM, and that one had to go down on something so as to achieve the other. Strand testified that there were a number of forces on a hull and a lightship and that there can be a number of combinations, and not all of these can be covered in the stability manual. That is why the load calculator is used. Strand also referred to the fact that the stability manual says that conditions shall be checked up against the load calculator in order to find the stability in question. For that reason Ulstein supplies only example conditions that are fairly representative, and that are the maximum of what the vessel can manage under given preconditions. In conclusion, Lund Mathisen asked whether it was more important for Ulstein that the vessel satisfied regulations than that they built a useful anchor-handling vessel, but Strand did not agree with that suggestion.

Attorney Horneland asked whether the use of roll reduction tanks was discussed at the meeting with Bjarte Grimstad, but he could not recall it. Nor could he remember the owner raising it. On the other hand, he had received feedback to the effect that the vessel was very pleasant to be on board at sea, which could be due to correct use of the roll reduction tanks. Strand testified further that all conditions had to be checked up against the load calculator and if this showed that the roll reduction tanks could be used, then they could go ahead and use them. Horneland noted that Transocean's experts had studied the stability manual, and not found a load condition where the roll reduction tanks could be used. Strand did not think that this was correct, and referred to condition nr. 2.

He testified further that they used max deck cargo in their conditions and if one filled the roll reduction tanks one cannot take on board max deck cargo and still be within the regulations, and they do not make such conditions. But the roll reduction tanks could be used in given conditions. Horneland then referred to a departure condition with fuel at 529 tonnes with an arrival condition of 460 tonnes, which means that one can use 69 tonnes fuel in an anchor-handling operation before the fuel runs out, which corresponds to about two days' operational use. Strand confirmed that this was correct in this example, but also testified that he had made other conditions with the same preconditions as otherwise, apart from there being 10% fuel. The only difference then is that one gets a smaller GM, but it will still be within the regulations.

Asked by Horneland whether the vessel could then be used for anchor-handling, Strand answered in the affirmative, and said that she would then have 53 tonnes of fuel on board on arrival. Attorney Horneland then asked whether there were conditions in which it was possible to use the vessel as an anchor-handling vessel with a consumption of more than 69 tonnes of fuel; Strand answered in the affirmative.

Attorney Nordby referred to e-mail that Strand had sent to the Norwegian Maritime Directorate which stated that in practice the wire would always be placed between the towing pins on the stern, and noted that the shark-jaw was outside the inner towing pins. Nordby asked whether the wire would always be within the towing pins when shark-jaw was in use, but Strand testified that it depended on what kind of operation the vessel was performing. Asked by Nordby whether they had considered moving the shark-jaw in consequence of this, Strand answered that it had not been considered. He also referred to what he had testified earlier, that there are so many factors that play a role and that in a normal case the vessel will never come up to 300 tonnes. Strand then confirmed that it would be necessary to use the shark-jaw in an anchor-handling operation.

The Commission asked whether Strand was familiar with the operations of anchor-handling vessels. He then testified that he had not been on board an anchor-handling vessel during an

operation, but only on tow tests and sea trials. In addition he has talked to the crew and gotten their experiences. The Commission asked further whether he thought that the crew would have been happy if they had known that the vessel could not have used the 300 tonnes on the winch for which she was designed, and referred also to witness testimony from survivors about there being read off a tension of 330 tonnes.

Strand agreed that this was overloading. The Commission pointed out that it was not a factor under the control of the crew during an operation.

Attorney With asked whether the owner had many any complaints concerning stability or anything else. Strand denied that any complaints had been made regarding stability.

Attorney Craig referred to his previous testimony to the effect that his calculations were considered by others at the shipyard and asked who these were. To this Strand testified that it was Terje Våge and Arild Breivik.

Craig also referred to his testimony that the results from the roll test were audited by anyone at the shipyard. Strand confirmed that the roll test result was considered and controlled on an Excel spreadsheet, but that no discrepancies were found.

Craig also referred to his testimony that there were other vessels with a lower GM than the "Dolphin", and Craig wanted to know the names of these vessels. Strand noted that there were six vessels belonging to the shipping company Swire that had been ordered a few years ago. All these vessels had very low GM in lightship condition. How low, Strand did not know. Strand then testified that at the meeting with Grimstad they did not discuss anchor-handling in particular, but reviewed the stability manual and the load calculator.

Attorney Nordby referred to the "Instructions for Master" that Strand had previously testified were the same as in other stability manuals. Attorney Norby also stated that the movement of the wire of 0.5 metres from the boat's centreline was unusual, and asked whether there was a simple way for a master coming on board to rapidly familiarise himself with such a major limitation. Strand referred yet again to the fact that it depended on what forces were acting on the vessel, and that it had to be checked on the load calculator in each individual case. There were no other restrictions than this.

Attorney Lise Siverts asked what reviews were performed after the accident. To this Strand testified there was something the whole organisation went through, both Ulstein Design and Ulstein Verft. They wanted to see whether there could be anything wrong with the vessel, not just related to stability. Most people in the company were involved in the review. On the stability side this included himself, Hareide and Kamsvåg, and they made suggestions. In Strand's opinion it was a good review. Siverts then asked about the meeting with Grimstad and what was Grimstad's purpose in seeking Strand out. He then testified that Grimstad contacted him privately and on his own accord, and asked him whether he could spare an hour to look at the stability manual and the load calculator, so that Grimstad could get more information about this.

Asked by the Commission whether they had any written documentation in connection with the review of the accident, Strand answered that he was not aware of this.

Attorney With asked about the capsize point for the "Dolphin". Strand testified that on a general basis there was no fixed capsize point and that everything varied with different stresses. Asked by the Commission whether it was between 15 and 25 degrees, Strand answered that it was impossible to say.

Supplementary comments:

Re page 1 paragraph 4 on control of calculations, Strand wanted to add that conversations about the work were made continuously with the others working on stability, on an informal basis.

Page 2 paragraph 2 on the lightship weight. As a supplementary point, Strand wished to add that the vertical centre of gravity is never known before the result of the roll test.

Page 2 paragraph 3 regarding new stability calculations in consequence of the increase in the lightship weight: Strand wanted to add that he made conditions based on the final lightship weight in order to check how they related to capacity and stability requirements. In addition, Strand would add that the stability characteristics were discussed with the shipyard, as is apparent inter alia from the e-mail from Riise to Remøy dated 30 August 2006.

Page 2 paragraph 4 regarding "Instructions to Masters" in the stability book. On this point Strand wanted to change his testimony. It is not Strand who prepares any of the "standard chapters" in the stability manuals. Strand wanted also to point out that this instruction was a part of the manual prepared by BAS Engineering in collaboration with old Ulstein (now Rolls-Royce).

Page 3 paragraph 1 (continuing from page 2) regarding fuel weights: Strand wanted to add that since the GM was good enough with 10 % fuel, Strand regarded this as illustrating that by filling up the centre tanks in this way, one got a higher GM with a very simple device.

Page 3 paragraph 2: These conditions of 10 % fuel and 300 tonnes (which are the correct figures according to Strand) were sent to the Commission on 29 October.

Page 3 paragraph 2 on a load of 400 tonnes: Strand wanted to add that the point was precisely to go down to a condition of 300 tonnes.

Page 3 paragraph 3 on use of the shark-jaw when the load is against the inner towing pins, Strand wanted to add that when one has load between the inner towing pins the shark-jaw cannot be used. This applies irrespective of the weight of the load.

Page 3 penultimate paragraph (about load condition with 400 tonnes): Strand wanted here to amend his testimony. Due to a misunderstanding it was said that the GM was within the limit curve. It was, however, only in rather unrealistic situations that one achieved an approved GM with a load of 400 tonnes (see mail from Riise to Remøy of 30 August 2006). These were not, therefore, included in the stability book. 300 tonnes on the inner towing pin (with the FO quantity as in the stability book or with 10 % FO) is the loading that lay within the regulations and followed from the stability book. This was also the load that Strand used in his condition. That was the reason why this condition was included in the stability book, and not a condition with a load of 400 tonnes.

Page 3 last paragraph regarding "Instructions to Masters". Strand wanted to add that information about roll reduction tanks and ballast routines was dealt with in other parts of the stability book.

Page 5 third whole paragraph: Strand wanted to add that MaxVCG could be compared with our GM limit curves in Chapter 11 of the stability book). When a whole report is run (direct calculation vis-à-vis IMO requirements) the calculator will take account of initial roll. The indicator for MaxVCG, however, takes as its only point of departure that list is equal to zero. In addition, Strand wanted to add to this paragraph: This follows from the IMO requirements. The user can check the ship's stability vis-à-vis the IMO requirements directly, by running the calculation/report in the load calculator. Checking against minimum GM (MaxVCG) is done continuously by the load calculator.

Page 6 paragraph 2, question from Attorney Horneland. Strand wanted to point out that conditions L2 and L3 (ballast on arrival and departure) make use of the roll reduction tanks (RRT). Strand wanted further to point out that 529 tonnes fuel is not the vessel's maximum fuel capacity with regard to fuel. Strand would also remind them that this is only an example condition.

Page 6 paragraph 3, question from Attorney Horneland: Strand wanted to point out that conditions sent by Strand as an attachment to his e-mail of 29 October 2007 were examples of this.

Page 6 last whole paragraph (question from Attorney Nordby). See commentary to page 3 paragraph 3 above.

Page 7 first paragraph (continued from the previous side), question from the Commission: Strand wanted to add that the vessel could be loaded with 300 tonnes in such a manner as is exemplified in the stability manual. On these preconditions, however, the shark-jaw could not be used.

Page 7 fifth paragraph, question from Attorney Craig. Strand clarified that Våge and Breivik worked on weight calculations. Strand's calculations, which were on stability, could therefore not be checked by Våge and Breivik. The possible cause of the result from the roll test, on the other hand, was evaluated by these individuals. In addition, the roll test report was checked by Tor Kåre Hareide as previously explained.

▪ **Witness No. 5 took the stand:**

Name: Ole Morten Fureli  
Date of birth: 10 August 1976  
Post: Senior Engineer, The Norwegian Maritime Directorate  
Address: Haugesund

Fureli testified that was trained as a chartered engineer and that he started work with the Norwegian Maritime Directorate in May 2005. He worked in the cargo ship division, and Frøydis Gaarder is his immediate superior. Fureli's area of responsibility was stability and load line. Fureli testified that his role as case officer was to go through stability calculations. This is done in two rounds, both during provisional and final calculations. The final calculations do not take place until after the roll test. The Commission referred to the fact that the roll test was on 20 August and Fureli testified that the final stability calculations were approved on 2 October. Asked whether he had been case officer for anchor-handling vessels previously, he replied in the affirmative. He was asked to amplify about the procedure for the stability manual. Fureli then explained that the approval is based on the regulations. They do not use checklists for the approval.

Asked whether he discovered anything in particular regarding the content of the load conditions in the preliminary stability manual, Fureli replied that he did not recall. In the final calculations there was an increase in the lightship weight, which was a little unusual. There were also changes in other conditions. Asked whether he noticed anything special with regard to capacities such as deadweight and deck cargo, Fureli replied that he did not remember having reacted to the values as compared with those of other vessels. He was then asked whether he looked at the load conditions for anchor-handling, despite their not being subject to approval. Fureli testified that everything that is written in the stability manual is looked at, but that these conditions are examples for the crew, and that the Directorate does not look at them carefully.

The Commission noted that the Directorate's approval letter was very specific what was approved and what was not, and Fureli stated that if there was a condition that did not satisfy the regulations, this would be noted explicitly. Asked why the Directorate did not approve anchor-handling conditions if they seemed satisfactory, Fureli replied that this was the way the Directorate had decided to do things.

Fureli testified further that he looks to see whether the loading conditions satisfy the regulations, but that he does not look for anything in particular over and above this. The Directorate assumes that the anchor-handling conditions are real and thereby applicable in practice. The Commission noted that there will often be one or more factors that have a limiting effect on stability, and Fureli was asked whether he remembered any such factors in this case. He could not recall any, but noted that experience showed that maximum deck cargo conditions were often close to the applicable requirements. In the case of the "Bourbon Dolphin", the departure condition is close to the area requirement of GZ max. Fureli replied that he had noted that there were consumption tanks with free liquid surface effect.

The Commission showed Fureli a list of three designs from Ulstein in which data were fetched from stability books, and GM set up in lightship weight, and asked whether Fureli had any comments on the figures. He testified that he did not notice that there were so great discrepancies as shown by the table. He had no particular opinion about whether a GM of 0.29 in lightship condition was startlingly low. Fureli focused on the rule conditions, and referred to what he had previously said about assuming that the anchor-handling conditions were real.

The Commission referred to a letter from the Directorate dated 22 October 2007 and that one was aware that fuel oil is meant for use and not for ballast, but noted that there was a large quantity of fuel oil that was intended for stability reasons. Fureli testified that he noted that there was little difference between fuel in the departure and arrival conditions and that this was a narrow time window. Asked how the low level of fuel oil should be understood in relation to the fact that there was so much fuel oil on arrival, Fureli replied that these were example conditions and that an anchor-handling vessel would be unlikely to be employed close inshore. Fureli also testified that low fuel oil tanks have a ballasting effect.

The Commission showed Fureli a transcript of 15 September 1992 No. 695 (the Building Regulations) Section 8, 13<sup>th</sup> paragraph, which states that “stability information shall be prepared that in a rapid and simple manner enables the ship’s master to have precise guidance about the ship’s trim and stability under differing sailing conditions”. Fureli thought that the “Instructions for Masters” on supply ships had very little vessel-specific information. Fureli was also shown Section 15 sixth paragraph and the requirement for preparing roll damp instructions. He testified that such instructions are rarely prepared for supply ships, but that it was apparent from the load conditions. Fureli noted that it was usual to prepare such instructions on fishing vessels and cargo other than supply vessels. He had investigated practice in the Directorate as regards roll damping instructions, and discovered that this regulatory requirement had not been enforced since 1997. He thinks this is because such vessels usually have load calculators in board and because there are so many ways to load an anchor-handling vessel that it is difficult to formulate general instructions. Asked whether in retrospect he could see any critical stability factors on the “Bourbon Dolphin”, Fureli replied that it was hard to say. The Commission noted that it can be difficult to put together load conditions, and wondered whether it was more difficult to find operational conditions that met the requirements. Fureli referred to what he had said earlier, about the existence of strong guidelines for use of fuel oil.

Asked whether there had been a review of stability after the accident, Fureli replied that he was not aware of it and that he had not participated in such a review. The Commission noted that the final stability calculations showed that they had been prepared and checked by the same person at the shipyard [Per Gullik Strand], but Fureli did not have any opinion about whether such a practice was normal or not.

The Commission referred to his testimony that it was common practice for supply vessels at the “Instructions for Master” were general and not vessel-specific, and wondered whether Fureli saw any danger factors in such a practice, or that information that should have been there was lacking. Fureli testified that the rule conditions were emphasised in the approval letter and that “Instructions for Master” were on another level than the stability calculations and had to be seen in context with the safety management system. Fureli was also asked to amplify what he meant by “example conditions”. He testified that this was information to the crew about possible use of the vessel and that this is entered in the stability book. To further questions from the Commission as to whether Fureli had any opinion about why there are checks of the stability manual, Fureli replied that it is an international requirement under the Load Line Convention and other regulations, and that it is important to map such an important factor as the vessel’s stability. The Commission noted that it was important that the basis on which stability was calculated was more or less identical, that the crew, which often works on different vessels, finds them familiar, and that the attack points over the entire stern roller can be used in anchor-handling operations.

After the witness Nerem had testified, Fureli was called back for follow-up questions.

Asked by Attorney Lund Mathisen whether the Directorate had its own model to calculate stability, Fureli replied in the negative. They had a paper transcript of input to NAPA, which

Ulstein uses in their stability calculations, but not in an electronic format and they have no computer tools to help them.

Attorney Craig asked about the Directorate's checking of the load conditions. Fureli testified that they always check the load conditions that are obligatory under the regulations. If a condition is sent in, they check, for example, that the conditions satisfy the GZ curve.

Attorney Siverts referred to the e-mail dated 22 August 2006 in which Strand writes that in practice one would always place wire between the inner towing pins and that the wire can maximally move 50 cm from the centreline. Siverts asked what Fureli thought of the e-mail. He replied that they discussed the e-mail within the Directorate with others who worked with stability, and they arrived at the answer written in the fax of 31 August 2006. Siverts then asked whether the shipyard was in the process of stipulating requirements that could only be met if the wire went through the inner towing pins, and thus be an erroneous precondition. Fureli noted once again that anchor-handling conditions were not subject to approval.

Attorney Nordby referred to the e-mail of 22 August that referred to a telephone conversation between Fureli and Strand, and asked what had been said. Fureli could not recall in detail what was said, but remembers that it concerned the "Bourbon Dolphin", which is not directly stated in the e-mail. Nordby also asked whether it was normal that there was a limitation to the effect that the wire had in practice to go through the inner towing pins. Fureli replied that he was not sufficiently familiar with the matter to give a general answer to the question.

...

After Fureli had read through the minutes, he wanted to make the following additions:

Re page 1, second paragraph, last sentence:

It was said here that these were checked against the intact and damage stability criteria.

Re page 2 first paragraph third sentence:

In practice we can discuss whether we can do anchor-handling with low fuel oil stocks. This because after completion of anchor-handling one is in all probability not close to land and it is obvious that one must have fuel oil to return to port as well.

Re page 2 first paragraph fourth sentence:

"Low" shall here be understood in relation to placement over the keel, and not geometric design. This was the conclusion from a statement by the Commission.

Re page 2 second paragraph, fourth sentence:

The formulation is not clear. An alternative formulation is "but this is apparent from the load conditions".

Re page 2 third paragraph, first sentence:

Here I misunderstood the question. I was aware that the stability documentation of the "Bourbon Dolphin" was reviewed again, shortly after the accident, in the Norwegian Maritime Directorate – by individuals who had not been involved in the approval process.

Re page 2 fourth paragraph, second sentence:

"Instructions to Master" are in practice standard texts to be found in the templates in the approval programme. Vessel-specific instructions are in practice assumed to be addressed through the safety management system.

Re page 3 second paragraph, third sentence:

One checks that the GZ curve satisfies the requirements for intact and damage.

▪ **Witness No. 4 took the stand:**

Name: Frøydis Kristin Gaarder  
Date of birth: 2 January 1961  
Post: Deputy Director, The Norwegian Maritime Directorate  
Address: Oslo

Gaarder testified that she was deputy director for the cargo ship division, which is responsible for approval of cargo ships. The division has about 20 employees. She graduated as a chartered engineer at the then Norwegian Institute of Technology [*now NTNH, the Norwegian University of Science and Technology – Translator*] in 1985 and had worked in the Directorate since 1986. Gaarder testified that an approval process begins with a notification of a newbuilding via the Directorate's local station. Via the local station a request is submitted for inspection with an appended general design. The station forwards this to the head office. In this case the local station was Ålesund. She testified further that the approval process in the Directorate is divided up into various disciplines, such as stability, hull, engine, load line, fire, navigation and rescue equipment. The great majority of areas on a ship are subject to approval to a greater or lesser degree, depending on the agreement made with the classification society.

The division of labour in this case, which was a NOR ship, is that the traditional class areas such as hull and engine and load line are approved by the classification societies. The class also issues an IOPP (International Oil Pollution Prevention Certificate). Gaarder testified that pursuant to the regulations an anchor-handling vessel falls into the category of cargo ships. She testified further that an AHV is perceived as a series vessel and as a variant of a supply vessel. There have been many such vessels certified by the Directorate. Several anchor-handling vessels are approved in the course of a single year.

The process in this case began around Easter 2005. In June 2005 the Directorate sent a standard letter with comments on the construction process to the shipping company (the owner). They based themselves on the vessel being used as both a supply ship and an anchor-handling vessel. Gaarder testified further that they started a continuous procedure in various disciplines. It is normal for correspondence to flow back and forth between the divisions and her task is to make sure that incoming letters are answered and that there is an overview of the process. She could not recall anything in particular about this process. She testified that there are always questions along the way in a process, but she could not recall anything special about this one.

The Commission referred to the Regulations of 15 September 1992 No. 695 (the Building Regulations) and Gaarder was asked why no specific stability requirements for AHV were made, for example in the form of load conditions for anchor-handling. Gaarder testified that special needs must be identified if a new regulatory system is to be prepared, and she was not aware that any such need existed for anchor-handling vessels. Asked whether it was not the case that anchor-handling vessels faced special stability challenges, Gaarder testified that after the accident the Directorate had prepared some emergency measures that pointed to special factors related to anchor-handling. Asked whether the lack of regulatory requirements gave the shipyard greater room for discretion, she testified that the Directorate's requirements are minimum requirements, and that the yard can build to higher standards than the Directorate's regulations.

Gaarder was shown Section 12 first paragraph of the Building Regulations, which states that a vessel must be built in such a way as to have sufficient stability to avoid listing in all relevant load situations, and she was asked to comment on the provision. She testified that the Directorate does not involve itself with the exercise of discretion on the part of the shipyard. She testified further that in the stability book there are load conditions that are

subject to for approval, and load conditions that are not. Asked what is subject to approval, Gaarder referred to a letter from the Directorate to the Commission dated 25 September 2007.

The Commission referred to Section 6 of the Building Regulations, which states that IMO Res A 469 shall be followed as shown by the individual sections. To this Gaarder testified that if a provision makes no reference to the Resolution, it is not obligatory to follow it. In response to a question from the Commission, Gaarder confirmed that IMO Res A 469 was the point of departure for the formulation of equivalent rules in separate regulations. Gaarder was then shown a document prepared by the Commission showing requirements for load conditions in both Section 43 third paragraph of the Regulations and Resolution A 469. It was apparent from the collation that, where the Resolution says that a "worst anticipated operating condition" shall be prepared, no corresponding requirement is to be found in the Regulations. Gaarder had, however, no comment on this dissimilarity. Asked whether anchor-handling conditions as such fall under the expression "worst anticipated operating condition", Gaarder replied that she could not comment on that, since the Resolution has not been implemented for anchor-handling vessels. She also testified that she did not know how other maritime administrations apply the Resolution.

She was thereafter shown the letter of approval, which states that the vessel was approved pursuant to IMO Res. 469, and asked whether the vessel and the stability book satisfied the Resolution. She testified that this was a standard text, but that she did not want to go deeper into the wording of the approval letter. Gaarder testified further that Den norske Veritas (DnV) had its class designations they use in the approval process, inter alia supplementary requirements for achieving a class designation.

Asked whether an anchor-handling vessel can get approval of stability without the anchor-handling conditions having been approved, she replied in the affirmative. Asked how she assessed the Directorate's practice in relation to the Building Regulations Section 12 first paragraph, Gaarder replied that anchor-handling conditions had not been interpreted as falling under the expression "all relevant load conditions". She further testified that a vessel could be used in many ways and that it is not possible to describe all possible load conditions.

She also testified that the stability manual should contain information that enables the crew to calculate the stability. Asked whether she had any knowledge of the stability manual, Gaarder replied that she had not gone through it in detail, neither before nor after the accident. She also stated that stability is not her main discipline. She was shown the Building Regulations Section 13, which make requirements as to what information for the captain the stability manual should contain ("Instructions for Master"). She was shown the stability manual's Part I "Instructions for Master". Gaarder testified that this is general and lays down principles, but not details for the vessel. It is normal and in line with established practice. The Commission referred to the fact that an anchor-handling vessel will experience a pulling force from a winch that will cause a roll factor. The Commission asked whether the Directorate expected that the stability calculations were to address the worst centres of gravity for the cargos. Gaarder testified that the Directorate expected the crew to be able to perform calculations for seeing how the vessel behaves in the condition concerned. Asked whether TCG (transverse centre of gravity) values were used on board, Gaarder replied that she was not aware of it. The Commission noted that there is then a possibility that the person who is to perform the calculations on board does not take account of the reduced stability effect the transverse force causes, which makes it difficult to check the stability by totalling areas oneself to a GZ curve one does not know how to compute. The stability requirements do not, therefore, contain anything that has to do with roll factors. Gaarder was then asked whether these difficulties in doing a manual check on board had been considered as a problem in the Directorate. To this Gaarder replied that she sees that the crew must make a complicated

calculation and that the emergency measures the Directorate had implemented were to make the crew aware of this. Prior to the accident the Directorate had not been aware that this was a problem.

Asked whether she was aware of Norwegian anchor-handling vessels having been modified because of defective stability characteristics, Gaarder replied that she could not recall it. The Commission notes that several anchor-handling vessels had been modified due to defective stability. Asked whether the Directorate had people analysing this kind of information, Gaarder testified that the Directorate was organised in vessel divisions and marine personnel, and a separate division for strategic accident prevention. It will be the latter division that would have been able to collect such information.

Asked whether the Directorate regards it as a challenge that a vessel is to be approved both as a towing vessel and as an anchor-handling vessel as regards stability, Gaarder testified that there are separate requirements for stability for towing vessels. The Commission also referred to the fact that the "Bourbon Dolphin" had a restriction in relation to the winch as regards vertical forces 0.5 metres from the centreline, that is, inside the inner towing pins, and on the outside of these was the shark-jaw. Gaarder was then asked whether they had thought about how this could be handled in a safe manner. She was uncertain whether the Directorate had undertaken any evaluations of this. She testified further that the towing equipment was approved by the classification societies, and that the Building Regulations had a separate section about equipment for anchor-handling vessels. Asked how the shark-jaw was to be used when it is outside what is approved, Gaarder replied that if it cannot be used at all, regardless of how the vessel is loaded, then one has a problem. The Commission noted that if they use the maximum safe workload (SWL) 400, the shark-jaw cannot be used. To this Gaarder replied that in that case the strain had to be reduced.

Gaarder was then asked whether IMO Res. A 469 was a provision that Norway was obliged under international law to implement. To this Gaarder testified that the Resolution was a guideline that was not obligatory for the states to follow. She was also asked to what kind of cases Section 12 first paragraph was applicable, and Gaarder testified that it was a very general provision that was not applied actively in an approval process.

After the witnesses Fureli and Nerem had testified, Gaarder was called back for follow-up questions.

Attorney Bruce Craig asked about the demarcation between the tasks of the Directorate and DNV. Gaarder testified that this was governed by an agreement between the authorities and the class. The class performs its assignments as a classification society in addition to work for the Directorate.

Attorney Lise Siverts asked whether the Directorate checked crew qualifications. Gaarder replied that there were certification requirements for various positions on board pursuant to the STCW Convention and that it is a requirement of the ISM Code that the owner must identify the training that is necessary over and above the requirements of the STCW Convention.

...

After Gaarder had read through the record, she wanted to make the following additions:

Re page 2, third paragraph:

The standard text in the approval letter has subsequently been evaluated as appearing somewhat imprecise, and has therefore been amended to read: "After having reviewed the above mentioned documentation, the Norwegian Maritime Directorate may approve the

[preliminary/final] intact- and damage stability to a maximum moulded draught of [w,xyz] metres, corresponding to the [DNV] assigned summer freeboard. The [preliminary/final] stability is found to comply with our regulation of 15 September 1992 No. 695 concerning the Construction of Passenger Ships, Cargo Ships and Barges, Section 43, i.e. the stability criteria put forward in IMO Res. A.469(XII), paragraphs 2.5.2 and 3.3.1 - 3.3.3." where the text in square brackets is completed for the specific case.

Re page 2, fifth paragraph, fourth line:

The day following the accident, a follow-up control of the stability documentation was requested, and this control was completed the week after. The control was carried out by a senior engineer in the passenger ship division who had not had any dealings with the original approval. The control concluded that the original control had been done in conformity with our procedures for such work.

▪ **Witness No. 6 took the stand:**

Name: Jon Terje Nerem  
Date of birth: 4 January 1946  
Post: Senior Engineer, The Norwegian Maritime Directorate (Ålesund station)  
Address: Ålesund

Nerem testified that his paramount task was to address safety at sea and secure workplaces and environmental issues. In relation to the "Bourbon Dolphin" he was a middleman between the owner/the yard and the head office of the Directorate. He had worked with the Ulstein Verft shipyard since 1975. Nerem testified further that he had little casework related to stability, since it was the head office that saw to approval of the vessel. When commissioning of the vessel approaches, the stations are present quite often, particularly in connection with testing of equipment. Nerem did not recall anything special in the construction process with the "Bourbon Dolphin". It was previously the Directorate who approved anchor-handling equipment, but it is now delegated to the classification societies.

Asked who decides when a roll test is to be performed, Nerem replied that it was the Directorate that decided that it could be performed. The Directorate is summoned to see whether the vessel is ready to take the roll test. Asked whether he regarded the vessel as completed at the date of the roll test, Nerem replied that not many weights had been taken on board and that he regarded the vessel as complete. He testified further that it was not unusual for newbuildings at Ulstein Verft that a month and a half elapsed between roll test and delivery. Nor did he have any misgivings about it taking so long. Present at the roll test were himself and another person from Ålesund station, and some from Ulstein, including Per Gullik Strand. He does not remember whether the shipping company (owner) was along on this trip.

Asked how the tank capacity was measured, Nerem testified that review of the tanks is what takes the longest time. There was scaffolding in the tanks, which was nothing unusual, but there are weights that were to go ashore. The tanks are often very variable shaped and are measured from the deck and down to the bottom of the tank, (01 31 38), and the most precise method is to measure with a yardstick. The way the measurements are performed was the same as for other vessels. Draught marks are applied and checked by laser, and it is the readoffs from these they emphasise the most. They row around the vessel and measure as precisely as possible. That day there were good conditions with no wind. He notes the readings concurrently and he thinks he had his notes from the roll test.

Asked whether he had any opinion about whether the weights were real and correct when the vessel was complete, Nerem replied that in relation to the lightship weight there was nothing more to check. He testified also that theoretically speaking heavy weights could have been put on board without the Directorate knowing about it. Asked whether he was aware of the weight increase, Nerem replied that new calculations came in that were ready just before the vessel was commissioned. He himself did not reflect over the weight increase, and experience showed that the shipyards got the weights a little wrong. He did react, however, to the fact that the GM in lightship weight was as low as 0.29. There was no internal discussion about the low GM. He could not comment as to whether the vessel was more top-heavy than other vessels. He was not on the sea trial and was not informed that there was a major roll on the trial. Nor did he expect the Directorate to be given feedback about details from the sea trials. Asked whether he had any control functions other than stability, Nerem replied that among other things he considered the internal communications, securing of loose objects, lifeboats and fire prevention/firefighting. Asked whether there was a requirement in the regulations or in the Directorate's internal procedures at the Directorate should be present on sea trials, Nerem answered in the negative, but testified that they had previously participated in sea trials. The Directorate was, however, empowered to be present if they

wanted. Asked what he would have done if he had been on the sea trial and experienced a roll of 17.2 degrees, he replied that it would have been unpleasant and that it was a relatively large roll. He also said that 30 degrees is considered the panic angle. Nerem did not think that the Directorate would have demanded new calculations if they had been made aware of such a roll.

There was a break in the testimony.

After the break Attorney Lise Siverts referred to what he had testified earlier, that everyone saw that there was a low GM. He clarified that he had not meant "everyone", but that it had been mentioned by individuals while they were standing on the quay. He did not remember with whom he spoke about this, but it may have been someone from the shipyard

Attorney Øyehaug asked whether the Directorate had considered that GM was poorer than in other similar ships, Fureli replied that he was not involved in such considerations.