P.T. Bumi International Tankers (formerly known as P.T. Bumi Indonesia Tankers) v Man B&W Diesel S.E. Asia Pte Ltd (formerly known as Mirrlees Blackstone (S.E. Asia) Pte Ltd) and Another
[2003] SGHC 152

Case Number : Suit 149/2001

Decision Date : 18 July 2003

Tribunal/Court : High Court

Coram : Judith Prakash J

Counsel Name(s) : Philip Tay (Rajah & Tann) for the Plaintiffs; Ung Tze Yang (Rajah & Tann) for the Plaintiffs; N Sreenivasan, Counsel (Straits Law Practice LLC) for the Defendants; Collin Choo (Straits Law Practice LLC) for the Defendants; Charles Lin (Donaldson & Burkinshaw) for the Defendants

Parties : P.T. Bumi International Tankers (formerly known as P.T. Bumi Indonesia Tankers) — Man B&W Diesel S.E. Asia Pte Ltd (formerly known as Mirrlees Blackstone (S.E. Asia) Pte Ltd); Mirrlees Blackstone Ltd

Damages – Assessment – Whether appropriate to grant order for assessment of damages where damages specific and calculable

Tort – Negligence – Damages – Pure economic loss – Whether pure economic loss recoverable

Tort – Negligence – Duty of care – Proximity – Negligent design and manufacture of engine – No contractual relationship between shipowner and engine manufacturer nor engine seller – Whether sufficient proximity between parties to give rise to duty of care on part of engine manufacturer and seller to avoid shipowner suffering pure economic loss

1 This is a claim in tort for damages arising out of the supply of a ship's engine. The allegation is that the engine was negligently designed and/or manufactured so as to be unable to meet the purpose for which it was supplied.

2 The ship concerned, the *M.T. Bumi Anugerah*, is an Indonesian flagged oil tanker owned by the plaintiffs, P.T. Bumi International Tankers ('Bumi'). It was built by Malaysian Shipyard and Engineering Sdn Bhd ('MSE') pursuant to a contract entered into between Bumi and MSE in October 1991. The main engine was supplied to MSE by the first defendants, Man B&W Diesel S.E. Asia Pte Ltd ('MBS'), a Singapore company which sold and serviced engines manufactured by their UK parent company, Mirrlees Blackstone Ltd ('MBUK'), the second defendants. The contract between Bumi and MSE provided for the construction and supply of a 6,500 tonne oil tanker with a main engine capable of meeting certain specifications. There was no separate contract between either MBS or MBUK and Bumi in relation to the engine. The only contract in relation to the supply of the engine on its own was a contract between MBS and MSE.

3 The engine was delivered to MSE in March 1994. On 22 December 1994, the vessel was formally delivered by MSE to Bumi. According to Bumi, within weeks of delivery, the engine had problems and the problems continued until the engine finally broke down in September 1997. The vessel was then laid up and has not operated since.

4 The losses sustained by Bumi as a result of the frequent problems experienced with the engine and its final breakdown have been economic losses. None of these incidents caused any physical damage to the vessel or its crew. Accordingly, this is a claim in tort for pure economic loss. Whilst the law in Singapore has recently recognised that tort claims for economic loss alone may be made, this is still a developing area of the law and this case raises interesting issues in this area. The

defendants have vigorously contested the allegation that the engine was negligently or defectively designed or manufactured. They have asserted that the problems that Bumi experienced with the operation of the Bumi Anugerah were essentially due to poor maintenance and operation practices on the part of the engine room crew.

Background

5 In 1991, Bumi obtained a long term charter contract for an oil tanker from the Indonesian oil company, Pertamina. The shipbuilding contract between themselves and MSE was entered into in order to acquire a vessel that would meet the requirements of this charter. The price to be paid by Bumi to MSE covered both the hull of the vessel and the engine although, from the start, it was recognised that MSE would acquire the engine from a third party. The original intention was to buy an engine from a company called Akasaka but this could not be confirmed in time and Bumi then asked MSE to recommend an alternative engine that could be delivered within the required time. MSE suggested engines from the defendants and Wartsila but only the defendants were able to meet the time requirements. Accordingly, MSE asked MBS to tender for the job.

6 On 19 July 1993, MBS sent a tender to MSE whereby MBS offered to supply MSE with one ESL 16 MK 2 marine propulsion engine designed to produce 4,000 ps at 1,000 rpm complete with all accessories and associated equipment for the price of MR2,225,629. It was an important feature of the engine that it would be able to run on both marine diesel oil (MDO), sometimes also referred to as light fuel oil or LFO, and the cheaper heavy fuel oil (HFO). The design of the engine was such that when certain operating specifications were met, specifically that the engine load reached 75% MCR and the jacket water temperature reached 70°C, the automatic valve would be activated and the engine would be automatically switched over to operating on HFO instead of on MDO.

7 There were meetings between representatives of MSE, MBS and Bumi. In late August 1993, MBS sent MSE two letters containing amendments to the original quotation. Bumi then instructed MSE to accept MBS' tender. On 7 September 1993, MSE wrote to MBS referring to their quotation. MSE confirmed they wished to purchase the engine on the terms contained in that letter and in accordance with the documents that were attached to the letter ie the purchase order specification, the general purchase order specification and MSE's commercial terms and conditions. The purchase order specification was revised subsequently and sent out again to MBS on 10 September 1993. At some subsequent time (the date is not indicated), both MSE's representatives and MBS's representative signed MSE's document entitled 'Commercial Terms and Conditions' which had been sent over to MBS together with the purchase order. Between September 1993 and March 1994, MSE sent MBS drawings of the vessel and other information so that MBS would be aware of the vessel design and in particular the design of the propeller and the stern equipment.

8 In February 1994, Mr TM Robert and Mr Ricky Singgih, Bumi's representatives, paid a visit to the factory of MBUK in order to be present at the factory testing of the engine. The purpose of this test was to show the customer that the engine was able to perform up to the contracted specifications. During the factory tests, however, the engine was not tested at 110% of the rated power for one hour as MSE considered was required by the contract. According to Mr Robert, MBUK told him that this was due to a fault in the brake system of their testing equipment.

9 The completed engine arrived in Malaysia in March 1994 and was installed in the vessel in May 1994. Construction of the vessel was completed by mid November 1994 and sea trials were held on 8 December 1994. The sea trials were attended by Mr Robert as Bumi's representative (Mr Robert was the managing director of P T Bina Usaha Maritim Indonesia, the company which managed Bumi's fleet of vessels), the ABS surveyor, commissioning engineers from the defendants and MSE personnel.

10 During the sea trials several difficulties with the engine were noted. First, the engine was unable to achieve its design speed of 1,000 rpm. The average full speed ahead was found to be 890 rpm and the maximum rpm attained was 960 rpm. The power developed by the engine was 2585 kw which was approximately 89% of the power that it was supposed to develop. MSE noted that at this stage the engine had developed high exhaust temperatures of 475°C and had problems with balancing of temperatures. Thirdly, the fuel pump injector failed. There was also a problem with the governor. Various rectification works were undertaken by the defendants. The vessel was scheduled to be delivered to Bumi on 20 December 1994 but the delivery was delayed by two days due to the discovery of a crack in the engine's vulkan coupling.

11 According to Mr Robert, after delivery many problems were encountered with the engine. First, on 5 January 1995, the engine governor malfunctioned. The engine had to be stopped for investigation and repairs. MBS ascertained that the governor drive shaft had sheared and had to be replaced. Repairs were completed on 11 January but the engine was not completely steady. In early March 1995, it was reported that the engine was overheating and that there was knocking sound in one of the cylinders. MBS sent an engineer to deal with the problems.

12 Amongst the problems noted at the sea trials was the need to replace the cam shaft. In late March 1995, an engineer from MBS attended on board to do this work. It turned out, however, that the wrong cam shaft was supplied by MBS and the correct cam shaft arrived only in mid April 1995 and was fitted on 25 April 1995. Other problems noted in March 1995 were that the indicator cock on one of the cylinders was broken, lube oil was found leaking from the crank shaft, the HFO heater module was found to be shorting and the two auto-contractors for the heater were out of order. In April, the engine raw water pump leaked. In May, problems were observed with the lube oil drive pump.

13 Bumi had specified that the engine should be able to run on HFO. This was required under its contract with Pertamina. Difficulties were encountered with running the vessel on HFO because of problems with the HFO heater. These began in March 1995. These problems continued in April 1995. The result was that the vessel had to be operated on HSD instead of HFO.

14 In May 1995, problems were observed with the lube oil drive pump of the engine. In July there were problems with the cam shaft, the raw water pump, the exhaust control panel and the light fuel oil pump. From about June 1995, the vessel began to experience high exhaust temperatures. This problem gradually worsened and, according to Mr Robert, was never rectified by the defendants. It continued until the time of the engine's complete failure.

15 In February 1996, major repairs of the engine took place when the turbocharger and fuel injection pumps were replaced. Damaged cylinder heads and all 16 fuel injectors, as well as the piston and cylinder liners, the air start valves and the indicators cocks, were also replaced. The vessel continued to experience high exhaust temperatures. In March 1996, there was a complaint that the exhaust manifold was red hot even though the engine was operating at only 600 rpm. In August 1996, Mr Robert sent a lengthy complaint to MBS (and copied to MBUK) about the malfunctioning of the engine and asked them to send their experts to look at and remedy the 'chronic problem' and 'to take immediate action to rectify all design and material defects' of the engine. In September 1996, there was a meeting in Jakarta between Bumi and the sales director of MBUK. Subsequently, MBUK acknowledged Bumi's dissatisfaction with the engine and offered to carry out various works on it.

16 On 19 September 1996, the turbocharger broke down again. The vessel had to remain at the port of Biak for two months to enable major repairs to be carried out. On 10 December 1996, sea

trials were held to test the engine on the completion of the repairs. It was reported during the trials that the exhaust manifold was red hot. Bumi considered that this was an indication that the overheating problem had not been rectified. Later that same month, the cylinder heads were found to be leaking.

17 By 1997, there had been numerous repairs and two major overhauls of the engine. On 20 January 1997, MBS was informed the engine's rpm could not be increased beyond 575 due to overheating of the exhaust manifold. MBS's engineers visited the ship and carried out work but in March 1997, it was again reported that the engine was experiencing high temperatures. The ship also reported that month that the HFO module was again faulty. Finally, on 19 September 1997, whilst the vessel was on route to Camplong, the engine completely broke down.

The action

18 This action was commenced in February 2001. By their statement of claim, Bumi pleaded that by reason of MBS having offered to supply the engine, (which engine was to be manufactured by MBUK), MSE's agreement to purchase the engine and Bumi having taken delivery of the vessel with the engine installed, MBS and MBUK owed a duty of care to Bumi 'to provide the engine that would be suitably manufactured and free from defect built for the safe and proper operation of *Bumi Anugerah* in ocean voyages'. In breach of this duty, the defendants had failed to exercise reasonable care and skill and provided an engine that was defective and failed to meet the required specifications. Particulars of this allegation were given but there is no need to deal with them at this point.

19 The defence of the defendants in its final form was to the effect that it was the responsibility of MSE to ensure that the specifications of the vessel's speed, design draft and engine power requirements met the vessel's performance criteria. The defendants denied that they had any duty of care to Bumi to provide an engine that would be suitably manufactured and free from defect built for the safe and proper operation of the vessel on ocean voyages. They averred that their only duty was to supply an engine that was suitably manufactured and free from defects and which complied with the engine power specifications as determined and specified by MSE. Alternatively, if there were defects these were rectified under the warranty provided for in the contract between MBS and MSE.

20 Subsequently, the defence was amended to add an assertion that the defendants were entitled to rely on a clause which had been part of the terms and conditions attached to MBS's letter of 19 July 1993 to MSE. Further or in the alternative, the defendants sought to rely on certain clauses of the shipbuilding contract between Bumi and MSE to relieve them from liability to Bumi or to limit such liability. The other paragraphs of the defence dealt with specific assertions in the further and better particulars voluntarily filed by Bumi and denied them.

21 The broad issues that arise from the pleadings are as follows:

(1) did MBS and/or MBUK owe Bumi a duty of care to provide an engine that would be suitably manufactured and free from defect, built for the safe and proper operation of the vessel so that Bumi could have avoided the type of losses that they sustained;

(2) if such a duty of care was owed, was there a breach of the duty in that the engine was defectively and/or negligently designed; and

(3) if there was breach, what damages did Bumi suffer and is it entitled to recover all such damages?

First main issue - did MBS and/or MBUK owe Bumi a duty in tort?

22 It has been decided in Singapore that there can in certain circumstances be a tortious duty imposed on one party to avoid negligently causing another party to sustain pure economic loss. The applicable principles were set down by the Court of Appeal in *RSP Architects Planners & Engineers v Ocean Front Pte Ltd* [1996] 1 SLR 113 and reaffirmed and explained further by the same court in *RSP Architects Planners & Engineers (Raglan Squire & Partners FE) v Management Corporation Strata Title Plan No 1075* [1999] 2 SLR 449. To avoid confusion, I shall refer to the first case as *Ocean Front* and to the second case as *RSP Architects*.

23 In *Ocean Front*, the management corporation of a condominium sued the company, Ocean Front, the developers of that condominium for damages arising out of faulty construction of the common property. One of the issues that had to be decided both at first instance and on appeal, was whether the management corporation had a cause of action against the developers in negligence for pure economic loss. The Court of Appeal characterised this issue as requiring it to determine whether the developers in the construction of the condominium and in particular the common property owed to the management corporation a duty to exercise reasonable care so as to avoid causing to the management corporation the kind of damage the latter sustained, namely, the costs and expenses incurred in making good the common property. On behalf of the Court of Appeal, Thean JA conducted a thorough review of the position in England, Australia and other commonwealth countries. At the end of the review, the court concluded that there was no single rule or set of rules for determining, first, whether a duty of care arises in any particular circumstance and, second, the scope of that duty. It noted that in determining the existence of a duty of care and its scope in different categories of cases, different judges had used different expressions such as 'proximity', 'just and reasonable' and 'fairness' and concluded that:

> whatever language is used, the court is basically involved in a delicate balancing exercise in which consideration is given to all the conflicting claims of the plaintiffs and the defendants as viewed in a wider context of society ... But the approach of the court has been to examine a particular circumstance to determine whether there exists that degree of proximity between the plaintiff and the defendant as would give rise to a duty of care by the latter to the former with respect to the damage sustained by the former. Such proximity is the 'determinant' of the duty of care and also the scope of the duty. (at p 139)

The court then went on to consider whether in the circumstances of *Ocean Front* there was sufficient proximity in the relationship between the developers and the management corporation which gave rise to a duty on the part of the developers to the management corporation to exercise reasonable care in the construction of the common property so as to guard against the management corporation sustaining the kind of damage complained of. Having found such proximity to exist in the circumstances before it, the court then asked whether there was any policy consideration which would negative the existence of a duty of care. In that case no such policy consideration was found to exist.

24 The Court of Appeal in *Ocean Front* therefore applied a two stage test in order to determine the existence of a duty of care. This two stage test was in large part derived from two English cases *Anns v Merton London Borough Council* [1978] AC 728 and *Junior Books Ltd v Veitchi Co Ltd* [1983] 1 AC 520. Both were decisions of the English House of Lords. In England the issue of whether a duty of care should be imposed to prevent pure economic loss was discussed in many cases over many years and there were decisions both in favour of imposing such a duty such as *Anns* and *Junior Books* and decisions against doing so. The anti-duty view finally won a resounding victory in *Murphy v Brentwood District Council* [1990] 2 All ER 908, another House of Lords decision, and presently English

law does not recognise such a duty.

25 In *RSP Architects*, the Court of Appeal was asked to reconsider the conclusions reached in *Ocean Front*. It was suggested to the court that its reliance on *Junior Books* in *Ocean Front* had been unsafe as that case was 'obviously no longer good law' and was also inconsistent with the reasoning of the Australian High Court in *Bryan v Maloney* [1995] 128 ALR 163. *RSP Architects* involved a suit by the management corporation of a condominium against the firm of architects that had designed the condominium for damages arising out of the need to make good defects in the cladding of the condominium arising out of defective design by the architects. The architects' argument was that having been employed by the developer of the condominium and not having had any contractual relationship with the management corporation, they did not owe the latter any duty in respect of the design of the structure. The court upheld the decision in *Ocean Front* after a further review of the relevant English and commonwealth authorities. It revisited both *Junior Books* and *Bryan v Maloney*. Thean JA who delivered the judgment noted that the attack on *Junior Books* arose because it had followed *Anns* and the proposition propounded in *Anns* by Lord Wilberforce that there was a single general rule which could be applied in every situation to determine whether a duty of care arises and that this test, based on the foreseeability of damage alone, had been heavily criticised. Thean JA then conducted a thorough analysis of the leading speeches in *Junior Books*, especially that of Lord Roskill and noted that notwithstanding that the two stage test propounded in *Anns* was followed by the latter, Lord Roskill did not premise the first test on foreseeability of damage alone as the foundation of the duty of care. It appears to me that the Court of Appeal did not accept that *Junior Books* was impugned simply by reason of its association with *Anns.*

26 The court next considered *Bryan v Maloney* and cited several passages from the case which dealt with a claim against the builder of a house by a subsequent owner (ie someone who had bought the house from the person of whom the builder built it). In these passages the Australian High Court pointed out first, that in such a case, it was foreseeable by the builder that negligent construction of the house with inadequate footings would be likely to cause economic loss, of the kind claimed in the suit, to the owner of the house at the time when the inadequacy of the footings first became manifest. Secondly, it pointed out that the relationship between the builder and subsequent owner was marked by 'the kind of assumption of responsibility and known reliance' commonly present 'in the category of cases in which the relationship of proximity exists with respect to pure economic loss'. In coming to the decision that there was sufficient proximity in the relationship between the builder and the subsequent owner to give rise to a duty of care, the High Court also considered whether there was any factor or policy consideration which precluded the recognition of such relationship.

27 The Court of Appeal then stated that the approach that it had previously adopted in *Ocean Front* was the same as that adopted in *Bryan v Maloney* and that the crux of such approach would be no more than this:

> the court first examines and considers the facts and factors to determine whether there is sufficient degree of proximity in the relationship between the party who has sustained the loss and the party who is said to have caused the loss which give rise to a duty of care on the part of the latter to avoid the kind of loss sustained by the former. … having found such degree of proximity, the court next considers whether there is any material factor or policy which precludes such duty from arising. Both on principle and on authority, we do not see why such an approach should not be taken in *Ocean Front* and in a case as the one before us. (per LP Thean JA at p 466)

The court dismissed the argument that in *Ocean Front*, the element of 'reliance' which was crucial to the imposition of a duty of care had not been present. It pointed out that in *Ocean Front* the element of foreseeability had been only one of the several elements taken into account and that

there were present in that case the elements of 'assumption of responsibility' and 'known reliance' in the sense stated in *Bryan v Maloney*.

28 The principles laid down by the Court of Appeal as to when one party owes a duty of care to another to avoid causing economic loss to that other are capable of application in a wide variety of circumstances. They are not confined to the types of factual situations that were seen in the *Ocean Front* and *RSP Architects* cases. There are substantial differences between the facts of the present case and those of the cases cited. That in itself is not decisive of the issue. The differences must be examined in the context of an investigation into whether the application of the principles to the existing facts provides a sound basis for the imposition of a tortious duty on the defendants. One cannot simply brush aside any suggestion of the existence of a duty by saying airily 'the facts are different'.

29 Therefore in order to determine whether either or both MBS and MBUK owed a duty to exercise reasonable care so as to avoid causing Bumi the kind of damages the latter sustained which are mainly the loss of income from the vessel by reason of the breakdown of the engine from time to time and the costs and expenses to be incurred in making good the engine, I must:

> (1) examine and consider the facts and factors to determine whether there is sufficient degree of proximity in the relationship between Bumi and MBUK and between Bumi and MBS which would give rise to a duty of care on the part of MBS/MBUK to avoid the kind of loss sustained by Bumi and such facts and factors would include but not be limited to foreseeability and reliance; and
>
> (2) if I find such degree of proximity to exist, consider whether there is any material factor or policy which precludes such duty from arising.

30 The defendants do not accept that *Ocean Front* and *RSP Architects* stand for the proposition that, generally, proximity between parties gives rise to a tortious duty to avoid negligently causing economic loss. They accept that proximity and foreseeability are essential ingredients of such a duty but argue that even where the same are present, proximity being determined by using 'assumption of responsibility' and 'reliance' the duty of care should generally only be imposed where it falls within recognised categories. If a duty outside recognised categories is to be imposed, an incremental approach should be taken, with justification based on the particular facts of the case, in particular the unavailability of any other remedy, and where it is fair, just and reasonable to impose a duty. Notwithstanding proximity, it is necessary to consider whether there is a material factor or policy consideration to preclude a duty to avoid the type of loss caused and, based on various authorities that they cite, they assert that the contractual matrix is a key factor which precludes the existence of the duty or even it does arise, severely limits its scope. The defendants are also strongly critical of the decision in *Junior Books* which they say should not be followed having been criticised severely by later English cases.

31 Having considered the defendants' arguments carefully, I think that their analysis is not completely consistent with *Ocean Front* and *RSP Architects*, cases which are binding on me. I consider that I am bound by those cases to approach this issue in the way set out in ¶ 29. I agree, however, that when it comes to the second stage of the enquiry, one of the policy considerations to be examined would be whether by imposing the duty, I would be leapfrogging the recognised categories or acting incrementally to expand them. I also consider that as far as Singapore law is concerned, the approach in *Junior Books* has been endorsed and has been found to be not inconsistent with high Australian authority.

(i) Proximity

32 In determining whether a relationship of sufficient proximity existed between the plaintiffs and the defendants in the present case, it may be helpful to have regard to the facts in *Junior Books*. The plaintiffs there had entered into a contract with a building contractor for the construction of a factory. The contractor in turn employed a specialist sub-contractor to lay the flooring. The plaintiffs sued the specialist sub-contractor for defects in the flooring arising out of bad workmanship and/or bad materials. They claimed the cost of replacing the floor and other items of loss such as the cost of removing the machinery and the loss of profit while the flooring was being re-laid. This was a purely tortious action as there was no contract between the plaintiffs and the defendant sub-contractor. Despite this, the English House of Lords, by a majority with one dissenter, held the sub-contractor liable. In this instance, the necessary proximity was found to exist, in the words of Lord Roskill (who delivered the main judgment), because:

> Turning back to the present appeal I therefore ask first whether there was the requisite degree of proximity so as to give rise to the relevant duty of care relied on by the respondents. I regard the following facts as of crucial importance in requiring an affirmative answer to that question. (1) The appellants were nominated sub-contractors. (2) The appellants were specialists in flooring. (3) The appellants knew what products were required by the respondents and their main contractors and specialised in the production of those products. (4) The appellants alone were responsible for the composition and construction of the flooring. (5) The respondents relied upon the appellants' skill and experience. (6) The appellants as nominated sub-contractors must have known that the respondents relied upon their skill and experience. (7) The relationship between the parties was as close as it could be short of actual privity of contract. (8) The appellants must be taken to have known that if they did the work negligently (as it must be assumed that they did) the resulting defects would be some time require remedying by the respondents expending money upon the remedial measures as a consequence of which the respondents would suffer financial or economic loss. (at p 546)

Another member of the majority, Lord Fraser, noted that the proximity of the parties was extremely close 'falling just short of a direct contractual relationship' (at p533).

33 The similarities in the factual situation in *Junior Books* and that of the present case are quite striking and it is no wonder that Bumi relied heavily on *Junior Books* in its enunciation of the facts present here which, they contended, established the necessary proximity between them and the defendants. In this context, the relevant facts are:

(1) before the contract for the engine was placed by MSE:

(a) there were meetings between Mr Donald Chua of MBS and Bumi and MSE and he told the parties that the engine was reliable and had not previously experienced problems;

(b) MBS sent its final terms and conditions for the supply of the engine directly to Bumi and was notified by Bumi that it would be accepting that offer in early August 1993; and

(c) MBS was actively marketing the engine to MSE and Bumi;

(2) MBUK was an experienced designer and manufacturer of engines for industrial and marine use;

(3) MBS was selected as the supplier of the engine by Bumi because it was the sole distributor in this region for engines manufactured by MBUK;

(4) MBS (and, therefore, MBUK) knew that the engine was required for an oil tanker that MSE was manufacturing for Bumi and that under the ownership of Bumi, this vessel would be on a long term charter to Pertamina and drawings and information were sent by MSE to MBS and MBUK (both at the request of MBUK itself and also on the initiative of MSE) so that they could decide how best to incorporate the engine into the vessel;

(5) before MBS tendered for the supply of the engine to MSE, it had received detailed specifications of the type of engine that MSE required and such specifications must have been passed on to MBUK so that both defendants knew exactly what product was required by MSE and Bumi;

(6) both defendants knew that MSE was constructing the hull only and that both Bumi and MSE were relying on them to supply an engine that would be suitably designed and manufactured for the requirements of the vessel;

(7) Mr Chua conceded that he knew that if there were problems with the engine, it was Bumi who would suffer and therefore MBS knew that if the engine could not perform as required, it was Bumi who would suffer loss;

(8) as the manufacturer of the engine selected by Bumi for the vessel, MBUK must have known that Bumi was relying upon its skill and experience and, Bumi's representatives having visited the factory to observe the testing of the engine, MBUK, like MBS, must have known that if there were problems with the engine it was Bumi who would suffer by having to expend money upon the remedial measures as a consequence of which Bumi would suffer financial loss; and

(9) for what is worth, when problems subsequently arose with the engine and there were correspondence and meetings between Bumi and MBUK and MBS, not once did either of the latter reject the complaints of Bumi on the basis that they did not owe Bumi any duty of care to supply a properly designed and manufactured engine.

34 In light of the facts enumerated, I can only conclude that there was a sufficient relationship of proximity between Bumi and MBUK so as to give rise to a duty on the part of MBUK to exercise reasonable care in the design and manufacture of the engine so that the engine delivered would be fit for the safe and proper operation of the vessel. Among the more important facts are MBUK's knowledge that the vessel was being custom built to meet a specific owner's requirements and that that owner had discussions with its sole agent and was relying on the expertise of MBUK as a specialist manufacturer of engines to produce an engine that was suitable for the vessel. MBUK could also foresee that if the engine was defective and continually broke down or required excessive maintenance and repair work, Bumi would suffer economic loss from disruptions in the use of an income producing chattel.

35 I have more difficulty with the relationship between MBS and Bumi. MBS was a subsidiary of MBUK and had to be dealt with because it was the entity that had the right to sell the engine to MSE. Bumi knew, however, that MBS was not the designer nor the maker of the engine. Bumi knew, or must have known, therefore, that during the construction of the vessel and the engine, the role of MBS would only be to liase between MSE and MBUK in relation to the technical details of the engine. MBS would have no part to play in the actual design or manufacture of the engine. Accordingly, it is difficult to hold that Bumi relied on the expertise of MBS in the manufacture and design of ship's engines when it selected MBUK's engine for the vessel. On the other hand, whilst it has been decided that the reliance factor is an important component of proximity, the 'assumption of responsibility' factor is also significant. By asserting that the engine was reliable and actively marketing it through the various tenders that they sent MSE and the various meetings with Bumi and MSE, I think that

MBS was assuming responsibility for the delivery of an engine that would meet Bumi's requirements. Thus, even though Bumi may not have relied on MBS's expertise as an engine maker, I have come to the conclusion that there was sufficient proximity between them and MBS to impose the same duty on MBS as was imposed on MBUK.

(ii) Policy considerations

36 I now have to consider whether there is any reason why the duty should not be imposed. From previous cases, the first question to be examined in this connection is whether imposing the duty would result in imposing liability in an indeterminate amount for an indeterminate time to an indeterminate class. Here, no question of indeterminate time arises as the provisions of the Limitation Act (Cap 163) apply to limit the time within which such claims may be made. As regards the amount recoverable, this is determinate as basically it comprises the cost of repairing or replacing the engine and the financial loss sustained by reason of the breakdown of the engine. Neither type of loss is infinite. The class of persons entitled to recover is finite ie the owner of the vessel. The second question to be considered is whether recovery for economic loss in a situation like this would result in an indefinitely transmissible warranty. Here, this question must be answered in the negative. The product complained about is not an everyday consumer product. It is an expensive engine custom-made for a particular ship and for a particular owner with specific requirements that were made known to the defendants. I think it would be difficult for any other party to contend that any transmissible warranty from the defendants arose in these circumstances.

37 The defendants have submitted that notwithstanding the above, direct liability of this nature should not be imposed on either of them for the following reasons:

> (1) The contractual structure adopted in relation to the supply (ie that MBUK contracted with MBS who contracted with MSE who in turn contracted with Bumi) precludes such a duty. The chain of contractual relationships was deliberately arranged as it was without any direct relationship. Of particular import is clause 17 of MSE's contract with Bumi which expressly states this.
>
> (2) Even if such a duty can be imposed, it is excluded or negated by clause 19 of MBUK's terms of supply and clauses 17 and 22 of MSE's contract with Bumi.

The above considerations were not discussed in either the *Ocean Front* or *RSP Architects* case. In my opinion, however, when the Court of Appeal considered only two issues in relation to whether any policy consideration would negative the duty of care, it did not do so because it considered that those two issues were exhaustive of the question. It did so because those two issues were general issues that have to be considered in each such case and there was no other more specific issue that needed to be determined in relation to the facts there. The claimants in those two cases did not have contractual relationships with any of the parties involved in the construction of the buildings concerned. There was thus no need to discuss whether the existence of a chain of contracts or any term in any of those contracts could negative any possible tortious duty that could otherwise be owed by one party in the chain to another with whom he was not in a direct contractual relationship. Since the situation does exist here, I must consider whether there is any policy reason in relation to this situation to negative the duty.

38 In my opinion, the simple fact that a chain of contracts exists cannot, as a matter of policy, mean that in all circumstances each party in the chain is limited to suing only the party with whom he is in privity of contract for any damages sustained as a result of the transactions undertaken under the contracts. Whether such a limitation exists must depend on the facts of the case and not simply on the existence of the chain of contracts. I must therefore consider whether there is any fact

present here which would make it unfair or unreasonable or against public policy to allow Bumi to sue the defendants instead of MSE.

39 The defendants contended that Bumi should not be allowed to leapfrog over MSE and take direct action against MSE's sub-contractors because, by their contract with MSE, they had agreed that liability for the suitability of the vessel and any damages sustained by reason of the vessel being defective would be regulated in a particular fashion. The relevant terms in the Bumi-MSE contract were clauses 14, 17 and 22. Under clause 22, MSE stated that they and their sub-contractors were fully experienced and properly qualified to construct the vessel, that MSE would control their employees and sub-contractors, and that nothing in the contract would create any contractual relationship between Bumi and any sub-contractor of MSE. Clause 17 dealt with MSE's responsibility for their sub-contractors and imposed on MSE full responsibility for any part of the work performed by their sub-contractors and for the acts and omissions of the sub-contractors.

40 Clause 14 contained MSE's warranties in respect of the vessel. By clause 14.1, MSE guaranteed the replacement of all parts and equipment of the vessel manufactured or furnished by MSE which had defects caused by defective or faulty design or by constructional miscalculations or by poor workmanship as long as these defects were discovered within 12 months of the delivery of the vessel and notice of them was duly given to MSE. MSE also agreed to be responsible for all machinery supplied by sub-contractors and guaranteed the same for a period of 12 months on the same basis as laid down in clause 14.1. This general responsibility was limited by clause 14.4 which provided that MSE would not be responsible for consequential losses including loss of time, loss of profit or loss of earnings of the vessel arising from the defects or work undertaken to remedy the defects.

41 The guarantee given by MSE was therefore limited both in time (12 months) and in extent (basically to the cost of repairing or replacing the defective part). By the time Bumi started this action against the defendants, it was too late to make any claim against MSE and, in any case, many of the heads of damage claimed against the defendants could not have been raised against MSE. The argument made is that since Bumi were content to contract with MSE on such terms, they should not be allowed to escape from that contractual regime by a direct action against the defendants.

42 Bumi submitted that it was wholly irrelevant to this action that they had not sued MSE and had agreed to a particular regime with MSE. Neither matter constituted a bar to Bumi's claim against the defendants. I agree. There is no reason in law or in policy why Bumi, simply because they entered into a contract with MSE whereby they agreed that MSE would only be responsible for defects discovered and notified within 12 months and even then only for the cost of replacing those defects, should be barred from making a claim against the defendants, who actually supplied the defective equipment, for their full losses more than 12 months after delivery. Whilst MSE did assume responsibility for the work and the design of their sub-contractors, nowhere in the contract did they specifically require Bumi to give up any separate rights of claim that Bumi might have against such sub-contractors. Though clause 22 did operate to prevent the creation of any contractual relationship between Bumi and MSE's sub-contractors, it did not attempt to deprive Bumi of any claim in tort against the sub-contractors which the general law granted to them. In my view, clause 22 was not drafted as a 'Himalaya' clause. In law, Bumi's agreement to limit their rights of recovery against MSE cannot constitute a bar to their fully exercising any rights of recovery against third parties that the law may allow them, notwithstanding that such third parties were MSE's sub-contractors. I have considered the various authorities cited by the defendants in this connection including the case of *Pacific Associates Inc v Baxter* [1989] 2 All ER 159 and in my judgment those cases are all distinguishable on their facts.

43 The other contractual provisions that the defendants rely on to argue that it would be wrong to impose any tortious duty on them are contained in MBUK's Conditions of Sale (Export). Basically, clause 18 of those conditions limits MBUK's liability to replacement of faulty parts during a period of 12 months after delivery of the engine. Under clause 19, all other representations and warranties are excluded and MBUK is expressly excluded from liability for direct or indirect costs, damages or expenses resulting from defects in or failure of the engine or any part of it and from any consequential loss or damage including loss of profits. The defendants say imposing the tortious duty on them would render their carefully drafted contractual terms nugatory and that would not be right.

44 The difficulty with the defendants' argument is that the facts do not support their contention that the sale contract between them and MSE included MBUK's conditions of sale. Mr Donald Chua testified that when he first sent out the tender for the engine to MSE, one of the documents attached to the tender was the conditions of sale. MBS's letter of 19 July 1993 itself, however, does not state that these conditions would be incorporated as part of any contract concluded if the tender was accepted. The evidence of MSE's Mr Manoel Gomes who conducted the commercial negotiations was that MSE did not receive any conditions of sale and that he had not seen them prior to the trial. In any case, when Bumi decided to use the defendants' engine, MSE placed the order under cover of their letter of 7 September 1993 which was accompanied by their purchase order and various other documents. In court, Mr Donald Chua was asked whether he agreed that the defendants had supplied the engine based on the MSE purchase order and his answer was an unequivocal 'yes'. He further agreed that he had signed MSE's commercial terms and conditions and that neither in this or in any of the documents MSE had forwarded to him, was there a reference to the application of MBUK's conditions of sale. In my judgment, MBUK's conditions of sale did not apply as between MBS and MBUK and therefore could have no impact on the existence of a duty of care.

45 I realise that by imposing a duty on the defendants to avoid causing Bumi to suffer financial loss by supplying them with an engine that was suitably designed and manufactured to meet the requirements of the *Bumi Anugerah* as known to the defendants, I am extending the class of cases to which the principles established in the *Ocean Front* decision apply. For one thing, the duty is being applied to a chattel rather than to a building and, for another, the beneficiary of the duty did have a contract in relation to the chattel though not with the defendants. As the facts here involve a large and expensive piece of equipment custom made for a particular ship which was to operate in particular conditions and the persons who would be owning and operating the vessel were known to and in contact with the defendants, however, I do not think that my decision is an extreme extension of the applicable principles. Instead, it is an incremental extension of the law and is appropriate on the facts. This case does not open the floodgates.

Second main issue – was there a breach of the duty?

46 There was a great deal of technical evidence on what problems the engine had experienced and what could have been the possible causes of those problems. Breakdowns of the engine do not by themselves establish a breach of duty. In order to decide whether there was such a breach, I have to consider whether the pleaded allegations of the ways in which the engine was defective have been established, (ii)(a) those defects were due to negligent or defective design or manufacture or (ii)(b) were due to negligent or inadequate operation by the crew and, (iii) such defects as I find to have existed establish a breach of duty on the part of the defendants. In this connection, I have to be guided by the pleadings and not only by the submissions. For example, in Bumi's submission, there was an allegation that MBS had failed in their duty to conduct proper trials of the engine during the sea trials of the vessel on completion of construction and/or had been negligent in the way that they handled the sea trials. It was not pleaded that MBS had any specific duty to Bumi in relation to the conduct of the sea trials. I will therefore not be considering any submission on breach of such a

duty.

47 I therefore return to the pleadings in relation to the allegations of defect. Paragraph 11 of the statement of claim set out the alleged defects of the engine. It read:

11. The engine was unable to achieve suitable speeds and was also unable to operate properly under normal circumstances. The engine suffered, inter alia, from the following defects:

(a) Inadequate power and speed provided by the engine.

(b) Engine overheating.

(c) Defective installation, design and manufacture of valve inserts;

(d) Defective installation, design and manufacture of the indicator cocks;

(e) Defective design, installation and manufacture of the turbo charger;

(f) Defective installation, design and manufacture of cylinder heads;

(g) Defective installation, design and manufacture of exhaust fuel pumps;

(h) Defective installation, design and manufacture of exhaust valve and valve guides;

(i) Defective design, installation and manufacture of fuel injectors.

48 In their voluntary further and better particulars, Bumi gave the following further details of their allegation that the defendants had failed to exercise reasonable care and skill and had provided a defective engine:

> a. As set out above, the engine to be supplied by the 1st Defendants and/or manufactured by the 2nd Defendants was represented by the Defendants to be rated 4,000 ps with engine's speed at 1,000 rpm.
>
> b. However, at the sea trials for the vessel on 8 December 1994, an attempt was made to increase the engine to full power at engine's speed at 1,000 rpm but the engine was not able to attain the full power of 4,000 ps with engine's speed of 1,000 rpm.
>
> c. Further, the vessel was also not able to attain 4,000 ps with the engine speed of 1,000 rpm after the vessel went into commercial operation following her delivery of Malaysia Shipyard to the Plaintiffs on or about 22 December 1994.
>
> d. …
>
> e. …

The plaintiffs contend that the engine which was supplied was negligently designed and was not able to operate normally or properly on heavy fuel oil, as a result of which there was repeated overheating and breakdown of the engine, as set out below. The Plaintiffs aver that the Defendants ought not to have supplied an engine that was modified from an industrial non heavy fuel oil using type of engine, for use on their vessel. The Plaintiffs further contend that prior to the supply of the engine in the

present case, the Defendants had already received repeated complaints regarding overheating and breakdown of the same type of engine supplied to other shipowners and therefore ought not to have supplied the Plaintiffs with the same type of engine.

49 When asked to state the alleged failure on the part of the defendants to exercise reasonable care and skill, Bumi replied that they would rely on the numerous occurrences of breakdown of the engine and its component parts despite complete overhauls as well as on the defects in the engine set out above as the basis of the defendants' failure to exercise reasonable care and skill.

50 The defendants denied paragraph 11 of the statement of claim. They asserted that the engine overheating and detachments of valve inserts had been caused by Bumi having:

> (a) persistently operated the engine in an overloaded condition resulting in high exhaust temperature causing engine overheating;
>
> (b) operated the engine with abnormally high exhaust temperatures with consequential loss of interference fit of the insert in the cylinder head directly causing valve seat insert detachment;
>
> (c) persistently operated the engine with instrumentation and protection devices which were either inoperative or disconnected;
>
> (d) failed to properly maintain the engine;
>
> (e) failed to comply with MBUK's maintenance recommendations as set out in MBUK's manuals given to Bumi;
>
> (f) used non-original lube oil filters; and
>
> (g) used poor quality lube oil and/or not properly purifying the lube oil and not properly monitoring the lube oil system.

51 As regards the two failures of the turbocharger, it was alleged that these were caused by debris from the valve seat inserts which debris had been created by Bumi's failure as described in sub-paragraphs (b), (c) and (d) of ¶ 50 and also by their failure to comply with MBUK's maintenance recommendations. The defendants also asserted that the cylinder heads had been damaged as a result of Bumi having disconnected the auto-changeover fuel valve and used HFO in incorrect conditions as well as by the wrongful actions described in ¶ 50(b), (c) and (d) and by failure to comply with the maintenance manuals. Similar reasons were given for the damage sustained by the exhaust valve and valve guides.

52 In closing, Bumi submitted that the evidence had established that:

> (1) the engine was not able to achieve full power and had high exhaust temperatures at the sea trials and that this was not due to the failure of the fuel pump;
>
> (2) the problem lay with the operation of the engine on a ship on HFO in the tropics;
>
> (3) following delivery of the ship, there were a series of breakdowns and failures of the engine which were not normal for a brand new engine;
>
> (4) the engine had been properly maintained;

(5) the engine had not been properly developed and its up-rating from 3,500 hp to 4,000 hp was not properly carried out;

(6) the modifications and improvements to the engine were the result of defective design of various engine parts in the first place; and

(7) Malaysian vessels which used similar engines produced by MBUK (except that the power rating for those engines was 3,500 hp) had experienced problems arising from defective design.

Bumi submitted that the evidence led directly to the irresistible conclusion that the problems faced by the engine of the *Bumi Anugerah* were due to its defective design which meant that it was not able to operate properly on HFO on a vessel in the tropics.

53 It may be helpful if at this stage, I identify the witnesses who gave evidence in relation to the operations of the vessel and of the seven Malaysian vessels. For Bumi, they were:

(1) Mr Mailvaganam Robert Tharmaseelan ('Mr Robert'), the managing director of Bumi Ship Management, the managers of the vessel;

(2) Mr Michael Kwan Tuck Lock, a marine engineer, who was Bumi's expert witness;

(3) Mr Chua Tiong Siong ('Mr TS Chua'), a senior manager in the design department of MSE;

(4) Mr Ooi Ka Lok, the general manager of the company which managed *Meridian Vega*, one of the Malaysian ships;

(5) Mr Mohd Zubir Bin Ab Latiff ('Mr Zubir'), a technical superintendent who worked on the *Meridian Vega*; and

(6) Mr Chan Kok Onn, a technical manager of the company which managed six Malaysian ships and Mr Hendricks Simon Dias, an engineering superintendent for the same company.

54 The witnesses who appeared on behalf of the defendants were, in addition to Mr Donald Chua:

(1) Mr Trevor Stringer who worked with Shell Malaysia;

(2) Mr Peter Crowle, formerly the chief service engineer of MBUK;

(3) Mr John Bilsbury, formerly a senior engineer with MBUK;

(4) Mr Graham Howard, formerly engineering director of MBUK;

(5) Mr Robin Cridland, formerly the spare sales manager of MBS;

(6) Mr Ronald Pereira, a marine engineer, the defendants' expert witness; and

(7) Mr Lee Meng Liang, a service engineer with MBS.

The evidence on which Bumi relied and the defendants' response:

(i) The factory test of the engine

55 Before the engine was shipped off to MSE, it was tested at MBUK's factory in England. Subsequently, a certificate on the result of the tests was issued by the American Bureau of Shipping ('ABS'). The engine was run on light fuel oil ('LFO') for the purpose of the tests and no tests were carried out using HFO. On LFO, the engine attained its design speed of 1,000 rpm and 4,000 ps. Bumi's complaint was that despite a contractual requirement for this to be done, the engine was not tested at 110% load (ie in an overloaded condition) for an hour (the MCR test) due to a fault in MBUK's testing system.

56 Whilst the defendants could not deny that they had not established that the engine could have passed the MCR test, they pointed out that the 110% MCR test is not a general requirement for marine propulsion engines. Mr Kwan agreed that once a vessel is operational, the engine would not be run at a 110% MCR and, to prevent this, the fuel rack would be locked at the 100% position. Mr Kwan also agreed that in general, the 110% MCR test is not required for vessels. Bumi did not explain the importance of the 110% MCR test and how if it had been carried out and the engine had failed the test that failure would have supported their assertion that the engine was not fit for its purpose. In the circumstances, I do not think that the failure to carry out the MCR test establishes anything about the engine. I agree, however, that the factory tests established only that the engine could run at full load on LFO. They did not establish the engine's ability to meet the design criteria when it was operated on HFO.

(ii) Sea trials

57 The official sea trials were held in December 1994. The engine specifications, as admitted by the defendants, included the following:

(a) that the engine should have a maximum continuous rating of 4,000 ps at 1,000 rpm; and

(b) that it should operate on HFO of viscosity at 1,500 seconds rw no. 1 at 50°C.

During the sea trials the engine, when running on HFO, was not able to attain 4,000 ps with an engine speed of 1,000 rpm. Instead, the engine developed only about 90% of its rated power at a maximum of 960 rpm. Additionally, the exhaust temperatures, as admitted by Mr Pereira, should have fallen within the normal range. Instead, during the trials, the exhaust temperatures were high, reaching 475°C. Various other problems were noted and after the trials, MSE sent MBS a list of defective parts and defects with the main engine that had to be rectified. At trial, the defendants through Mr Howard agreed that the matters complained of were matters that had to be dealt with.

58 Dealing first with the problem of power, it should be noted that there was not one occasion after delivery when the vessel attained its rated or design speed of 1,000 rpm. During a sea passage on 25 December 1994, the engine speed went up to 970 rpm. During a voyage two days later, a maximum of 960 rpm was achieved. Thereafter, the engine speed varied between 800 and 890 rpm. Bumi relied on the early manifestation of the engine's inability to attain full speed as an indication that this inability was due to a design defect rather than to any mishandling of the engine by the crew.

59 Two days after the trials, MSE asked MBS to explain why the main engine could not develop full power. Their response was that this was due to the failure of the fuel injector pump in cylinder B1. When asked why such a failure had occurred since the engine had been shop-tested in the factory, MBS responded that the failure could have been contributed to by debris contamination and that they would 'revert after the pump [had] been returned to [their] store for investigation'. Bumi contended that this explanation for the failure of the engine to develop full power during the sea trials could not be accepted since no debris was found in the pump and, contrary to its promise, MBS never

reverted to state the cause of the failure. Further, internal correspondence between MBS and MBUK in March 1995 showed that they did not consider the pump to be the cause of the failure. Finally, Mr Pereira and Mr Howard agreed that the assertion by MBS that debris caused the fuel pump to fail was a statement of opinion, not a statement of fact.

60 The pleaded case of the defendants was that the inability to achieve rated engine speed during the sea trials was due to the over-pitching of the propeller. They did not plead the fuel pump failure as a cause. Following from this, in their closing submissions, the defendants continued to rely solely on the assertion that the propeller was over-propped or over-pitched as the explanation for the deficiency in the engine's performance during the trials. This was an allegation which they had to prove.

61 The defendants sought to discharge their onus of proof through the evidence of Mr Howard. In his affidavit, Mr Howard made it clear that the fuel pump failure could not explain the 11% power loss experienced by the engine during the sea trials. He asserted that since under factory conditions, the engine had reached full speed, its failure to do so during the trials could only be due to overloading caused by over-pitching of the propeller. He explained his views in this way:

> 43. I am quite sure one of the major problems in this case is overloading by the propeller. When the engine was tested at the factory, it achieved full load and 10% overload, after which the fuel racks were locked at full load as required by ABS and all Marine Classification Societies. … During sea trials the engine would only reach 950 rpm even though the fuel pumps were at full rack of 29mm, … The official sea trial report, states that the vessel should achieve 12 knots at 90% engine MCR. At 90% MCR engine should be at 1,000 rpm and fuel pump racks should be at 26-27 mm. The engine was clearly well into overload during the sea trials, and the naval architect and shipyard engineers did nothing to look into the reasons.
>
> 44. Operating at full fuel and 950 rpm is dragging the engine down its natural torque curve, that is it is being stalled down. … The relationship between power and speed for a fixed pitch propeller is a power law with an index of between 2.5 and 3. Therefore, to reach 1,000 rpm from 950 rpm with this propeller would require a power increase of between 12.5% and 16%, depending on the actual index. The obvious conclusion from this is that the engine has been overloaded from day one. On work test, the exhaust temperatures were 416 deg C average. Ambient temperature difference (the Work test was in England while the sea trials were in Malaysia) would cause a small rise but the vast majority of the difference is because the air flow through the engine dropped because of the engine speed reduction, but the fuel input has remained at full fuel. This means that the air fuel ratio dropped, causing all the components in the combustion chamber to be operating at beyond the 10% overload condition experienced in industrial applications, and the conditions under which we development test these products.

62 The defendants conceded that Mr Howard was not a naval architect but contended that this was irrelevant. He had not been giving evidence of propeller design but was analysing the engine's performance when attached to the load (propeller). It was the shipyard's job and their naval architect's responsibility to ensure that the load generated by the propeller was not an overload for the output of the engine. As an engineer, Mr Howard was amply qualified to analyse the engine test sheets. The defendants pointed out that Mr Kwan, Bumi's expert, had no qualification to comment on whether the propeller was over-pitched though he had admitted that there was a possibility of this having been the case.

63 Under cross-examination, Mr Howard agreed that issues relating to over-prop should be dealt with by a naval architect. The defendants had originally planned to adduce evidence from a naval

architect but in the event they did not do so. Instead, they relied only on Mr Howard's opinion and his expertise as an engineer. Mr Howard had never seen the vessel or the engine in question although he was familiar, by reason of his work, with the type of engine installed on *Bumi Anugerah*. Notwithstanding this, he confidently asserted in his affidavit that since full power had been reached during factory tests, the only reason why it could not be reached at sea trials had to be over-propping of the propeller. When it came to cross-examination, however, he agreed that the factory and sea trial conditions are different and therefore there could be other reasons, apart from over-propping, why the engine could not reach 1,000 rpm during the sea trials. It is also notable that Mr Howard admitted that he had never attended any sea trial of any engine and had no idea what would normally be done during a sea trial. He also agreed that he would expect the advice of a naval architect to be sought if it was sought to determine whether or not a vessel was over-propped.

64 Mr Howard made the assertion in his affidavit that MSE had, prior to the construction of the *Bumi Anugerah*, over-propped other vessels that they had constructed. Under cross-examination, Mr Howard admitted that this assertion should have been made in respect of one vessel only. He had also stated that Mr Donald Chua had informed him that MSE had compensated for the over-propping by increasing the fuel racks of the vessel. Mr Donald Chua, however, admitted that in that case, MSE had simply asked whether there was a way in which they could get more power out of the engine because the engine was not achieving its rated speed and that they had not admitted that the engine concerned was over-propped. It was therefore Mr Howard's interpretation only that in the earlier case there had been over-propping. No such situation had been acknowledged by MSE. Further, in the second affidavit made by Mr Howard, he suggested that the seven Malaysian ships may also have been over-propped. He agreed that this suggestion was based on his comparison of the results of the factory tests of the engines concerned with how they had performed during sea trials.

65 In my judgment, the defendants have not established that the failure of the engine to achieve full speed during the trials was due to over-pitching of the propeller. First, there was no evidence from a naval architect as to the relationship between the design of the vessel and the design and weight of the engine and the propeller and the likelihood or otherwise of the vessel being over-propped once the propeller was installed.

66 Secondly, if over-propping was such an obvious possible reason for the inability of the engine to achieve its rated speed, surely MBS's engineers at the sea trials would have suggested it to Bumi and MSE at the time so that steps could be taken by the shipbuilders to modify the vessel in order to solve the problem. They did not do so. The idea does not even appear to have occurred to them which in itself is strange since, if one goes by what Mr Howard says, over-propping was the reason why many of the engines of the seven Malaysian ships also under-performed at their respective sea trials. By the time the *Bumi Anugerah* was commissioned, one would have expected the defendants to be on the lookout for over-propping and to point out the possibility to the builder and owner immediately. Further, the evidence shows that MBS did not tell Bumi or MSE at the time of the sea trial that there was a problem with the engine speed. The first indication that MBS considered this a problem came in an internal memorandum in March 1995 to MBUK when MBS told the latter that the vessel could not achieve its design speed and asked MBUK for advice on how to deal with the problem. Mr Crowle responded to MBS that the cause was likely to be that the propeller was over-pitched. MBS did not, however, act any further on that suggestion. They did not bring it to the attention of Bumi or MSE even though the latter had asked them why the engine could not develop full power and there is no evidence that they investigated it further even though shortly after Mr Crowle's letter their service engineers made a visit to the vessel. Their conduct indicates to me that MBS did not seriously consider over-pitching of the propeller as having been responsible for the deficiency in the engine speed.

67 Finally, the whole basis of Mr Howard's opinion was the difference in the engine's performance during the factory tests and during the sea trials. Since he himself had to admit that the conditions in which these two sets of tests took place were different and that therefore other reasons could have contributed to the non-performance of the engine, the strength of that opinion was undermined. His willingness to make assertions with regard to other vessels previously built by MSE and MSE's acceptance of the over-propping problem without sufficient basis for such assertions also undermined the credibility of his evidence.

(iii) Overheating and breakdowns

68 The other matter that was complained of relating to the sea trials was that the exhaust temperature stood at 475°C. Bumi's case was that this was the first manifestation of the tendency of the engine to overheat. They asserted that throughout the years that followed, the engine frequently overheated when operated on HFO and that this perennial problem was one of the strongest indications of a defect in the engine design. The vessel had been designed to be operable on both LFO and HFO but it was not able in practice to operate on LFO as there was an inordinate number of breakdowns and there was chronic overheating.

69 In the report that MBS gave MSE after the sea trial, it did not accept that the average exhaust temperature of 475°C recorded when the engine was at full ahead was a serious problem. The report stated that this temperature was 'slightly higher than normal'. However, in the March 1995 memorandum to MBUK, MBS in listing the problems with the engine encountered during the sea trial mentioned that the exhaust temperatures were found to be 'relatively high'. Mr Pereira agreed that this memorandum showed that as of March 1995 there were still unresolved problems with the engine. Mr Howard too agreed that based on the internal correspondence, the indications were that the temperature was high. Bumi submitted that this evidence showed clearly that the cause of the high exhaust temperatures was the design of the engine rather than the crew's operation of it. At the sea trial stage, the engine was operated at full power but nevertheless developed high exhaust temperatures and experienced problems with balancing of temperatures.

70 Bumi asserted that the problem with overheating continued after the trials. To establish this, they relied on the analysis of the ship's records carried out by Mr Kwan. None of the engineers who had served on the ship were called to give direct evidence of the alleged overheating problem. Mr Kwan's evidence was that for the two and a half years the engine was operating, the principal problem was overheating. He also noted from the records that the engine exhaust temperatures could not be balanced from as early as the sea trial and had remained in an unbalanced state thereafter. Mr Kwan stated that the engine had experienced high exhaust temperatures at all times from delivery onwards even when it worked at loads well below 100% and that this problem had worsened progressively resulting in the exhaust manifold being red hot and glowing. He also noticed that the turbocharger had experienced regular surging during much of the period between 1996 and 1997 when the vessel was operating on HFO at lower loads. The problem became so bad that, in order to reduce it, from 14 April 1997 the main engine was operated with HSD instead of HFO. Mr Kwan noted that the service engineers from MBS had visited the vessel repeatedly to deal with Bumi's complaints. In his view, the persistence of the problems experienced by the engine indicated that the engineers were neither able to find the cause nor solve the problems completely. Mr Kwan was of the opinion that the overheating phenomenon was attributable to an inherently defective design. His opinion was also based on the fact that between delivery from MSE and final breakdown on 1997, a period of 999 days, the engine had clocked only 7,223 running hours since for approximately 25% of that period the vessel had been out of operation due to main engine problems.

71 Bumi also made much of the failure of the defendants to state what the maximum allowable

exhaust temperature was. Mr Kwan pointed out that in the instruction manual whilst a recommendation was made that the temperature differential between the inlet temperature and the exhaust temperature should not exceed plus or minus 30°C, the manual did not state what the maximum allowable exhaust temperature was. Theoretically, the engine could have been operating at temperatures of 600 to 630°C and this would still have met the defendants' operating requirements. Secondly, the defendants had given different advice from time to time on that maximum temperature. Mr Donald Chua had stated it was 540°C whereas Mr Patrick Teo, a senior service engineer, stated it was 480°C and, in their answers to interrogatories, the temperature given was between 500 and 520°C. At the trial, Mr Pereira's evidence was that, based on his experience, the maximum allowable temperature was 500°C.

72 There were also variations in the defendants' evidence as to what the normal operating exhaust temperature should be. Mr Pereira said 460°C, Mr Crowle said 450°C and, in a letter, one of MBS's employees stated that temperatures falling within the range of between 370°C and 400°C would be normal. Mr Howard was not able to give the normal operating temperature. At first he said it would vary from contract to contract, then that it would depend on the application, then that it would be necessary to use a computer to get the figure and, finally, that it would depend on the sea trial. It was odd that a mechanical engineer who had more than 30 years of experience designing and building diesel engines for both land based applications and marine propulsion applications was not able to give an indication of the normal operating temperature of an engine type with which he said he was familiar.

73 The defendants in their closing submissions dealt with the overheating problem in two parts. First, they dealt with the issue of the temperature differential between cylinders. They accepted that the instruction manual provided by MBUK stated that the difference in temperature between any two cylinders should be plus/minus 30°C. They also appeared to accept that on this engine, the temperature differentials constantly exceeded the 30° guideline. Their argument was that such excessive temperature differentials did not in themselves mean that the engine was overheating and did not of themselves prove defective engine design. They also pointed out that the engine instruction manual stated that the temperature differential guide of 30° was to be used 'only when the engine is on full load'. The manual stated the differential at no load would be at 120° which indicated that if the engine was operated at less than full load, the maximum differential would lie somewhere between 30° and 120°.

74 The defendants argued that Bumi had chosen to use the 30° figure slavishly, either out of ignorance or to create a misapprehension of the facts. They pointed out that in his first affidavit, Mr Kwan did not mention the implications of the exhaust temperature differential exceeding 30° other than to state that it showed a defective design. Throughout his supplementary affidavit which dealt with the seven Malaysian ships, however, Mr Kwan equated the exhaust temperature differential with overheating even though he had admitted in cross-examination that overheating is a separate matter.

75 Mr Crowle's evidence in chief on temperature differentials was that:

the temperature differential is a guide to show whether the cylinders are balanced and whether there are any other problems that have occurred. Where this is a high differential on a constant basis, balancing will be needed or other components and fuel and fuel treatment may have to be checked. The exhaust temperature differential is a guide and in unmanned machinery space ships, is used to trigger an alarm for engine room staff to be alerted.

When Mr Crowle was cross-examined, it was put to him that he had tried to downplay the significance of the engine temperature differential by calling it 'a guide' when in fact it was a warning of problems

with the engine. Mr Crowle denied this and maintained his stand that it was a guide rather than a warning though he did admit that the purpose of the alarm triggered by the differential in unmanned machinery space ships was to warn of problems with the engine. He also conceded that in the view of MBUK, the exhaust temperature differential was even more important than the maximum allowable exhaust temperature since the first was mentioned in the manual and the second was not. It should also be noted that even in his evidence-in-chief, he agreed that where there was a high differential on a constant basis, corrective action and/or checking of components had to be effected. It is also notable that Mr Crowle did not assert that the greater than 30° differential frequently noted in the engine room records was within normal limits because during the times when it was recorded the vessel had been operating at less than a full load.

76 The defendants did not deny that there had been numerous overheating problems with the engine. They admitted that their service engineers had attended on board on several occasions to deal with Bumi's complaints of overheating. Their position was that the mere fact of such complaints having been made did not mean that the design was defective. Overheating, the defendant said, was a symptom. It indicated that the engine was not operating well. It did not mean that the engine was poorly designed. Overheating could arise from poor combustion, maladjustment of fuel settings, poorly maintained nozzles and design defect. They submitted that in this case the overheating problems were symptomatic of the improper operation of the engine by Bumi.

77 It was accepted by Mr Pereira that the number of breakdowns and problems encountered by *Bumi Anugerah* before the vessel was two years old was not normal for a brand new engine. He agreed that if the engine was operated in a correct manner but still had this level of breakdowns and failures, the cause of the same could be a combination of bad design and bad manufacture. It was Mr Kwan's opinion that one has to look at the performance of an engine to assess the viability or success of its design. Mr Crowle agreed that the success of an engine design could be shown by the performance of an engine and that if the engine was properly maintained and operated but it persisted in breaking down, that would mean that the design was defective.

78 The evidence before me does establish, on the balance of probabilities, that the engine overheated more frequently than would be expected from a normal and newly installed engine. The overheating manifested itself from the very beginning and continued up to till the engine's final collapse. The question now to be determined is whether on the balance of probabilities the overheating was symptomatic of the improper operation of the engine by Bumi as asserted by the defendants.

(iv) Improper operation

79 The defendants submitted that there was clear evidence that Bumi had failed to operate the engine properly which consequently led to the overheating problems. Their first supporting point was that the propeller was over-pitched. I have already dealt with that.

Heat shields

80 The second point was the assertion that Bumi had operated the engine with abnormally high exhaust temperatures. MBS's service engineer, Mr Lee Meng Liang, testified that he had discovered on a visit to the vessel that the heat shields had been removed from the engine. The chief engineer had stated that had been done to enable the engineers to observe the exhaust pipe. Mr Lee told the crew that it was wrong to remove the shields because if the engine was operated without the shields, the engine room ambient temperature would increase causing the engine to draw in hotter air and this would eventually result in higher exhaust temperatures. When the heat shields were reinstalled in Mr

Lee's presence, he observed that both the room temperature and the exhaust temperature decreased immediately. I note here that this was an isolated incident and that Mr Lee could not state under cross-examination by how much the temperatures had been lowered when the shields were reinstalled.

Protection devices

81 The third point was that Bumi had intentionally disconnected the instrumentation and protection devices of the engine. This was to enable Bumi to operate the engine on HFO when the conditions were not right. Correct conditions for HFO operation would be a jacket water temperature of 70°C or more and an engine load of 75%. The evidence supporting this allegation came from service reports issued by MBS engineers. In the first, dated 17 May 1996, an MBS engineer named Patrick Cheo noted from the performance log that the engine had been operating on HFO since the vessel had been put into service despite very low water jacket temperatures and speeds not exceeding 630 rpm. The jacket water temperature switch which had been set at 70°C should have prevented the changeover under these conditions, but it was apparent to Mr Cheo that the HFO operating system had been bypassed to facilitate manual changeover to HFO. This report was the first time any observation or allegation of a deliberate bypass of the HFO system was made. When a different MBS engineer had visited the ship in February 1996, no such matter was noted or alleged.

82 The next report related to three visits made to the vessel between October 1996 and December 1996. It was noted that the engine protection alarms and trips system were completely malfunctioning, that the jacket water temperature normal protection switch had been disconnected, that the heavy fuel pressure low protection switch had been disconnected and the viscosity high/low protection alarm had been disconnected. The defendants made much of the fact that the job sheet on which these observations were recorded was countersigned by the then chief engineer. They asserted that such counter signature meant that the chief engineer accepted the observations as being correct and pointed out that Mr Kwan's opinion was that the chief engineer would have verified the information in the job sheet before signing it. It should also be noted that during the service engineer's visit, all the protection devices were reconnected and the whole HFO protection system was then tested again to ensure it was in good order. Mr Crowle also visited the ship in late September 1996. He noted that from readings in the log sheet, it appeared that between July 1995 and 18 September 1996, the engine had been running on HFO even though the jacket water outlet water was consistently below 70°C. He also noted that whilst the engine had been running on HFO between 9 September 1996 and 18 September 1996, no speeds above 575 rpm had been recorded. Thus, the 75% MCR requirement had definitely been breached during that nine day period.

83 Mr Kwan agreed that it was bad practice to run the engine without any thermostat or protective devices. He also agreed that there were no entries in the log book which recorded the disconnection and/or malfunctioning of the auto changeover system. He agreed that a reasonably competent and hardworking engineer would record a defect in the auto changeover valve.

84 The defendants' case was that if the protective devices were malfunctioning or deliberately disconnected, that would allow the crew to operate the engine on HFO even when the appropriate conditions did not exist. For one thing, fuel with a higher than allowed viscosity could then be injected into the cylinders. Mr Kwan agreed that if this was done, the result would be high exhaust temperatures. The defendants submitted that this was precisely the circumstance in which the vessel's engineers were operating the engine. Without any protective devices, they were operating the engine manually on HFO, according to the job sheet, for a long time. That the exact length of time is not known is due they say to the shoddy records kept by Bumi and the fact that none of the engineers were called as witnesses.

85 Bumi's reply to the above assertions was that there was no basis to say that the devices had been deliberately or recklessly shut off. The reports of MBS themselves showed malfunctioning which had been repaired. Further, Mr Crowle had agreed that manual operation of the changeover system would not cause damage to the engine. It should be pointed out that Mr Crowle's agreement was on the basis that when the crew effected the manual changeover from LFO to HFO, the temperatures were correct and the engine load was also correct.

86 It is difficult to assess the evidence on this point. On the one hand, only three out of the 12 reports that the defendants' engineers produced between 1995 and 1997 mentioned the disconnection of the protective devices and it is not clear whether the devices were disconnected before or after the engine broke down. On the other hand, there is no record in the ship's documents of when these devices malfunctioned (as should have been the case had the devices ceased to operate because of breakdowns) and no way of knowing how long such malfunctions continued before the engineers were called in. It appears to me that it is likely that for certain periods of time, at least between around March 1996 and mid October 1996, the engine was operated on HFO despite the non-functioning of the protective devices and that during those periods there was a possibility of overheating and damage to the components from such operation. There was also evidence of the engine running on HFO between July 1995 and May 1996 despite low jacket water temperatures. When this happened, damage to the engine could have occurred.

Fuel quality and lubrication system

87 The defendants' next argument was that prior to the commissioning of the *Bumi Anugerah*, Bumi did not have experience in operating a medium speed HFO engine. They based this on Mr Robert's confirmation that before the vessel was built, none of Bumi's vessels had a 16 cylinder V-type medium speed HFO 1,000 rpm engine. The defendants submitted that Bumi's inexperience in operating medium speed engines on HFO manifested itself in two ways:

> (1) fuel quality – Bumi were not aware of the importance of fuel quality and since no samplings were recorded in the log book and no test reports were obtained it is likely that no bunker samples were taken; and
>
> (2) Bumi were also not aware of the importance of the regular operation of the lube oil purifier and carrying out regular lube oil sampling in order to maintain the lubrication system properly.

88 In their submissions on the first point, the defendants stressed the need for the HFO used on the vessel to have the specifications set out in their manual. They pointed out that there were no records of bunker sampling having been done on supply of the bunkers to the vessel. Also, there was no documentary evidence on the quality of the bunkers supplied apart from a 1986 Pertamina document setting out the specifications of HFO that it dealt in. There was nothing to show that the bunkers supplied by Pertamina between 1995 and 1997 met these specifications. The inference that the defendants want me to draw is that the HFO supplied was not of the correct quality. It is no doubt true that there is nothing from the ship that indicates that the bunkers were of any particular quality. However, this is an allegation made by the defendants. They would have had the burden of proving it had they pleaded it. They did not plead that the problems with the engine were due to the use of poor quality bunkers. If they had, some documents on the bunkers used might have been provided. The defendants cannot use this argument now. In any case, their engineers went on board the ship on many occasions and noted that the engine was running on HFO. If they had been in any doubt about the quality of the bunkers, they could have warned Bumi about this and ascribed the difficulties with the engine to poor quality of HFO. They did not do so. I do not find any merit in this complaint.

89 Next in respect of the lubrication system and the lube oil purifier, the basic allegation was that the engine was operated on dirty or poor quality lube oil. The importance of this issue is that when an engine's lubricating system is not operated properly, it will not be able to perform its function of cooling the moving parts of the engine and the engine will overheat. The defendants therefore say that it is critical that the lubricating system is in full working condition at all times and that the lube oil is regularly monitored. In their defence, the defendants ascribed engine overheating and the damage sustained by exhaust valves and valve guides to poor quality lube oil and the use of non original lube oil filters. The defendants said that the lube oil system had these specific problems:

(1) the lube oil purifier was frequently either not in operation or had malfunctioned;

(2) it is probable that Bumi were using the wrong lube oil; and

(3) Bumi were using non-genuine filter elements.

90 The defendants submitted that there was absolutely no evidence that lube oil samples were taken by the vessel's engineers. There were no records of lube oil sampling in the log book. No other records of such sampling or the results of any lube oil tests were disclosed by Bumi. In this respect, Mr Kwan agreed that it is prudent for periodic sampling and testing of lube oil to be carried out and that records of the lube oil tests should be kept. He also agreed that any well run ship would have records of lube oil sampling if such sampling had been carried out. In my view, the defendants did establish that Bumi did not operate the ship properly in that it did not follow established procedures for sampling and testing lube oil and recording the results. Improper operation of the lubrication system in that manner does not, however, mean that overheating resulted.

91 The only evidence of the actual condition of the oil came from a sample taken by Mr Cridland when he went on board the vessel in September 1997 after the engine failed. It was taken from a barrel on the ship which Bumi told Mr Cridland contained the engine oil which had been in the sump when the engine failed. This oil, when analysed, was deemed satisfactory and suitable for use. That was a finding that did not support the defendants' stand. They therefore tried to get around it by casting doubt on whether the oil had actually come from the sump or not. Mr Cridland's opinion was that the complete test results showed that the lube oil sample was too close to the specifications of new unused lube oil. Under cross-examination, however, he agreed that the 'TBN number' of the analysed oil was lower than the TBN number of new oil would be and therefore that it appeared that the sample oil had been used. Mr Pereira also opined that if the oil in the barrel had been through the engine before being put into the barrel, the analysis result would have been different though he modified his opinion later and said that it was possible the oil had been used.

92 The defendants also relied on the alleged failure of the lube oil purifier to function for substantial periods of time. They pointed out that their service engineers had on various visits to the ship found the purifier to be inoperative. Such findings were noted during visits in September/October 1996, October/November 1996, December 1996 (on two visits), January 1997 and September/November 1997. Bumi's position, based on Mr Kwan's review of their documents, was that the oil purifier was operated where necessary during sea passage. There were, however, occasions when it malfunctioned and could not be operated until spare parts arrived. In response, the defendants submitted that it was not possible to tabulate the running hours of the lube oil purifier based on the log books because the entries there were inaccurate and inconsistent. For example, whilst there was an entry that the lube oil purifier was switched on, there was often no corresponding entry when it was switched off. Yet, there would be another later entry stating that it was switched on again. That must mean that some time between the two entries, the lube oil purifier had been switched off. The length of time during which the lube oil purifier was run between any such two

entries could not be ascertained since none of the engine room crew responsible for the entries was called to testify. Mr Kwan admitted that the log book entries on the use of the lube oil purifier were unsatisfactory.

93 Mr Kwan also said that although the use of the purifier was desirable while the main engine was operating on HFO, it was not mandatory as otherwise MBUK would have installed oil purifiers so that there would be some form of backup. He also commented that switching off the purifier would not explain the high temperatures. In any event, it would appear that the lubrication oil was changed regularly and therefore it may not have been necessary to have the purifier on all the time. Mr Pereira agreed that the purifier need not be on all the time. Mr Cridland's report stated that there were records showing regular use of the lube oil purifier and that he got the information from the engine log sheets.

94 Regarding the lube oil filters, the defendants had specified that Vokes filters were to be used on the engine. Mr Crowle testified that this was because these were strong filters and strength was required to prevent the filter from bursting as it collected more dirt from the lube oil. The Vokes filter had been developed specifically for the type of engine supplied to the *Bumi Anugerah*. The defendants asserted that Bumi had used non-Vokes filters. Bumi denied using non-Vokes filters. They pointed to Mr Crowle's report that he had found Vokes filters in use on the ship and to Mr Cridland's testimony that he had found both Vokes filters and filters of unknown manufacturer on board. In October 1996, however, Bumi did tell MBS that they had used 'pirate filters' from time to time when Vokes filters were not in stock in MBS's store in Singapore. They stated that these pirate filters had been manufactured by a reputed company and had the same micron filtration rate. Mr Pereira's evidence was that it would make no difference to filtration of the lube oil as long as the filter that was used had the correct micron filtration rate, even if it was not the Vokes type. He agreed that non-robust filters would burst. Bumi pointed out that on both occasions when the filter canister was examined by the defendants' engineers, the filters were found to be intact.

95 The final assertion in this connection was that Bumi used the wrong type of lube oil. The defendants' position was that the right type of oil was one that had a TBN number of between 25 and 30 when new. In October 1996, an MBS engineer noted that the oil in use was 'Shell Argina T30'. No adverse comment was made about this. Subsequently, on a visit in December 1996, the service engineer found that the lubricating oil used was Pertamina Meditran S40. That had a TBN of 10.6 which he considered too low for HFO operations although in the case of another ship with the same engine Mr Chua had advised that a TBN of 10-12 was acceptable for such operations. In January 1997, the lubricating oil used was found to be 'Argina T40'. At the time MBS notified Bumi that one of the reasons for the high exhaust temperatures was the use of unsuitable lube oil which had a low TBN number and that lube oil used should have a TBN number of 25 to 30 when fresh. Bumi's response was that they had always used proper lube oil such as Shell Argina T40 and that whilst they had bought Meditran S40 and that was also compatible with the engine, they had not used it on the vessel after having purchased it. In a subsequent message MBS referred to Bumi using 'our [ie MBS] approved Shell Argina T40 oil'. It should be noted that the sample of oil that Mr Cridland took from the ship in September 1997 was found to have a TBN number of 26.6 when tested and it was therefore of suitable quality.

96 This is another issue on which the defendants have the burden. Having assessed the evidence in total, it has not been established on the balance of probabilities that the use of non-Vokes filters contributed to dirty lube oil. It has not been established either that overall Bumi used the wrong lube oil though they might have used an incorrect type of oil for short periods of time. The defendants' evidence points to the correct oil being used more often than not. Since no records were produced of lube oil sampling or when the lube oil was changed, it is difficult to ascertain whether the

lube oil was always changed before it became too dirty. However, whilst there is evidence from the defendants' engineers that they repeatedly warned Bumi of the necessity of ensuring that the purifier worked, there is very little evidence of actual dirty oil. Mr Crowle saw sludge in the crankcase and considered this made it clear that there had been periods when the lube oil had had very high levels of solids and the oil in use at that time might not have reached the required performance level, but that is not evidence of consistently dirty oil. It was Mr Crowle's opinion that the bearing failure in September 1997 resulted from poor lubrication. Even if that opinion is correct, it does not mean that the overheating that arose from the time of delivery of the vessel was, on balance, due to lubrication failure.

(v) Proper maintenance

97 It was Mr Kwan's opinion based on his review of the vessel's documents that the engine had been properly maintained and operated. He pointed out that when the engine finally broke down many of the maintenance milestones had not been reached. Whilst he agreed that maintenance work had to be done on the engine, his view was that as this engine was brand new, not much work would have been required or expected. In his view also, the engine had to be designed in such a way that maintenance work was practical. If it had to be maintained or operated in an unrealistic manner then he would consider that the engine design had failed.

98 Mr Pereira agreed that maintenance of an engine usually involves watch keeping duties. Change of engine parts and maintenance work would only be done if the engine had been stopped. Further, the engineer would not be changing parts unless there was a breakdown or a service interval had been reached.

99 The defendants' criticisms of the way in which the engine had been maintained and operated were limited to the matters discussed in ¶ 79 to 96. I have discussed those already and need not deal further with this issue.

(vi) The engine was not properly up-rated and developed

100 The *Bumi Anugerah* was one of 12 vessels fitted with the same engine type manufactured by MBUK. The only difference between its engine and the other 11 was that Bumi's engine was rated 4,000 hp at 1,000 rpm whereas the other 11 engines were all rated 3,500 hp. Bumi asserted that their engine was not properly up-rated and developed to produce 4,000 hp. The defendants' pleaded case was that the engine was designed from the outset to produce 4,000 hp plus 10% overload and that in order to supply the other 11 lower horsepower engines, they had de-rated the engine by limiting the fuel racks.

101 Bumi submitted that if the defence case was true, the engine would have no problem producing 4,000 hp and, logically, in order to provide Bumi with a 4,000 hp engine, no modification of it would be required. All that would have to be done would be to set the fuel racks in such a manner as to allow 4,000 hp to be produced. The defendants had pleaded that when the engine was up-rated back to 4,000 hp, they made minor changes to the piston rings and pistons based on long term development to ensure adequate sealing. Bumi submitted that the need to make these changes showed that the engine was actually designed to produce 3,500 hp and had to be modified to produce the greater power.

102 Mr Howard was cross-examined on this point. He said that the changes to the piston rings and pistons were to withstand the higher horsepower. It was then put to him that if the engine had been designed to produce 4,000 hp there would have been no need to make such changes. His

response was that minor changes to piston rings details are always part of an engine development programme after testing as it is not possible to completely design the piston rings on a drawing board. Mr Howard explained that the design of this engine began in 1984 with the design output of 4,000 hp from 16 V line cylinders run on both distilled and heavy fuel. MBUK spent two years on performance and endurance testing before they released the first engine in 1987 at a lower rating than designed. If design engineers could get it right the first time from the drawing board, the company would not spend millions of pounds on development and that development by its very nature would involve changes to component design. Piston ring technology was still changing and MBUK would when necessary change designs to ensure that they provided the best possible product. The changes to the piston and piston rings were not made because the original components could not withstand a 4,000 hp. They were made in order to improve the product. Mr Howard emphatically disagreed that the engine was originally designed to produce 3,500 hp and that the changes to the piston rings were made in order for it to produce 4,000 hp.

103 Whilst it might seem logical to Bumi that changes to the piston rings were made in order to up-rate the engine, I cannot decide a technical point like this on logic alone. Mr Howard was an engineer and a designer and had the relevant experience as to what it takes to design an engine and then develop it to the stage when it can be put into production and market it. Bumi did not produce any witness with any knowledge of what the engine was originally designed to do or who could say that it was only able to produce 4,000 hp because of the changes in the piston design. I have no basis on which to reject the evidence given by Mr Howard on this point.

104 Bumi also submitted on the basis of evidence elicited from Mr Crowle, Mr Howard and Mr Pereira that MBUK's development of the engine was haphazard and that MBUK having originally built the engine as an industrial engine for use on land, had not subjected it to sufficient testing on vessels and in tropical environment. There was no evidence from other marine engine makers as to how they develop and test their engines. I am not able to hold that the engine was haphazardly developed or insufficiently tested.

(vii) Defective parts and modifications and improvements

105 In the course of the trial, evidence was given that the defendants periodically recommended modifications and improvements in respect of the engine. It is Bumi's case that these modifications and improvements were attempts to rectify existing inherent defects in the engine rather than to upgrade the engine.

106 Bumi relied on the cross-examination of Mr Crowle on this issue. He explained during cross-examination that when a service engineer visiting a ship found that an engine part had failed, he would replace the part and return the failed component to MBUK for investigation accompanied by his report. These items would be directed to MBUK's engineering department for review. In the review process, MBUK would consider whether a part is unsuitable because of material or design. Mr Crowle named some instances where defects in design or material were identified. These were:

> (1) the change of the material used for exhaust valves from stellite to nimonic so that the valve could withstand higher temperatures. The stellite valve had worked well when the engine used LFO but there had been problems when it was working with an engine with HFO;
>
> (2) changes had been made to the exhaust valve seat insert to improve the grip of the seat. This part had worked well with an engine functioning on LFO but Mr Crowle did not agree that the original design was not suitable for HFO and suggested it was a progressive improvement;

(3) the material of the injector tube was changed from copper to stainless steel. This was a design change. Mr Crowle agreed that when the engine operated only on LFO there were no problems with copper injector tubes;

(4) changes were made to the fuel pump so that it worked better with HFO than the original pump had;

(5) changes were made to the indicator cock because the existing cocks kept breaking off. No problems had been experienced when the engine ran on LFO. The cocks were changed only in 1995 when most of the engines were operating on HFO and a pattern of failure had led to the change; and

(6) there were changes made to the flame ring of the cylinder liner.

During cross-examination Mr Crowle also dealt with the service bulletin which the MBUK issued in March 2000 in respect of the ESLMK2 VEE engines recommending a change in the tightening torque of the studs of the large end bearing housings. His position was that the change was advised because of a change in the manufacturing process and not because the original recommendation had been wrong.

107 Bumi had also pleaded in ¶ 11 of the statement of claim that various components of the engine had been negligently designed, manufactured and/or installed. A list of these parts is set out in ¶ 47 above. Some of them were also improvements mentioned by Mr Crowle. I will deal with these parts and the various items identified as design improvements by Mr Crowle and listed in ¶ 106 above together.

Exhaust valve seat inserts

108 On 1 January 1996, the turbocharger was found to be damaged and could not be operated. In the course of investigations and repairs, the exhaust valve seat insert which was supposed to be in the cylinder head of piston B5 was found to be missing. MBS's service engineer concluded that the prolonged running of the engine with a high exhaust temperature had caused the insert to become detached from its pocket in the cylinder head and to travel down the exhaust manifold and then enter and damage the turbocharger. In a subsequent report from another MBS engineer, the failure of the valve seat was again ascribed to continuous operation of the engine on high exhaust temperatures. Mr Kwan noted this information and reviewed the exhaust temperature records of B5 unit for the two months prior to the incident. He found that on one occasion in November 1995, the temperature reached 512°C and in December the temperature ranged between 420° and 486°C. During the watch preceding the turbocharger failure, the exhaust temperature for the B5 unit was 458°C. Mr Kwan did not agree with the conclusions of the service engineers that the failure of the insert was due to running the engine on high exhaust temperature since the instruction manual did not provide an exhaust temperature limit and therefore, theoretically, it was safe to operate the engine on very high temperatures. In his view, the more probable cause of the failure was the design of the insert. It was prone to detaching during operations. Mr Kwan considered that his conclusion was supported by the fact that MBUK came out with a modified valve seat insert in September 1997 which had more grip and holding power than the one originally fitted on the *Bumi Anugerah.*

109 In court, Mr Kwan agreed that simply because an engine maker made a modification or improvement to his engine that did not necessarily imply that the engine had been bad before the improvement. The improvement could have been intended to make the engine better rather than to correct a defect. Mr Kwan also agreed that if there was a localised hot spot that would have

affected the particular insert where the hot spot was created and cause it to be detached.

110 The defendants asserted that the change in the design was to cater for the effects of poor operation and to limit damage if the insert burnt through. Mr Crowle's evidence was that the modification was taken from a different type of engine and was effected to give additional security to the insert. MBUK effected the modification as they did not understand the cause of the failure and it was considered prudent to change to a design which would give better security anyway. So it was a progressive improvement. Mr Howard also testified that the modification was meant as an increased safety measure and was not a re-design or rectification of the existing insert design.

111 On balance, there is insufficient evidence to establish that the original insert was of a defective design. During the period of operation of the vessel, there was only one failure of an insert despite the fact that the engine was mostly run on HFO and despite the frequent occurrence of the engine overheating. I accept the evidence of the defendants that the change in the design was to improve a satisfactory component. However, even a satisfactory component can malfunction if subjected to prolonged high temperatures that were not anticipated.

Indicator cocks

112 Each of the engine's 16 cylinders had an indicator cock to allow purging of the cylinder. Although the defendants' manual did not specifically mention servicing the indicator cocks it did state that the cylinder heads should be serviced after 6,000 hours. This would imply that the indicator cocks being part of the cylinder heads would be serviced at the same time. Bumi's case as pleaded was that the indicator cocks on their engine started to fail after 1,200 hours of operation. The first failure took place in March 1995. Problems with the indicator cocks were experienced on 8 June 1995, 21 June 1995 and 5 July 1995, and in February 1996, many cocks were found leaking. More indicator cocks leaked in March 1996 and had to be welded. Eventually, all the indicator cocks had the same problem and were repaired by the ship's crew until the defendants came up with a modified version of the cocks.

113 The defendants really did not have much of a reply to Bumi's recital of the failures noted in respect of the indicator cocks. No explanation was given as to why these components failed. The defendants argued that as not all the Malaysian ships experienced problems with indicator cocks, that was a strong indication that a defective design was not the cause of the problem. However, Mr Crowle's evidence was that the indicator cocks were modified after review because they kept breaking off. He also confirmed that no problems with the cocks were experienced when the engine operated on LFO. On the evidence, I find that the original design of the indicator cocks was defective.

Turbocharger

114 The turbocharger broke down twice while the vessel was operating. The first breakdown, in January 1996, was attributed by the defendants to the detachment of the insert. The second failure took place in September 1996. Bumi's case as pleaded was that that failure was caused by the bad design of the orifice of the oil line. This had a diameter of 5.2 mm and Bumi contended that that diameter was too small as it meant that even a minute object or tiny accumulation of dirt could block the flow of oil to the turbocharger. They also pointed out that on the *Sari Marina,* another vessel installed with the same engine and turbocharger, the diameter of the oil line had been modified to 8 mm in 1993. They argued that the defendants ought to have used due care and fitted a lubrication oil line with an 8 mm orifice to the engine supplied to them as well.

115 The defendants submitted that Bumi had no justification for their criticisms of the size of the orifice apart from Mr Kwan's opinion that 5.2 mm was too small because the orifice was modified to 8 mm on another vessel. Mr Kwan himself had agreed that this was the sole basis of his opinion that the design of the oil line was bad. The defendants submitted that the evidence did not support Bumi's allegation. The obvious consequence, if the orifice size of 5.2 mm was indeed too small, was that there would be sludge or deposits in the orifice itself. However, when Mr Crowle visited the vessel in September 1996, he measured the orifice and noted that the entry port was '50% blocked with sludge sloping back toward orifice'. Mr Crowle did not note that there was any sludge blocking the orifice itself. Mr Crowle's observation meant that the sludge was in the oil supply line and not in the orifice itself. Mr Crowle had also noted that the supply pipe final bend had a severe kink which would reduce oil flow to the turbocharger.

116 Mr Crowle's visit was for the purpose of determining what had caused the turbocharger to breakdown. He found that severe wear had occurred to the thrust bearing resulting in damage to the compressor wheel and turbine. He considered that this was due to a restriction in the oil supply caused by a built up of sludge in the oil supply flange. MBUK stated that that could only have been due to crew negligence in maintaining lube oil condition to a suitable standard. They warned Bumi that if the engine was run with a turbocharger in that condition it was likely that a major failure would occur.

117 The turbocharger was not designed nor installed by the defendants. It was manufactured by ABB, a very well known turbocharger manufacturer. Whilst Mr Kwan considered that the size of the orifice of the oil line was too small, there was no physical evidence of blockage of the orifice itself. Such sludge as was found was deposited at the entry port and along the supply line. The fact that the orifice on another turbocharger was increased in size cannot mean that this orifice was too small. This criticism of the turbocharger has not been proved. Mr Kwan had also asserted that the turbocharger supplied was not suitable for the engine. This assertion, however, was not pleaded and I do not have to deal with it.

Cylinder heads

118 Bumi pleaded that the cylinder heads were negligently designed, manufactured and installed. During repairs to the ship from 20 September to 10 December 1996, cylinder heads B1, 4, 5 and 6 were found to be cracked and were replaced by new cylinder heads. Cylinder heads A1, 3, 4, 6 and 7 were overhauled. Despite this, just after the vessel went back into operation, leakage of fuel oil from the cylinder heads was observed and cylinder heads A2 and A3 were found to be leaking at the injector tubes. It is Bumi's case that due to poor design, the cylinder heads were not capable of withstanding the normal operation of the engine and/or that they could not withstand the persistent high exhaust temperatures experienced.

119 Mr Kwan's opinion was that the leakage was probably due to the design of the cylinder head, which could not accommodate the variation in temperature and thermal stresses on the cylinder head when the engine operated on HFO. This caused slight deformation after a period of use resulting in the leakage.

120 The defendants while admitting that some of the cylinder heads were damaged and replaced, asserted that this damage was due to the improper operation of the engine on HFO at speeds less than 700 rpm and water temperatures of less than 70°C and the fact that the automatic changeover valve in the fuel system was found disconnected, causing overheating, poor combustion and other related problems.

121 During cross-examination, Mr Kwan was asked several times whether he had evidence that the cylinder heads had been slightly deformed. Eventually, he admitted that he had no evidence of a slight change of shape of any cylinder head.

122 Mr Kwan's theory of deformation may not have been supported by any physical evidence. On the other hand, the defendants did not put forward much evidence in support of their suggested cause of the damage to the cylinder heads. They stressed the fact that after a major overhaul of the cylinders was done in early 1996, there was no evidence that Bumi's engineers had balanced the cylinders. Definitely, Bumi had not asked MBS service engineers to help them in this task, something that was good practice after such a major overhaul. The defendants did not, however, cite any evidence to establish that the failure to balance the cylinders was what led to the cracks and leakage problems seen in the last quarter of 1996. They simply assert that the undisputed evidence is that the problems with the cylinders were due to the bad operations/maintenance or ignorance of Bumi in the operation of the engine.

123 It was accepted that there was damage to the cylinder heads and that there was leakage. It was also accepted that this was not a normal condition for a new engine. Mr Kwan put forward a possible theory based on the pattern of failures that he observed. The defendants did not discredit this on the basis that such deformation was not possible or that their engineers had investigated and found no such deformation to exist. They simply criticised the theory for being a theory. On the other hand, they did not put forward sufficient evidence to establish that the actual cause of the damage was improper operation. On balance, I find that the cylinder heads were defective.

Fuel pumps

124 Bumi pleaded that all 16 fuel pumps were replaced in February 1996 after one year or 4,366 hours of operation. They contended that replacement of the fuel pumps at this stage was premature and not normal. There was actually no apparent failure of the fuel pumps and the replacement was volunteered by the defendants as a 'warranty exchange' although at this time the warranty of the engine had already expired. The new fuel pumps were of an upgraded design and Bumi alleged that this meant that the original fuel pumps were not of the correct design to begin with.

125 As the defendants submitted, Bumi did not particularise any specific deficiency in the design of the fuel pumps. Their logic was that because a new pump was put in, the original pump was defective. Mr Kwan also agreed in court that the original fuel pumps were not defective. Mr Crowle's evidence was that the new fuel pump had been developed by the pump manufacturer and had been found to be very good with HFO burning engines. The main reason that the new pump type was introduced was improved fuel consumption. Mr Howard agreed with this point. The new pump did work better with HFO than the old pump but that did not make the design of the old pump defective. I find no merit in this allegation of defective design.

Exhaust valve and valve guides

126 In February 1996 after 4,366 hours of operation, the exhaust valves and valve guides were found to have excessive wear. The defendants admitted that these components were worn prematurely. The true cause of the premature wear is what is in issue.

127 Bumi asserted that the excessive wear in itself was evidence of defective design, manufacture and installation. They also alleged that the design of the guides was not suited for HFO operation. Bumi disagreed with the defendants' contention that poor lubrication and poor maintenance caused the wearing of the exhaust valves as the inlet valves and rocker arm bearings

were not similarly affected and these parts shared a common lubrication system.

128 The defendants pleaded that the failure was caused by seven different factors. In their closing submissions, however, they concentrated on the issue of poor lubrication. They relied on Mr Crowle's evidence that notwithstanding the common lubrication system, the loads and manufacturing tolerances for different types of bearings would be different. Even bearings with similar loads would not be affected in the same manner by bad lubrication. Thus the fact that the inlet valves and rocker arm bearings did not show signs of excessive wear even though they shared a common lubrication system with the exhaust valves, did not mean that the excessive wear of the latter was not due to bad lubrication.

129 As I have stated in ¶ 97, there was some evidence that the lube oil was dirty from time to time during the vessel's operation. There was not, however, sufficient evidence for me to find that the lube oil was consistently dirty. The failure of the exhaust valves occurred only one year after the vessel went into operation. The service reports issued by the defendants' engineers mentioned leaks in the lubrication system but not that the oil was dirty. There was no mention of bad lubrication in the first two reports issued in 1996. In my view, the premature wearing of the exhaust valves indicates a defective product.

Fuel injectors

130 Bumi pleaded that the fuel injectors were poorly designed leading to dribbling after they had been in service for a short period and to the engine room crew having to constantly lap the valves of the injectors in order to maintain operations.

131 The defendants on the other hand submitted that the failure of the fuel injectors must be attributed to the improper operation of the engine in that:

(a) the crew had constantly removed and lapped the fuel injectors when they were not supposed to do so; and

(b) the crew had used non-original copper washers that had probably contributed to the high exhaust temperatures.

There was also an assertion that the crew had failed to follow the proper procedure for the maintenance of the nozzle cooling system but the defendants did not present any evidence on improper maintenance apart from the constant lapping of the injectors.

132 In the instruction manual for the engine, it is expressly stated that 'on no account must any attempt be made to lap the nozzle in the valve'. Mr Robert, however, considered that it was normal practice to lap fuel nozzles. That the crew thought so too was shown by Mr Kwan's report which, based on his perusal of the log books, mentioned frequent occasions of lapping of the fuel injectors. There was also evidence that non-original copper washers were used as these were found on board by the service engineers on visits to the vessel in the first half of December 1996 and again at the end of January 1997. Following this latter visit, MBS warned Bumi that using ordinary copper washers for the injectors would lead to leakage of hot combustion gases into the injector tube compartment affecting its water tightness. The evidence given by Mr Lee who was the engineer who visited the ship in January 1997 was that the copper washer is an interface between the fuel injectors and the cylinder heads. The washer prevents the combustion gas from coming out of the combustion chamber. If non-genuine washers are used the interface may not be correct thereby allowing gas to leak through the copper washer.

133 Having considered the evidence, I am satisfied that the crew did not maintain the fuel injectors properly in that they were lapped too often and incorrect washers were often used. It has not been established that the problems with the washers arose from defective design.

Extractor fan

134 Bumi pleaded that the defendants had been negligent in their design of their engine in that they had failed to fit an extractor fan to reduce the crankcase pressure in the engine. There was also no manometer or vacuum gauge fitted. A properly designed engine should have had these devices.

135 There was no merit in the first allegation as, as Mr Kwan readily admitted, the engine was in fact fitted with an extractor fan. As regards the second allegation, it appeared to be based on a recommendation made by an MBS service engineer in March 1995 that a manometer be fitted to the fan. There was no direct evidence that a fan without a manometer would be badly designed. Mr Kwan could not even remember whether he had ever sailed on a ship where the engine had been fitted with an extractor fan. He agreed that the level of instrumentation on ships varies very greatly. I find no merit in the criticism of the extractor fan.

The governor drive shaft

136 Bumi pleaded that the governor drive shaft was a negligently designed or manufactured part in that it sheared after only 180 hours of operation. The defendants admitted that the metal used to manufacture the governor shaft was inherently defective and that that defect could not have been discovered with reasonable care and skill. As a consequence they had replaced the shaft and the replacement shaft did not fail. In my view, one failure of the governor drive shaft due to defective material does not mean that the shaft was negligently designed. In any case, since the defective part was replaced by a good part very early on, that defect did not contribute to the final breakdown of the engine and cannot be considered as part of the case.

(viii) The effect of prolonged overheating

137 Mr Kwan's evidence was that the prolonged overheating of the engine and the unbalanced exhaust temperatures would have affected the material structure of the components of the main engine. The full impact of the overheating would be felt by the pistons, liners and cylinder heads and the engine block, crankshaft and other parts of the engine would be affected to a lesser degree. The defendants did not seriously dispute that prolonged overheating of the engine would have adversely affected its performance and the effectiveness and longevity of its components.

(ix) The Malaysian ships

138 It was Bumi's case that the breakdowns and problems faced by them in relation to the engine were not a restricted or isolated case. They adduced evidence relating to seven Malaysian ships equipped with the same type of engine and submitted that this evidence showed that the engines of these ships had exactly the same or strikingly similar problems to those faced by Bumi. These ships, *Meridian Vega, Budi 1, Hafetzah, Sari Marina, Budi Permai (ex-Asikin), Rohas Ria* and *Shafinaz Ria*, also had the same problems in operating the engine with HFO and experienced inexplicable high exhaust temperatures. Further, the defendants' evidence showed that six of the ships had now switched permanently to using MDO instead of MFO because the cost of maintaining the engines on HFO had become so high that it was cheaper for the ships to operate on the more expensive MDO. Bumi also made submissions on four other ships using the same engine and operated by another shipping

company but there was no evidence on exactly what difficulties had been experienced by those engines and I will not comment further on those vessels.

139 The defendants pointed out that this was not a trial about the problems with the seven Malaysian ships. There was no evidence that the owners of the ships had ever complained of any design defects and Bumi's allegations of defective design were based on Mr Kwan's review of the defendants' files on the ships. The defendants also considered it significant that there was a change of ownership in 1994 when Global Carriers took over ownership of six of the ships and MCM started to manage them. The initial problems were slowly resolved after this change in operation. Mr Kwan's attitude, as the defendants noted, was that if the engines on all the seven ships had had similar problems from time to time, then these problems must all have had the same cause. That was not logical as even similar problems may have different causes. Further, the cross-examination of Mr Kwan showed that the different ships had different problems, even though there was an overlap. The constant factor was an inability to reach 1,000 rpm on LFO or HFO. The defendants, taking a leaf out of Bumi's book, suggested that the common cause of this problem was overloading since all the vessels and their propellers had been designed by MSE.

140 Six of the seven ships are currently managed by a company called Maritime Consortium Management ('MCM') and owned by a shipping group called Global Carriers. The seventh ship, the *Meridian Vega*, is managed by Prima Shipmanagement and owned by Halim Mazmin Bhd. Evidence in relation to the MCM ships was given by Mr Hendricks and Mr Chan who had previously worked for MCM. Mr Hendricks was also able to give evidence on the *Meridian Vega* as he had been chief engineer on that ship for seven months. Other evidence on that vessel was given by Mr Ooi Ka Lok and Mr Zubir. No evidence on the vessels was given for Bumi by any current employee of MCM or Prima Shipmanagement.

141 I will deal briefly with the evidence Bumi adduced and the defendants' response.

Hendricks Dias Simon

142 Mr Hendricks had about 15 years of seagoing experience as an engineer on board various types of ships including the *Meridian Vega* and the *Budi 1* where he was the chief engineer for short periods. Thereafter he was an engineer superintendent in the employment of MCM. In this position, he monitored and supervised the technical operations of the vessels managed by MCM including the *Hafetzah*, *Sari Marina* and *Budi Permai*.

143 Mr Hendricks filed a fairly long affidavit of evidence-in-chief. Many of the paragraphs of his affidavit were subsequently expunged and I was surprised to note that Bumi's submissions nevertheless recited the material in these paragraphs as part of the evidence given by Mr Hendricks. That was something that should not have been done and Bumi's solicitors ought to be criticised for the lack of care in the preparation of the submissions.

144 The part of the affidavit that was admitted contained an assertion that all the engines on board the seven Malaysian ships experienced abnormally high temperatures leading to breakdowns. Mr Hendricks was aware of and had to tackle this problem during the time he sailed on *Meridian Vega* and *Budi 1*. Later when he worked as engineer superintendent he continued to tackle the same problem. The engines frequently had difficulty going to higher speeds without overheating. On average the rpm was restricted to between 850 and 880 rpm. The exhaust manifolds of the engines were continuously in a red hot condition. There were clearly problems with the use of HFO. When Mr Hendricks first took over as engineer superintendent of the *Sari Marina* and *Hafetzah*, he found that the crew were using marine gas oil (MGO) which is a better quality fuel than HFO. They did so in

order to reduce the breakdowns as the engines performed better with MGO. To solve the problems that arose when the vessels burnt HFO, MCM would flush the engines with MGO after every 24 hours or whenever there were problems with high temperatures or when there was excessive black exhaust smoke. The flushing procedure was to clean the system in order to bring the temperatures down. This procedure was still being followed by MCM. Bumi pointed out that Mr Pereira agreed that the flushing described by Mr Hendricks was an unusual procedure.

145 Mr Hendricks observed that the defendants recommended that cylinder heads be overhauled once every 6,000 hours and that a major overhaul of cylinders be carried out every 12,000 hours. In practice, however, MCM had to do a top overhaul of the cylinder heads every 2,000 hours when HFO was burned or every 3,000 hours when MDO was burned. Major overhauls were carried out approximately every 6,000 hours. MCM had to develop its own schedules which brought forward the recommended service intervals and overhauls because of the poor performance of the engines. He also made an allegation that more spare parts were purchased for the defendants' engines than for engines made by other makers.

146 The defendants submitted that Mr Hendricks' testimony was extremely suspect and should not be believed. First, he had said that he was approached by Mr Singgih of Bumi some time in early July 2002 and asked to testify. He met Mr Singgih in Indonesia as he was already there to attend to a vessel. He subsequently admitted that he had made an unsolicited approach to Bumi to assist them because he wanted to obtain 'justice'. He also admitted that he had been involved in persuading another MCM employee to give evidence on Bumi's behalf, though that employee had later changed his mind. Mr Hendricks agreed that he had been suspended from his employment by Global Carriers and MCM for disobeying their express instructions not to be involved in the action. He, however, denied the suggestion that he had been offered material incentives or employment with Bumi for his assistance to Bumi. The defendants submitted that that denial could not be believed and pointed out that Mr Hendricks was now working as a 'consultant'. They also relied on a letter written by Global Carriers' solicitors to Bumi's solicitors asserting that Bumi had offered to employ Mr Hendricks in the event he was dismissed for disobeying his employers' instructions not to assist Bumi. The letter specifically stated that none of the Global Carriers staff had the authority to divulge any information in relation to the company or in relation to the engines let alone appear in the Singapore High Court to give evidence on behalf of Bumi.

147 Mr Hendricks was clearly a partial witness. It was amazing that he was willing to give up his job in order to achieve 'justice' for a company which was, he said, not going to reward him in any way and with which he had had no previous connection. Mr Hendricks' evidence consisted mostly of generalisations with hardly any particulars. He had no documents to substantiate his assertions. His main experience was with only two vessels and in the case of one of them, the *Budi 1*, the period during which he sailed on this vessel (March to September 1995), was a period when it did not have any problems at all as confirmed by Mr Kwan. Yet, Mr Hendricks was able to include the *Budi 1* as a vessel that always experienced the problem of overheating. In the circumstances, his evidence carries weight only where corroborated by other evidence.

Chan Kok Onn

148 Mr Chan had ten years of seagoing experience as an engineer on various types of vessels. He worked for MCM as technical manager between 1994 and 1999. At the time of testifying he was working for another ship management company. Mr Chan testified that the engines of the six ships managed by MCM had persistent high exhaust temperatures. He frequently received calls for assistance from the ships and MCM frequently had to stop the ship concerned in order to investigate the cause of the problem. The high temperatures affected the performance and conditions of the

engines. The engines had difficulty building up speed and could not go to higher revolutions without the temperatures going up. To illustrate this assertion, he referred to reports issued by MBS in 1995 and 1998 and a fax sent by MCM in 1999.

149 MCM also forwarded data sheets on various vessels to MBS giving them information on the engine temperatures so that they could review the situation. Copies of these data sheets were attached to the affidavit. Mr Chan said that MCM could not find the reason for the high engine temperatures. The engines were regularly maintained and serviced and therefore there should not have been high exhaust temperatures. Further, MCM found that when the engines were operated on LFO, they performed much better than when run on HFO in that the engines did not overheat as much. Despite repairs and modifications by MBS the high temperatures and the problems with the engines continued.

150 The defendants submitted that Mr Chan did not have personal knowledge of the alleged problems as he did not sail on board any of the vessels. As he admitted under cross-examination his evidence on the high temperatures experienced and the maintenance of the vessels was mostly based on documents shown to him by the lawyers and on information reported to him by third parties. He did, however, maintain that he had been on board the ships to carry out inspections. However, he could not remember when he went to the vessels and how many times he went to each ship and he was also not able to remember everything he saw on the ships. Whilst Mr Chan's evidence was also quite general, there was no reason to disbelieve his assertions that the engines of the six ships had often overheated and there had been difficulty in curing this problem. His evidence did not, however, deal with the cause of the overheating.

Mohd Zubir bin Ab Latiff

151 Mr Zubir's evidence was restricted to the vessel *Meridian Vega* on which he had served as second engineer from August 1992 until the middle of 1993 and as chief engineer from July 1995 to May 1996. Thereafter up till August 1998, he worked as a technical superintendent in Prima Shipmanagement, the managers of the *Meridian Vega*. At the time of giving evidence, Mr Zubir was employed by MSE as project manager of their ship repair division.

152 Mr Zubir testified that he was one of the officers who attended at the sea trials of the *Meridian Vega* and also on delivery of the vessel by MSE. He was also on board the ship during its maiden voyage to Port Dickson in October 1992. Mr Zubir's evidence was that during the two sea trials and the maiden voyage, the engine kept on shutting down. He did not agree that this was due to the malfunctioning of the electrical system of the ship supplied by MSE. Mr Ooi, Mr Zubir's superior, however, readily agreed that that was the cause of the engine shutting down. It would seem that Mr Zubir as an employee of MSE was not able to take an impartial view on this issue.

153 After delivery, the engine experienced persistent high exhaust temperatures of about 500 to 550°C. This occurred especially during periods when the vessel was changing over from HFO to LFO. There were also overheating problems and an exhaust temperature of about 450°C when the vessel operated at above 85% MCR. The exhaust manifold was frequently observed to be 'very hot'. No solution was found for the high exhaust temperatures. In order to prevent breakdown while running on HFO, the engine operating range had to be reduced to 85% MCR and lower speeds of approximately 800 to 860 rpm had to be maintained. This evidence given by Mr Zubir appears credible.

Ooi Ka Lok

154 Between 1992 and 1995, Mr Ooi, a marine engineer, was employed by Prima Shipmanagement in various technical capacities ending up as its General Manager-Technical Services. He gave evidence on the sea trials of the *Meridian Vega* and confirmed that the engine kept shutting down during both sea trials and during the maiden voyage. Mr Ooi was the chief engineer during that voyage and found that when the main engine speed was raised to about 800 rpm this would trigger off the low lube oil pressure alarm and the over speed alarm.

155 After delivery, the vessel had a host of main engine problems. There were abnormally high temperatures. The managers were not able to find a reason for these temperatures. As a result of the high exhaust temperatures, the vessel would encounter consequential damage to engine components such as cylinder heads and exhaust valves. Mr Ooi confirmed that to reduce the likelihood of breakdown, the engine had to be operated at lower speeds and loads.

156 As stated in cross-examination, Mr Ooi admitted that the engine had shut down during the sea trials and the maiden voyage because of problems with the electrical system. The defendants also criticised his evidence that the *Meridian Vega* was regularly maintained and serviced and there ought not to have been high exhaust temperatures, on the basis that he did not have or refer to any of the ship's documents or company records. His only basis for the evidence was that he had visited the vessel twice in every six month period. Again, Mr Ooi's evidence on the experience of overheating and the difficulty in dealing with it was credible.

Michael Kwan

157 Mr Kwan reviewed the defendants' files on the seven Malaysian ships and issued a report setting out his analysis of the performance of the seven engines. He was subjected to detailed cross-examination on his comments and conclusions and it must be said that many of these conclusions did not stand up under cross-examination. In fact he was shown to be a rather partial witness rather than the impartial expert that he presented himself as. It would have been more helpful to the court had he been objective and only reached conclusions when there was sufficient evidence to support them. As it is, I have had to wade through pages of cross-examination where he prevaricated and was evasive. However, not all his opinions were unsubstantiated. In what follows I will only deal with the main points.

158 First, on the sea trial results, Mr Kwan found that except for *Hafetzah*, the ships' engines could not run up to 1,000 rpm and could not achieve 100% MCR when they were operated on HFO. I note that under cross-examination, Mr Kwan conceded that it was not 'could not' but 'did not'. I also note there was a report from MBS that the *Shafinaz Ria* reached 1,015 rpm on LFO but that the rpm dropped by 300 when the engine was switched over to HFO. Secondly, Mr Kwan found that the exhaust temperature differentials of the engines all exceeded MBUK's maximum allowable differential of 30°C. In this connection, the defendants submitted that this was not significant in respect of the vessels *Shafinaz Ria*, *Hafetzah*, *Sari Marina* and *Rohas Ria* because in each of these cases, the engine had been run on HFO for too short a time for the cylinders to be balanced.

159 Mr Kwan asserted that all seven engines had high exhaust temperature problems when the vessels were operating. Further, the temperatures became progressively higher than those experienced during the sea trials. In respect of the *Shafinaz Ria*, the defendants pointed to evidence that contaminated oil had been used on the main engine in 1990 and that this could have caused the high temperatures. In the case of *Budi Permai*, there were only three documented instances of high exhaust temperature, two in 1991 and one in 1995. These did not establish any pattern and in one case there was evidence that the owners themselves thought that the high temperatures were due to the crew having tampered with the fuel pump rack adjustment. There were two incidents of high

exhaust temperatures for the *Sari Marina*, one in 1992 and the second in 1999. The defendants have satisfied me that those incidents had nothing to do with defective design. In relation to *Meridian Vega*, there were six incidents of high exhaust temperature falling in 1994 (twice), 1998 (twice), 2000 and 2001. The defendants submitted these incidents were insignificant bearing in mind the span of time during which they occurred. They also sought to explain them away, with some degree of success. Next, in the case of *Budi 1*, the sea trials were completed in 1991 and the single incident of overheating occurred nearly ten years later in 2000. For *Hafetzah*, problems in 1992 were noted but since no high exhaust temperatures were recorded for the five years between 1993 and 1998, it seems unlikely that the earlier problems were due to defective design. For *Rohas Ria*, the high exhaust temperatures were noted between 1992 and 1994 and after 1994, no further complaints were received. The defendants' documentation therefore appeared to show that for most of the vessels high exhaust temperatures were not a consistent feature of engine operation. These records were therefore at odds with the recollections of Mr Chan, Mr Ooi and Mr Hendricks.

160 Mr Kwan reported that on five of the vessels, the fuel injector nozzles had failed frequently and well before the 6,000 hours cleaning interval stipulated in the instruction manual. For *Shafinaz Ria*, the documentation showed only one occasion when the nozzles were found blocked and that was in October 1990. Thereafter, there was no recurrence. For *Budi Permai*, three instances of premature failure were cited. In the second case, there was evidence to show that this could have arisen from maladjustment of the fuel control linkage. In the third case, out of the nine injectors that required replacing, four had been found without copper washers and the absence of these washers could only be due to crew negligence. Three instances were also cited for *Sari Marina*. In the case of the first instance, the defendants were able to show evidence that the quality of the HFO that was used by that vessel at that time was bad. As for *Meridian Vega*, the defendants asserted that the premature failures of the fuel injectors had been caused by the fault in the electrical system. After that was rectified and the fuel injectors changed, there was no further complaint of this nature. On the *Hafetzah*, in November 1992, the fuel injectors had to be serviced after less than 4,000 hours of operation. The defendants contended that this was related to the high exhaust temperatures in 1992 and that thereafter there was no further problem.

161 Next Mr Kwan drew attention to problems with the fuel pumps on four vessels. For *Budi Permai*, he noted that the fuel pumps were badly worn after 3,521 hours of operation. For *Sari Marina*, in October 1993, the fuel injection pumps of A1 and B1 unit were found to be badly worn. The defendants' service engineer attributed the high wear to operation of the engine on HFO under unsuitable conditions but Mr Kwan considered this unlikely as the other fuel pumps were not found similarly worn. During the sea trials of the *Hafetzah*, the B3 fuel pump was found to be jammed open and the pump housing was cracked. In the case of *Budi 1*, excessively worn fuel pump elements were considered by MBS to have caused high exhaust temperatures in the year 2000. Parts of the pump had to be replaced after 11,000 hours of operation instead of after 48,000 hours as recommended in the manual.

162 Next Mr Kwan pointed out problems with exhaust valves and inserts on six vessels. For the *Shafinaz Ria*, two incidents of premature damage were noted, in 1991 and then again in 1995. The defendants adduced evidence that the first incident was possibly due to the use of poor quality HFO and that the second, four years later, may have resulted from a knock on the cylinder head. In any case, the *Shafinaz Ria* operated for four years without any problems and after 1995, no further problems with these components were noted. For *Budi Permai*, in December 1991, about 15 months after the vessel started operation, some exhaust valves were found burnt. That was no doubt premature but considering that no similar problems were reported thereafter, it is unlikely the problem was due to a design defect in the valve itself. In the case of *Sari Marina*, while three incidents of excessive wear of exhaust valves were noted, in 1992, 1997 and 1998, on the evidence, the first

case was not one of premature failure. Burnt exhaust valves were noted on the *Hafetzah* in 1992 and again in 1993. It appears that these may have resulted from the high exhaust temperatures experienced at those times. In relation to *Rohas Ria*, there were complaints in August 1992 of high exhaust temperatures and two exhaust valves were found burnt. In 1994, the exhaust valve insert dislodged from its position and damaged the piston and turbocharger. Another insert dislodged in 1997. The defendants ascribed the problems to high exhaust temperatures. The *Meridian Vega* had one incident of an exhaust valve being burnt after only 3,700 hours of operation.

163 Mr Kwan noted that four vessels had had problems with their cylinder heads. However, in relation to *Hafetzah*, the evidence was slim. As for the other three, the complaints ranged from leakage from the fuel injector tubes or pockets on the cylinders to cracks on the heads themselves. In Mr Kwan's opinion, there was a major problem with the injector tubes as there were far too many instances of failure to be explained away by the various reasons relating to improper operation put forward by the defendants. The fact that the cracks on the cylinder heads had occurred in similar areas also suggested that the probable cause was an inherent design or manufacturing defect. In the case of the *Budi Permai*, two incidents of cracked cylinder heads were noted and premature failure was alleged. There was insufficient evidence to establish this in the first case. For *Sari Marina*, incidents of leaking injector tubes were noted in 1992, 1993 and 1994. Then things were quiet up till 1998 when there was one incident of failure. Thereafter, no further complaints were received. The *Rohas Ria* had many problems with cracked cylinder heads in March, April and June 1994 and again in May 1996. As regards the 1994 failures, MBUK investigated and concluded that it resulted from problems with the engine cooling water systems caused by dirt in the inter-cooler. Mr Pereira adopted these conclusions.

164 Mr Kwan made comments about the turbocharger on six of the vessels. He observed that turbocharger on *Budi Permai* broke down prematurely in 1992. In my view there was insufficient evidence to support this observation. In regard to *Sari Marina*, he noted that a new turbocharger had been fitted in around October 1993 which was an indication of premature failure. The *Hafetzah*'s turbocharger was damaged and broke down in September 1994. Only those bare facts are known about the breakdown. Under cross-examination Mr Kwan conceded that he had presumed the turbocharger had failed due to defective design since he had no other explanation for the damage. In 1994, the turbocharger of the *Rohas Ria* failed but that was not due to anything inherently wrong with the turbocharger itself. In May 1993, a new turbocharger was installed on the *Meridian Vega* because the previous turbocharger was found to have sustained heavy damage. Mr Kwan opined that this failure was due to a lack of lubrication and that the original design of the lubrication system was defective.

165 On the crankshaft, Bumi submitted that Mr Kwan had noted repeated instances of crankshaft failure. A number of the vessels had also experienced problems with ovality of the crankpins. In March 2000, MBUK changed the tightening torque for the large end crankpin bearings from 15,000 psi to 13,000 psi. This was done to improve the bore shape so that the large end bearing would wear more evenly. In Mr Kwan's view, this change indicated that the ovality of the crankpins existing at the time of the various crankshaft failures could have been caused by the original torque and that that specification was a design error. However, Mr Crowle and Mr Howard testified that the change in the tightening torque was due to a change in the manufacturing process of the large end bearing after 1997. Under cross-examination Mr Crowle agreed that if the torque was too tight, damage would be caused to the bearing.

(x) Conclusion on the engine

166 Having considered all the evidence I have come to the conclusion that Bumi have proved their

case that the engine was not suitable for its intended operation as a 4,000 rpm rated engine operating on both LFO and HFO. This inadequacy must have arisen from some defect in the design of the engine even though it was not possible for the expert witness to pinpoint exactly what that defect was. The frequent overheating of the engine and the consequent damage suffered by its component parts were not explained away by improper operation and ignorance on the part of the engine room crew. Such matters to the extent that they existed might have aggravated the problems. They did not cause them. Also as I have found, certain components were defective. The evidence on the Malaysian ships was more equivocal. They did show similar problems, especially in regard to overheating and premature failure of some components, some much more than others, but the engines have remained fully operational. If I had had to decide the case based on that evidence alone, I would not have found in Bumi's favour. My findings are based on the evidence given in relation to this engine on this ship. The defendants knew the requirements of the ship and, as I have held above, had to supply an engine that was suitably designed and manufactured to meet those requirements. They failed in that duty.

167 This hearing of this case has been unnecessarily prolonged. Bumi tried to bolster their main argument by grasping at every possible criticism of the engine and its components. I have made my comments on their specific allegations. As can be seen from the discussion, some of them should not have been made at all. Further, the case would have been shortened and the evidence easier to analyse had the experts appointed by both sides been more objective in their testimony and realised that their primary duty was to assist the court rather than to assist their respective clients. While experts are employed by parties, they must remember that they are only helpful to the court to the extent that they are objective and do not overstate the evidence in favour of one side or the other. It is time that the courts take party appointed experts to task when they fail in their duties to the court.

Third main issue - damages

168 Bumi have claimed the following as damages for the defendants' breach of duty:

> (1) loss of hire in the sum of US$939,589.675, being the charter hire lost by them when the vessel was not able to operate and was thus off-hire in relation to its charter by Pertamina during the period from January 1995 to September 1997;
>
> (2) continuing loss of use following the final breakdown of the vessel;
>
> (3) US$849,834.64 being expenses incurred as a result of the breakdown of the engine;
>
> (4) the cost of the engine being RM2,225,000; and
>
> (5) the cost of the work required to replace the engine estimated at US$2.04 million and the loss of the use of the vessel during the period when the work is being carried out estimated to be US$1,983,030 based on the work requiring a period of 12 months.

As an alternative to the above, Bumi have asked for damages to be assessed. In this instance, I do not think that it is correct for there to be an order for damages to be assessed. Bumi's losses are specific and calculable. They are special damages rather than general damages. Accordingly, they must be pleaded and proved as part of Bumi's claim and not left for later assessment. Bumi unfortunately did not pay as much attention to proving their case on damages as they did to proving their case on liability. Particulars of the damages were given at a late stage and supporting witnesses and documents were inadequate in several areas. I will consider the various heads of claim

in turn.

(i) Loss of hire from 1995 to 1997

169 From the time it was delivered to Bumi, the vessel was on a long term charter to Pertamina. Mr Donald Chua testified that he was aware by August 1993 that the vessel was intended for charter by Pertamina. The charterparty contract fixed the hire as US$165,252.50 per month. It also provided that the vessel would be off-hire when it broke down and that all fuel expenses, port expenses and other expenses incurred during the off-hire period were to be borne by Bumi.

170 In their voluntary further and better particulars of the statement of claim, Bumi set out the dates when the vessel had been off-hire and the amounts of hire lost during those periods. The total amount lost was given as US$1,315,077.89. In their closing submissions, Bumi reduced the number of occasions for which off-hire was claimed from 13 to four and the total amount claimed to US$939,589.675 arrived at as follows:

Off-Hire Period	Total off-hire amount
1.4.95 – 2.4.95	US$7,107.38
1.1.96 – 14.2.96	US$247,878.765
19.9.96 – 9.12.96	US$445,610.86
16.12.96 – 27.1.97	US$238,992.67
	US$939,589.675

The evidence on Bumi's loss was given by Mr Jaka Aryadipa Singgih who held the position of President Commissioner or Chairman of Bumi. He produced the debit notes issued by Pertamina and, in relation to the dates, Bumi also relied on the relevant log entries and the dates given in the defendants' own service reports. Mr Singgih himself had no personal knowledge of the off-hire periods as cross-examination showed. Some of the off-hire claims were shown to be unconnected to engine breakdowns and that is probably why nine of the claims were dropped and the closing submissions related to only four of them.

171 The defendants submitted that the loss of hire due to the alleged breaches had not been proved because the only witness put forward to substantiate such loss could not give the reason for the various periods of off-hire. Although Mr Singgih had no personal knowledge of the reasons why the vessel was off-hire on each occasion, however, he was able to confirm that Pertamina had not paid Bumi charter hire for each of the periods mentioned. When his confirmation that no hire was paid for the four periods claimed for is taken together with the information in the log books and in the various service reports issued by the defendants' engineers, there is sufficient evidence that those four periods of off-hire were due to main engine problems. The defendants did not adduce any positive evidence to show that, during these periods, the inability of the vessel to operate was not related to the difficulties with the engine. This claim is allowed.

(ii) Continuing loss of use

172 Bumi is claiming compensation for the loss of use of the vessel from 19 September 1997 to

the time it goes back into operation. Their claim is for US$4,253.087 for every day that the vessel remains laid up on the basis that this figure represents the net daily earnings of the vessel. The figure is derived from charter-hire of US$5,508.17 per day less daily operating expenses. There are two issues to be considered here: the period for which post break-down loss of use is allowable and, secondly, the rate at which this loss should be calculated.

173 On the first issue, it was Bumi's contention that the period should stretch from the date of breakdown up to the date of completion of works to replace the engine. The defendants' response was that the period of claim should be determined strictly by the length of time it would take to do the works. Bumi's evidence was that although they received a quotation from MSE in July 1998 for the necessary works, they were not able to proceed with the works at that time due to financial difficulties. Bumi stated that they had built the vessel and purchased the engine in part with loans from their bankers. As a result of the loss of earnings due to the off-hire of the vessel, they were unable to keep up the bank payments and had to pay penalty interest. This put them into the financial difficulties that prevented them from proceeding with the repair work. Bumi submitted that the defendants had to take Bumi as they found them and be liable accordingly for the delay in repairing the vessel. In this connection, Bumi relied on the case of *Singapore Bus Service (1978) Ltd v Gwee Sok Ai t/a Chuan Bok Wong Trading* [1996] 3 SLR 662.

174 The defendants submitted that Bumi's financial impecuniosity could not be a factor in assessing the compensation payable. They pointed out that in the *Singapore Bus Service* case, there had been no question of financial difficulties delaying the repairs of the bus concerned and all that had to be assessed was the minimum period of time it would have taken to commission the replacement bus. In the English case of *Liesbosch Dredger v Edison SS* [1933] AC 449, the defendant tortfeasor was not held responsible for hire of a substitute vessel during the period of time when the plaintiff could not replace his damaged vessel due to impecuniosity and had to hire a more expensive replacement. This was because the impecuniosity had not arisen from the tortious act.

175 There was insufficient evidence to establish that Bumi's inability to conduct immediate work to replace the engine was due to the loss of hire during the period from 1995 to 1997. Bumi was not a one-ship company and may have had other income. No evidence was given of its general financial situation and how this was affected by the loss of income from *Bumi Anugerah*. Further, the breakdown of the vessel coincided in time with the Asian financial crisis. Mr Singgih during cross-examination admitted that because of this regional problem, banks in Indonesia were not willing to give corporations financial assistance. Bumi bore the onus of proving that it was the defendants' default that caused their impecuniosity. They did not discharge that onus.

176 Accordingly, Bumi are only entitled to recover continuing loss of use from 19 September 1997 up to such date as the engine could have been replaced had they put the work in hand within a reasonable time of the breakdown. The evidence as to how long it would take to replace the present engine with a new one was given by Mr TS Chua of MSE. He said it would take between nine months and a year. In cross-examination, Mr Kwan agreed with this estimate. On that basis, the maximum period for which this claim can be made would be a year for the work itself and another four to six months to obtain quotations and sign a contract.

177 The second issue is the quantum of loss that Bumi would have sustained during that period. When the court assesses what financial loss the owner of a damaged vessel that was previously on charter has incurred because he has not been able to charter out the vessel during the repair period, the court is guided by the available charter rates in the market at the time of the repairs. Bumi did not adduce any evidence on what the market rates for charter of a vessel such as the *Bumi Anugerah* were either in 1998 or at the time when the trial commenced. They were content to rely

on the rate agreed to in their charter with Pertamina. That rate could not, however, by itself establish the market rate at the relevant times as it had been agreed before the vessel was delivered in 1993 and there was no evidence that the market rate was determined by Pertamina's rates. Additionally, charter rates for vessels like *Bumi Anugerah* could have been affected by the financial difficulties facing Indonesia after 1997. There was thus no evidence before me as to what Bumi could have expected to earn from the vessel during the period of the repair work.

178 An additional problem results from the fact that Bumi cannot claim simply the gross loss of income. In this case, they would have to deduct from the notional charter rate the notional expenses that they would have incurred in running the vessel in order to arrive at the net loss of income. In their submissions, Bumi stated that the expenses per day of the vessel 'based on an estimation of the normal operating expenses' were US$1,255.33. They did not, however, adduce admissible documentary evidence or any oral evidence from anyone with personal knowledge of the facts to establish that the expenses would indeed amount to US$1,255.33 per day. In the circumstances, there is insufficient evidence for me to determine what loss Bumi would suffer whilst the engine works are being carried out. I cannot make an award under this head.

(iii) Expenses

179 In ¶ 44 of his affidavit of evidence-in-chief, Mr Singgih gave details of expenses that Bumi had to incur by reason of the various breakdowns of the engine. These expenses included the cost of spare parts, airfreight charges for the parts, superintendent's expenses, bunkers, port disbursements and survey charges. He also gave details of expenses incurred after the vessel was laid up like security costs, insurance premiums and crew wages.

180 During cross-examination, Mr Singgih admitted that he had no personal knowledge of the expenses that were claimed. This was because the figures he had put in his affidavit had been given to him by his finance department. He had no personal knowledge of any of the amounts. Bumi put the documents supporting these claims into a bundle at a late stage in the proceedings. The defendants did not accept the authenticity of those documents. As the makers of the documents were not called, the documents could not be admitted. Further, most of those documents were in Bahasa Indonesia and no English translations were supplied. I accept the defendants' submission that this item of Bumi's claim has not been properly proved. There were lots of individual items and no one who could testify as to how the expenses were incurred and paid and that they indeed related to the vessel and not to any other vessel in Bumi's fleet.

(iv) The cost of the original engine

181 MBS sold the engine to MSE for RM2,225,000. Mr Kwan testified that further repairs to the engine would not serve any purpose and it ought to be replaced with a new engine. Bumi submitted that this meant that there was in effect a total loss of the engine and they ought to be reimbursed the cost of the engine. I cannot accept this argument. I indicated as much to counsel in the course of argument and was surprised to see this claim in the submissions. Bumi used the engine for three years. It is too late for them to recover its cost. Additionally, since they are also claiming the cost of a new engine, this claim is duplicitous.

(v) The cost of a new engine

182 Mr TS Chua testified that in mid 1998, Bumi approached MSE about the re-engineering work for the vessel. On the basis that the new engine would be a Wartsila 6R 32 wet sump model, MSE gave Bumi a quotation of US$2.04 million for the work and new engine. Attached to the quotation

was the work specification prepared by Mr Chua. He justified the high cost on the basis that the re-engineering work would involve a whole series of steps, involving the cutting up of the hull of the vessel, removal of the existing engine and associated parts, equipment and systems, modification of parts followed by the introduction of new parts, equipment and systems, alignment, fitting of a new propeller and other works. Mr Chua estimated that the time taken for the entire re-engineering project would be between nine months and one year.

183 Mr Kwan's conclusion that it is no point repairing the original engine since repairs would not guarantee that it would not break down again meant that he also opined that a new engine should be installed in the vessel. Mr Kwan was shown the quotation from MSE to Bumi offering to replace the engine for US$2.04 million. In his view, this was a reasonable estimate of the cost of the necessary work.

184 The defendants criticised Mr Kwan's evidence that the MSE estimate was reasonable. They pointed out that he had very little experience in the costing of marine engines. The defendants did not, however, put forward any other estimate of what it would cost to take out the present engine, buy a new one and install it. They did not produce any evidence to show that it would be viable to repair the existing engine. Nor did they give an estimate of the repair costs. The defendants had the opportunity to put forward such evidence. They did not take it.

185 The defendants have not established that the engine can or should be repaired instead of replaced. They have not established that the costs of replacing the engine quoted by MSE are unreasonable. Accordingly, I award Bumi the sum claimed under this head.

Conclusion

186 For the reasons given above, there shall be judgment for the plaintiffs against each of the defendants for the following sums:

(1) US$939,589.675; and

(2) US$2,040,000.

Each of the defendants owed the plaintiffs an independent duty to supply a suitable engine. They are several, not joint, tortfeasors. I do not apportion the damages between them.

187 I will hear the parties on the appropriate awards to be made in respect of interest and costs.