

SECTION 10. HOW HOSES OF INADEQUATE DESIGN CAME TO BE FITTED

MAINTENANCE ARRANGEMENTS

WESTRALIA's maintenance program

10.1 HMAS WESTRALIA is maintained in accordance with a usage upkeep cycle that includes dedicated maintenance periods and refits. Under the RPLSS contract, HMAS WESTRALIA is programmed for approximately two Assisted Maintenance Periods (AMPs) per year. Refits are programmed on a cycle of approximately 60 months. Refits are normally programmed 18 months in advance and AMPs approximately six months in advance.[E25 Attachment A clause 3.3] As a petroleum tanker modified for underway replenishment, HMAS WESTRALIA is a single ship class within the RAN, and much of its maintenance is contracted.

OAWA

10.2 The Ordering Authority of Western Australia (OAWA) is the Navy organisation responsible for managing the Western Australian Ship Repair Program for ship maintenance activities.[E203 DC2] The aim of ship maintenance in the RAN is to sustain material efficiency, reliability and performance of ships, their systems and equipment, to enable the successful completion of assigned roles and to provide optimum responsiveness for Naval Operations.[ABR 5454 Chapter 1]

10.3 OAWA maintains all documentation and controls the physical and financial aspects of all awarded contracts raised in support of maintenance on both homeported and visiting ships at Fleet Base West (FBW).[E203 para 6, DC2] The RAN's policy for the logistic support of WESTRALIA is outlined in ABR 5454 Chapters 1 and 30. ABR 5454 sets out in detail the basis for the provision of logistic support to fulfil the Fleet's operational requirements.[E223 PWB2] CMDR Coverdale became the Officer in Charge (OIC) OAWA on 3 October 1997.[E203 para 5]

10.4 OAWA appoints a Principal Naval Representative (PNR) to provide on-site customer representation to progress Navy contracts.[T3271] At the relevant time, the RAN's PNR was LCDR Barrett. The PNR is supported by maintenance managers who manage and coordinate all contractor work carried out on difficult classes of ship. Responsibility for management of HMAS WESTRALIA's maintenance is delegated to the WESTRALIA Management Officer (WMO), namely, WO Jones.[T3271] The WMO is supported by one Chief Petty Officer.[T3271]

ADI RPLSS contract

10.5 On 14 April 1997, the Commonwealth entered into the Refit Planning and Logistic Support Services (RPLSS) contract for the maintenance of HMAS WESTRALIA with ADI. The RPLSS contract provided for ADI to commence work on 15 May 1997 and to continue to do so for a term of five years.[E25 clause 2.1.1] Prior to the RPLSS contract, WESTRALIA was maintained by Dawson Engineering/Brown and Root under a

Logistic Support Contract. No Brown and Root records of work (planned or executed) were formally passed to ADI, although some records and files were passed to the WMO. At a meeting on 19 August 1997, the WMO confirmed that all archive material from Brown and Root had been collected by his office.[E223 para 99]

10.6 The RPLSS contract describes its scope of work in general terms as:

The work performed under this Contract will provide support to HMAS WESTRALIA in three main areas; Logistic Support Services, Refit Planning Services and the Management of certain Maintenance Activities. The nature of the work to be performed covers the spectrum of management, engineering, quality assurance, financial control and logistic support activities necessary to sustain the RAN Auxiliary Oiler replenishment Tanker.[E25 Attachment A Clause 3.1]

10.7 Tasks are to be performed by ADI on either a 'continual' basis for the period of the contract, or on a 'fee for service' for occasional tasks.[E223 para 14]

10.8 In order to carry out its obligations under the RPLSS contract, ADI set up the RPLSS office at Rockingham. It was initially staffed with a team of four (4) staff who would perform the core RPLSS functions including a project manager/ship's agent, two technical specialists (hull and electrical), an information document officer and a clerical assistant/librarian.[E216 para 6] The RPLSS contract further provided that six (6) subcontract staff would be engaged by ADI to form the AMP management team.[E25 Attachment A, clauses 3.18-3.20. E223 para 24] The latter provision has recently been varied by arrangement with Navy.[E411]

10.9 The RPLSS office was principally staffed with former senior sailors with tradesman qualifications or equivalent. The senior staff member was Mr Roger Sergeant who was the project manager/ship's agent WESTRALIA. Mr Sergeant left the RAN as a CPOETC (Chief Petty Officer Electrical Technical - Communications). Mr Alan Morland was employed as a mechanical supervisor or mechanical technical specialist in February 1998 as a result of problems encountered during WESTRALIA's AMP11 in August 1997, Mr Morland had served in the RAN from 1972 to 1983 and was a POMTPD3 (Petty Officer Marine Technical – Propulsion Diesel) when he left. Before joining ADI he worked, from 1993 to 1997, with Dawsons Engineering, the company that the RAN had contracted with to perform HMAS WESTRALIA's logistic support. Dawson's Engineering was later taken over by Brown and Root. Mr Morland was involved with WESTRALIA's AMPs 9 and 10 while at Brown and Root.[T2554]

FLEXIBLE FUEL HOSE PROPOSAL

Origin

10.10 The history of fuel leaks in WESTRALIA has been discussed in Section 8.[R8.2 – R8.6] The fuel leaks problem had existed since at least September 1991 when WO Jones joined WESTRALIA as Deputy Marine Engineering Officer.[T1967]

10.11 Fixing the leaks was a frequent and time consuming process made worse by difficulty in aligning the rigid fuel lines between the injector pumps and the supply and return fuel rails. The origin of the idea to replace the rigid lines with a flexible version is

not clear but the first evidence presented to the Board was in relation to AMP 10 in November 1996.

10.12 WO Bottomley explained:

AMP 10 (November/December 1996) was my first AMP in WESTRALIA. During the AMP Mr Morland and I had a number of discussions concerning the way ahead to cut down the fuel leaks from the fittings and lines connecting the fuel pumps and fuel rails on both main engines. Alan told me that there was a Pielstick service bulletin, which referred to fitting flexible fuel lines, which would allow for more accurate alignment and ease of installation. He informed me that this would alleviate most of our problems relating to fuel leaks.

Mr Morland stated that he had already started documentation to get approval for this configuration change implemented. He told me that Lloyds had already given their approval but it was bogged down with MISD.[E209]

10.13 LCDR Crouch gave evidence that on or about 22 November 1996, just prior to the beginning of AMP 10 and shortly after he joined the ship, he had a general informal discussion with Mr Alan Morland. At the time, Mr Morland was an employee of Brown and Root. LCDR Crouch stated:

...in the course of our conversation, Mr Morland mentioned to me that he had a Pielstick Service Bulletin which referred to fitting flexible fuel hoses to main engines. He told me that he was in the process of getting approval to fit these hoses to the main engines. He handed me a document and said, 'This is the one we're looking at, the one that's circled'. That document had a facsimile imprinted date of 22.11.96 and thus I believe the date of this conversation was either on that date or shortly thereafter. I retained this document and filed it amongst the MEO handover notes.[E188 para12]

10.14 The document referred to by LCDR Crouch was an Aeroquip product brochure. The product reference which is circled is FC234 AQP hose.[E188]

10.15 LCDR Crouch also stated:

...It was the same day or shortly thereafter, that Mr Morland showed me a Pielstick Service Bulletin which related to flexible fuel hoses. I remember looking at the bulletin but did not study it in detail. I was not given a copy of this document.[E188 para18]

10.16 Mr Morland gave evidence on 19 and 22 June 1998. This was before LCDR Crouch's statement was produced to the Board. On 22 June 1998, Mr Morland became unfit to continue with his evidence. Medical evidence submitted to the Board indicated that Mr Morland would remain unfit to give evidence for the foreseeable future.[E436] As a result, the substance of this evidence by WO Bottomley and LCDR Crouch concerning this conversation has not been put to Mr Morland. Mr Morland did, however, repeatedly give evidence to the effect that he had no recollection of having dealt with the issue of flexible fuel hoses in 1996, or for that matter, prior to early 1998.[T2575-2579, T2581-2585]

10.17 Although LCDR Crouch did not study in detail the Pielstick Service Bulletin, a copy was in fact held onboard WESTRALIA in a ring binder containing Pielstick Service Bulletins. The ring binder was found to be located in HQ1 and was only discovered during the course of this Inquiry. WO Bottomley was, but LCDR Crouch was not, aware of the

existence of the Pielstick Service Bulletin binder.[T3420] The binder contained bulletins numbered from one to 94, the last one being issued in 1994.[E189]

1996 Proposal

10.18 When the ship requires external assistance with maintenance, it raises a TM 200 form to request that work be undertaken. The TM200 is used by the ship to rectify defects and deficiencies in order to restore the ship to its approved configuration. If the work required involves a change to the configuration of the ship, then the procedure to be adopted is set out in the RAN Ship Maintenance Administration Manual (ABR 5230 Chapter 4).[E139] The Board has heard a great deal of evidence about what constitutes a configuration change and the way in which changes to the configuration of a ship are achieved.

10.19 A configuration change is initiated by a form TM187. The TM187 process involves a preliminary assessment of the engineering practicability and a user assessment. Following consideration by a configuration control board, the proposal may be authorised for further development. In this instance, Navy's Manager of In Service Design (MISD) will be involved in the design process or may grant design delegation to the RPLSS contractor. When all engineering documentation is completed and all equipment, stores and material are available, a form TM188 authorising installation is issued.[ABR 5230 Ch 4, E139]

10.20 There are a number of legitimate ways of arranging a configuration change on a temporary basis. A ship could submit an URDEF (Urgent Defect) to obtain permission to effect a temporary design change to regain some lost capability following system or equipment failure. Alternatively, an application to trial material or equipment can be made on a form TT117. A TT117 application must be approved before the trial is commenced or equipment installed. Finally, an 'Application for Production Permit or Concession' can be made on Form SG2. The SG2 is used to accept supplies not conforming to contract, where it is known in advance that a specification cannot be met or if there is a need to vary the specification set out in a contract at short notice. The SG2 can also be used by a contractor, as a matter of expediency, to gain interim approval for a configuration change.[E139 para 457] In this case, the normal configuration change process must follow.

10.21 An SG2 application for concession to manufacture 56 flexible fuel hoses and 28 airlines from Aeroquip FC234AQP hose to replace existing rigid fuel lines on WESTRALIA's main engines was raised by Mr Morland on 27 November 1996.[E58 yellow Tab 5] Annexed to the SG2 was a quote from CHES Engine Reconditioning dated 26 November 1996. It quoted the sum of \$12,369.84 for the work and included some diagrams. It did not annex the Pielstick Service Bulletin.[E58 yellow Tab 5]

10.22 Mr Morland gave the SG2 to the WMO - WO Jones.

10.23 WO Jones gave evidence to the effect that he had no recollection of discussions in 1996 concerning the Pielstick Service Bulletin or concerning the general background of the SG2.[T1968, T1978, T2062]

10.24 WO Jones forwarded the SG2 to MISD on 29 November 1996.[E58 yellow Tab 5]; it does not appear on the AMP10 file.[E304] The same day, Mr Morland sent a fax to Lloyds advising that Brown and Root intended fitting Aeroquip FC234 AQP flexible

hoses 'to WESTRALIA main engine timing valves and delivery fuel lines' and asking whether this would be acceptable to Lloyds.[E103 Tab 1]

10.25 On 4 December 1996, MISD replied that '...the proposed changes relate to the integral parts of the Pielstick Main Engines' and, 'It is recommended that the SG2 applicant [Brown and Root] seek advice from an authorised Pielstick Agent on these matters. Any records of communication between the applicant and the agent are to be forwarded to MISD for consideration prior to SG2 approval.' The MISD reply was directed to OAWA and was produced by CMDR Sippel to the Board on 28 May 1998.[E58 yellow Tab 6] CMDR Sippel is Navy's Afloat Support Amphibious Class Logistics Manager (ASACLM) and is responsible for the logistic support for WESTRALIA.

10.26 WO Jones gave evidence that he thought he would have passed on MISD's letter to Brown and Root at a weekly meeting.[T1967] A copy of the MISD letter does not appear on neither OAWA's file or the Brown and Root files passed to OAWA.

10.27 Mr Morland raised a contract change proposal (CCP) 9685 for manufacture of new fuel hoses on 13 December 1996.[E298] No OAWA approval is indicated and CCP 9685 does not appear on the OAWA file. It is possible that it was never submitted, since AMP 10 was scheduled to end on 21 December 1996. As a result of Mr Morland's ill health and inability to continue to give evidence, his comments on the CCP could not be obtained.

10.28 Work Instruction 3882/03 for manufacture of new flexible fuel hoses for both main engines was raised by Brown and Root on 23 December 1996.[E298] Although it is marked 'cancelled', it is not apparent when or in what circumstances it was so marked. This document, too, could not be put to Mr Morland.

10.29 WO Bottomley said:

...It was towards the end of AMP 10 that Alan Mr Morland informed me that he had received approval for the installation of the new flexible fuel lines. I believed that this approval had come from MISD since he had previously told me that they were the ones holding up approval. Funding was not then available nor could the task be achieved in the time frame. If it had been earlier in the AMP I would have pushed for them. I can be very stubborn at times and I wanted them fitted. Because of the budget and time constraints it was decided to put the task off until the next AMP.[E209]

10.30 Again, the substance of this conversation could not be put to Mr Morland.

Developments in 1997

10.31 On 8 January 1997, Lloyds replied by fax (No.F0027/97) to Mr Morland at Brown and Root, firstly, quoting a response received from their London office stating that the Aeroquip hoses were not approved, and secondly, giving general advice about the type of hose that would be necessary, including, that the hose should be:

constructed from synthetic rubber with single or double closely woven integral wire braid reinforcement and external wire braid protection and that the design should have been certified to have been burst tested with the end fittings attached to at least five times the maximum pressure as per Part 5, Chapter 12, Section 6 of the Rules.[E103 Tab 2]

10.32 This fax was produced to the Board by counsel for ADI. It does not appear on the Brown and Root or OAWA files given to the Board.

10.33 Attachment D to the Brown and Root management report to OAWA dated 7 March 1997 contained a list of future work recommendations arising from AMP10. The manufacture of new flexible fuel hoses was not on the list of recommended future work.[E303]

10.34 MISD have indicated to the Board that they received no further correspondence in relation to the SG2.[E445]

10.35 On 7 July 1998, Lloyds produced various documents to the Board. These included a fax dated 16 April 1997 from Lloyds Fremantle to Lloyds London, advising in relation to 'Flexible Hoses for Main Engine Use' that 'Navy has put this project on hold'.[E396] Lloyds have advised that their Mr Wilson-Mitchell believes he received that information by speaking to someone, he cannot remember who, at Brown and Root.

10.36 WESTRALIA's problem with fuel leaks persisted during 1997. WO Bottomley gave evidence that:

...in the lead up to and during AMP 11 there were several casual conversations between ship's staff, WO Jones and Roger Sergeant concerning the flexible hoses. I can remember being told that there had been problems locating some of the LSC documentation following the hand over of the maintenance contract from Brown and Root to ADI. Some of this documentation related to the installation of flexible hoses. WO Jones and Mr Sergeant stated that they would locate the documentation for the next maintenance period (AMP 12) which was due to commence in March 1998. I felt angry and frustrated that the flexible lines had been put off yet again. I particularly remember this because WO Jones used to state in jest at the end of most weekly meetings, whether I had any points to raise and then pass the comment, 'Apart from your lines', or words to that effect.[E209]

10.37 Since 16 June 1998, WO Jones has also become medically unfit and took sick leave and was unavailable to be recalled to give further evidence.[E437] He was not able to be questioned on WO Bottomley's evidence, nor on other aspects of evidence given by WO Bottomley and LCDR Crouch.

1998 Proposal

Discussions

10.38 In early 1998, a discussion or discussions concerning flexible fuel hoses took place involving LCDR Crouch, WO Bottomley and WO Jones. WO Jones said in his statement that:

...the issue of replacing the fixed fuel lines with flexible hose lines was raised again with me prior to AMP 12 in early 1998 by the ship's MEO LCDR Crouch and his Deputy WOMT Bottomley. I do not now recall the precise details of any conversations on that topic nor their dates. However, I do recall some details of our discussion as to the appropriate way of proceeding.[E130A]

10.39 WO Jones' statement then set out 'the possible options discussed and their relative advantages and disadvantages' as follows:

(a) **Configuration change: form TM187.** On one view, this job involved a change in configuration of ship's parts and should therefore have been the subject of a TM187 in accordance with ABR 5230 chapter 4. I did not favour this approach as, in my view, this would have been time consuming (as a response, based on past experience, might have taken some months) and perhaps frustrating evolution, although I believe it would ultimately have been approved.

(b) **Application for concession: Form SG2.** I did not favour this approach either as, in my view, this would have also been a time consuming, (as a response, based on past experience, might have taken some weeks) and perhaps frustrating evolution, although I believe it too would ultimately have been approved.

(c) **Material or Equipment Trial Proposal, Form TT117** in accordance with DI(N) Log 82-3. Under this approach, approval for which is often given within 2 days, equipment which has been successfully trialled for 12 months, then feeds into the configuration stream (TM187) process. The equipment could be ordered by way of TM200 and a TT117 would follow. This was my favoured approach as it would have been less time-consuming and would have permitted the material to be purchased and then trialled with little loss of time. I recommended that the ship take the course of raising a TM200 to be followed by a TT117.[E130A]

10.40 When he appeared before the Board, WO Jones was unable to provide any detail of the conversations. He described the discussions as being '...just general ones, sir, around the traps.'[T1969] WO Jones also said that whilst in these conversations he had discussed these options, he had not discussed their relative advantages and disadvantages.[T1974]

10.41 LCDR Crouch said that between July 1997 and January 1998 he was in regular contact with WO Jones.[E188] He frequently asked WO Jones when they could get flexible fuel hoses and WO Jones informed him that approval was required. 'It was always my belief that the Contractor was organising approval for the installation of these hoses', LCDR Crouch said.[T2826] He gave evidence of another informal conversation that took place in January 1998 on the flight deck. WO Bottomley and Mr Roger Sergeant, ADI RPLSS Supervisor, were present. The conversation was described by LCDR Crouch in his statement:

...I asked WO Jones, 'When do we get the flexible hoses?' He replied, 'Submit a 200.' Bottomley said, 'That's it is it, after all that waiting?' Jones said, 'Yes.' I then instructed WO Bottomley to raise a TM200. I was very pleased when WO Jones told me to raise a 200 because I believed that finally we had the go ahead to install the flexible hoses...[T2826-7]

10.42 LCDR Crouch denied that in the discussions there was any reference to a TM187, SG2 or TT117, indeed to any form other than a TM200.[T2845] He adhered to that view during extensive questioning.[T2875] When asked by Counsel for ADI about the alleged discussion with WO Jones concerning the three methods of obtaining approval for the flexible fuel hose job, LCDR Crouch said:-

Actually that particular statement that WO Jones made dovetails exactly into a conversation we had about LP air compressors...the LP air compressors require changing now and we discussed the best way we could do it and WO Jones raised the subject and we discussed the virtue of 187s, SG2s and 117s.[T2867]

10.43 On the second day of his evidence LCDR Crouch raised a concern. He said that he had been:

...going through questions in my mind and at about 4 o'clock this morning, the picture that popped into my mind of turning to WO Jones and saying 'Well why not raise a 117, then?' Now, it was a conversation which took place sometime last year and I don't remember exactly what the conversation was that led to it...I've racked my mind and I just can't remember...I've eliminated everything else. It must have been an association with hoses.[T2996-7]

10.44 WO Bottomley disagreed with WO Jones' account of the conversation and said:

Around February 1998 I was present during a conversation with WO Jones and LCDR Crouch, which was on the starboard side of the flight deck near the swimming pool. I am not sure but I believe that Mr Sergeant was also present. It was during this conversation that WO Jones told us to raise a TM 200 for the flexible fuel lines to be manufactured so that they could be included in the forthcoming AMP 12 work package. I was over the moon that we were getting the fuel lines but exasperated that all that was required was to submit a 200. I expressed my exasperation to WO Jones in a forceful manner.[E209]

10.45 WO Bottomley explained in greater detail in oral evidence how he 'expressed (his) exasperation in a forceful manner':-

Yes. Well, you do describe your surprise to some extent in your statement there but because it's an important discussion, and it might be some way of triggering people's memories, what did you say? ---Okay. I had a go at him. I was over the moon at being finally told that it was a TM200 because once it's a TM200, we set the priorities on high it is in the listing so the engineer's got some say of where it goes and I was really happy about that, but after all this time and all this battling and head-butting brick walls, that that's all it required, was a TM200 and to be honest I was - - I swore quite loudly and I think I threatened to probably bash him or something.[T3458]

10.46 WO Bottomley confirmed LCDR Crouch's association of the TT117 conversation with the air compressors in the following terms:-

Do you recollect any aspect of that conversation being mentioned? ---None whatsoever...the only time conversations of a TT117 were raised was over a general service air compressor.[T3429]

10.47 The evidence of LCDR Crouch and WO Bottomley indicates that they believed that the procedures to implement the change to flexible fuel hoses had been completed.[T2827, T2870, T3422] The history of the flexible fuel hoses proposal set out above provides some justification for that belief but the ship did have the opportunity to, and did not, make enquiries on the due completion of the procedures.[T2878-2879]

Conclusions

10.48 A change to the flexible fuel hoses was clearly a configuration change as defined in RAN documentation and the correct procedure for obtaining approval was not followed.

10.49 The weight of evidence is against WO Jones' account, which is not accepted, and WO Bottomley's account is regarded as the most reliable. The Board is of the opinion that WO Jones told the ship simply to raise a TM200.

10.50 WO Jones' statements to LCDR Crouch and WO Bottomley concerning the TM200, were such as to mislead them into believing that circumstances had transpired which made a TM200 the appropriate procedure to obtain funding for the work.

10.51 Nonetheless, LCDR Crouch should have made his own enquiries in the absence of any official approval documentation, namely, a TM188.

10.52 The Board has difficulty in understanding why none of the documentation relating to the SG2 remained on an OAWA file. WO Bottomley and LCDR Crouch gave evidence of frequent mention or discussion of the flexible fuel hoses with WO Jones.

10.53 It is remarkable that despite WO Jones' long association with WESTRALIA's fuel leak problem, his obvious commitment to the ship, and his ongoing discussions with WO Bottomley during 1997, that WO Jones does not remember any of the circumstances surrounding the SG2 application in late 1996 and that it did not come to mind during his ongoing conversations with WO Bottomley and LCDR Crouch.

TM 200

10.54 A TM 200 was raised by the ship on 1 February 1998 and given to WMO. WO Jones passed the TM200 to ADI and as his statement explained:-

Their normal practice as I understand it, having decided to sub-contract the task, would be to put the work out to tender, evaluate any responses, and submit a quotation for the task.[T1979, E130A para 5.7]

10.55 When giving evidence, WO Jones initially thought that a copy of Pielstick Service Bulletin 78 was attached to the TM 200.[T1978] On checking his records, WO Jones found this was not the case.[T2201]

10.56 The TM 200 specified the work as 'investigate the manufacture and installment of Lloyd's approved flexible fuel lines from the fuel rails to fuel pumps and return lines to rail on both M/Es (total 60)'. [E103 Tab 3] Under the heading 'Task Summary' were the words 'Manufacture and install flexible fuel lines on both M/E's'. The form was drafted by PO Reynolds with changes suggested by WO Bottomley and then LCDR Crouch. LCDR Crouch added the word 'investigate' and explained that addition and the requirement for the flexible fuel hoses to be Lloyds approved:-

...It was sometimes my practice when raising these forms to include an instruction to the contractor to 'investigate' the particular work order. This was particularly so in situations where the job was beyond my level of

knowledge and expertise. This was such a case. I wanted and expected the contractor to make all the necessary inquiries and investigations concerning the manufacture and fitting of the hoses. Thus I specifically directed the contractor to ensure that the hoses complied with Lloyd's requirements. If they did, then I knew that the hoses would have been a safe product.[E188 para 33, Bottomley T3419]

ORDERING OF THE HOSES

ADI's initial actions

Clarity of the TM 200

10.57 The significance of the word 'investigate' in the TM200 was canvassed during the hearing. ADI contended [eg.T2114-6] that the word 'investigate' was not a word of technical definition, whether in the contract or elsewhere.[E25-section 8.8 of Attachment A; E139] This contention was pressed in the closing address on behalf of ADI with submissions such as 'It is self-evident that the word 'investigate' of itself is inherently ambiguous and imprecise, not containing within itself the measure or extent of investigation required' and 'Any investigation envisaged did not extend beyond ascertaining if Lloyd's had approved hoses that could be used as fuel hoses'.[T4345]

10.58 Counsel assisting the Board, on the other hand, submitted that 'investigate' is a word of common usage and meaning and should be read as such and that the Board should not be persuaded that in some way the word was required to be read down or ignored.[T4325]

10.59 Many witnesses were invited to give their impressions of what the word 'investigate' might require. The Board has considered all that evidence. In questioning WO Jones, Counsel Assisting drew his attention to, and asked him to accept, the fact that the word 'investigate' did not appear in what ADI suggested to be relevant glossaries or lists.[T2187] The evidence then continued:-

...did you have any difficulty in understanding the expression 'investigate' when you referred to the maintenance control record? ---No, sir.

Did you feel the need to speak to the ship to seek clarification by what they meant by 'investigate'? ---No, sir.

Did you feel the need to explain to ADI what...would be involved in the need to investigate? ---No, sir.

Did ADI enquire of you what was meant by 'investigate'? ---No, sir.[T2187]

10.60 Later in WO Jones' evidence, this question (on behalf of ADI) and answer appeared:-

Well, this is what I'm trying to ascertain: did you expect them to carry out, and want them to carry out, an engineering analysis of the consequences of the proposed change? ---Assessment or analysis, sir, I believe they're...both the same term, and ADI, being our prime contractor are there to advise 'yes, it's a good idea', 'no it's not a good idea'.[T2207]

10.61 Mr Bruce, the RPLSS Manager from Sydney, ultimately accepted that (if the phrase 'Lloyd's Approved' was taken out of consideration) the word 'investigate' would require 'the consideration and indeed the forming of a judgement as to what was appropriate to go in as flexible fuel lines'.[T3839]

10.62 ADI also contended that a TM200 would not require ADI to make any engineering analysis 'at its own expense', 'without a specific request to do so' [e.g. T2068] or as it was later formulated, 'any engineering analysis of the possible operational consequences of the fitting of flexible lines'.[T2123]

10.63 It has also been put on ADI's behalf that the TM 200 did not set out details of the job requested to the full extent required by ABR5230 para 558.[T802-804] Even though the TM200 is clearly deficient in much of the detail normally expected, the overriding facts however, are that ADI accepted the form without seeking further information and chose to act on it.

Conclusion

10.64 ADI were not specifically requested to do an engineering analysis, certainly not one of the type called for by a TM187. Nevertheless, the Board is of the opinion that the ship's request to ADI to 'investigate' cannot be confined in the ways ADI contend. In addition ADI had a general obligation as the engineering contractor to make a proper engineering assessment of the proposal taking all factors into account. The standard of that consideration should have accorded with the engineering expertise [T3096] and 'world class' [E405] which ADI claims.

Request for information from Lloyds

10.65 On 11 February 1998, Mr Morland telephoned Lloyds to ask for a list of suitable hoses. He confirmed his oral request by fax. The fax confirmed ADI's intention to fit flexible fuel hoses to WESTRALIA's main engines and requested a list of Lloyds approved hoses.[E103 Tab 5] Mr Morland's fax included the statement, 'We believe Brown and Root Engineering has made a similar request in the past on Lloyds fax message No F0027/97' Lloyds replied the same day enclosing a list of Lloyds type approved products.[E103 Tab 6] No one from ADI or the subcontractor had any further communication with Lloyds.

10.66 Mr Ridland, Lloyds Australasian manager, gave evidence that this sort of request was '...a general inquiry' and '...was the first part of the chain and ADI should have involved Lloyds in the procedure they were doing'.[T4028, T4029]

Lloyds requirements

10.67 None of WESTRALIA's engineering staff, the WMO, and ADI RPLSS personnel properly appreciated that the main engines came under the provisions of survey certificates issued by Lloyds. None of them was alert to the fact that any change to the ship's hull or machinery configuration was required to be submitted to Lloyds for approval, and then during execution to be inspected by Lloyds surveyors. The conditions under which a ship retains its class are clearly stated in the Lloyd's Rules. In particular, in relation to WESTRALIA, these conditions are stated on the reverse of the Certificate of Class as well as on the reverse of all sheets relating to the Interim Certificate issued in July 1996.[E138] Condition 1.5 reads as follows:

Plans and particulars of any proposed alterations to the approved scantlings and arrangements of hull, equipment, or machinery are to be submitted for approval, and such alterations are to be carried out to the satisfaction of LR's Surveyors.[E138]

10.68 Condition 6.19 of the RPLSS Contract is in similar terms:-

All repairs to hull, equipment, and machinery which may be required in order that the Vessel retains class, and approved alterations to scantlings and arrangements of hull, equipment or machinery shall be carried out under the inspection of and to the satisfaction of the Lloyd's Classification Society / AMSA Surveyors as applicable.

10.69 Certain items of hull and machinery also come within the scope of the standards laid down by the Safety of Life at Sea 74/78 (SOLAS). Arrangements for oil fuel, lubricating oil and other flammable oils are items covered by SOLAS 74/78. Chapter II-2, Regulation 33(viii) requires that:

Oil fuel pipes and their valves and fittings shall be of steel or other approved material, provided that use of flexible pipes shall be permissible in positions where the Administration is satisfied that they are necessary. Such flexible pipes and end attachments shall be of approved fire-resisting materials of adequate strength and shall be constructed to the satisfaction of the Administration.

10.70 Despite the requirement in the TM200 that the hoses be 'Lloyd's approved' ADI (and the subcontractor) failed to take any appropriate action to secure such approval.

Conclusion

10.71 Lloyds was not involved by either ADI (or its subcontractor) in approval of plans and particulars of the flexible fuel hoses or in inspection and assessment of their manufacture and installation. 'Lloyds approved' hoses were not manufactured and installed.

Work Instruction A1161/Specification

10.72 Mr Morland prepared Work Instruction A1161 describing the job as:

Manufacture 64 new lines to Lloyd's approved standards. All lines must be protected with outside braiding. There is to be 4 spare delivery lines and 4 spare return lines delivered to ADI Limited Engineer as on board spares for the ship.[E216 Tab RS5]

10.73 That description was deficient in various respects, in that it:

- a. omitted the requirement to 'investigate';
- b. substituted for 'Lloyd's approved hoses', '(hoses) to Lloyd's approved standards';
- c. introduced a requirement for protection by outside braiding;
- d. contained no dimensions and no drawing; and

- e. contained no specifications for things such as reinforcement, operating parameters or test requirements.

10.74 The Work Instruction was also formally deficient in that the title block was incomplete as to the identification of the ADI Officers who had approved and authorised it and in that it was later stamped 'Approved for Production' without any authentication of the affixation of that stamp.

10.75 Deficiencies in the Work Instruction were conceded by both Mr Morland and Mr Bruce.[T2587-2590, T3856]

10.76 WO Jones did not see the Work Instruction.[T1979]

10.77 In his statement dated 10 June 1998 Mr Morland did not mention the 1996 SG2 application relating to flexible fuel hoses [E179]. When he gave evidence on 19 June 1998 he said that he could not remember that documentation (or the matters referred to in it) even when it was produced to him, beyond the fact that it had been shown to him in the previous several days.[T2577-2578, T2584] Nevertheless, as has been noted above, the fax which he prepared and sent to Lloyds on 11 February 1998 refers to 'Lloyd's fax message No. F0027/97' (dated 8 January 1997 responding to Mr Morland's fax of 29 November 1996 from Brown and Root to Lloyds). That fax from Lloyds also referred to part 5, chapter 2, section 7.1 of the Lloyds Rules and that reference was repeated by Mr Morland in his fax of 11 February 1998.[E103 Tab 2] Mr Morland said that he had not been shown the MISD response of 4 December 1996 [E58 Yellow Tab 6] until 'recent times'.[T2577]

10.78 Mr Morland accepted under further questioning [T2585, T2634] that he must have read the Lloyds fax of 8 January 1997 when he wrote his fax of 11 February 1998, in particular the paragraph:-

However, it would still be expected for the hoses to be constructed from synthetic rubber with single or double closely woven integral wire braid reinforcement and external wire braid protection and that the design should have been certified to have been first tested with the end fittings attached to it at least five times the maximum pressure as per part 5, chapter 12, section 6 of the Rules.[E103 Tab 2]

10.79 The explanation which Mr Morland gave for having added the requirement for external braiding was that he had looked at the Lloyds list of approved hoses and noted that most of the hoses on the list had external braiding.[T2555] However, in the course of his evidence, Mr Morland was unable to identify a significant number of hoses from the Lloyds list which did have the external braiding.[T2746-2747] As noted above, he also accepted that he had failed to specify anything in the Work Instruction in terms of reinforcement and that he should have done so.[T2588]

10.80 Mr Morland gave evidence that he had not been familiar with the concept of high pressure pulses in fuel hoses prior to this Board of Inquiry.[T2627, T2651] Mr Morland confirmed that he had seen the Pielstick Service Bulletin 78 when he was employed by Brown and Root [T2628], but that he did not refer to it when he prepared the Work Instruction.[T2632] Copies of the Pielstick engine operating manual and Pielstick Service Bulletins are held by ADI, and copies held onboard WESTRALIA.[T2628] Mr Morland said that he had a 'quick look' at the Manual. He agreed that he looked at no other technical information and made 'no assessment, engineering or otherwise' in respect of the flexible fuel hoses.[T2630]

10.81 Mr Sergeant, Mr Morland's supervisor, said he did not read the body of the TM200.[T3587] He also had not heard of spill pulses until about a week before he gave evidence before the Board of Inquiry.[T3700]

Conclusion

10.82 The Work Instruction prepared by ADI was deficient in that it failed adequately to specify the job which the ship wanted done.

Selection of subcontractor

Preliminary notification

10.83 AMP 12 comprised 86 tasks, 52 of which were to be taken on by ADI, the flexible fuel hoses being one of these. On 12 February 1998, Mr Sergeant sent out a pro forma letter setting out the dates for AMP 12 to all companies which ADI anticipated would be involved as subcontractors.[E216 Tab RS6] The letter did not contain any specifications for the various items of work. It would appear that the purpose of the pro forma letter was to alert prospective tenderers of the upcoming AMP. The pro forma letter advised that work instructions would be relayed on 18 February 1998 to enable the submission of tenders and listed other milestone dates. The letter was not sent to Enzed or the Hose Doctor.

Invitation to quote

10.84 Four ADI employees, Messrs Sergeant, Morland, Singh and Baird-Orr, met on or about 15 February 1998 to decide which subcontractors should be invited to quote. It was decided to ask Mr Old to quote on the flexible fuel hoses, Mr Sergeant said:-

Although ADI had not contracted with Enzed before, I was aware from my own experience that Enzed is a supplier of high performance industrial hoses and held a Quality System Certification to Australian Standard ('AS') 3902.[E216 para 37]

10.85 A second pro forma letter, dated 12 February 1998, but in fact despatched on or around 20 February 1998, was sent to subcontractors enclosing the work instructions on which the companies were invited to quote.[E103 Tab 8] Both Mr Morland and Mr Sergeant said that the invitation to quote on the flexible fuel hoses was sent only sent to three subcontractors, namely, CHES Engineering, Rolls Royce and Enzed.[T2555, E216 para 402] The letter enclosed a copy of Work Instruction A1161. In fact, Wartsila NSD Australia Pty Ltd (Wartsila) also received a copy of the letter and work instruction, this having been ascertained by Board of Inquiry staff on or about 3 July 1998.[E402] The fact that ADI sent the invitation to tender to Wartsila was not included in any evidence or documentation produced to the Board by ADI including the matrix which they used to summarise and evaluate the tender process. The omission of any reference to Wartsila is a sign of inattention by ADI to the detail of the tendering process.

The Hose Doctor and Parker Enzed Technology

10.86 Shortly after the letter of 12 February 1998 was sent, Mr Sergeant states he was visited by Mr Kelvin Old at ADI's Rockingham office. He knew Mr Old to be a

competent ex CPOMT as they had both served in the RAN. Mr Old informed Mr Sergeant that he was now an Enzed franchisee at Naval Base, Western Australia. Mr Old gave Mr Sergeant his business card that showed the names Enzed and Parker in prominent positions.[E216 para 36] Mr Old is in fact a director and employee of Jetrock Pty Ltd, a company which trades as an Enzed Hose Doctor. Jetrock Pty Ltd is a franchisee of Parker Enzed Technology.[E343]

10.87 Mr Old, who gave evidence to the Board before Mr Sergeant's statement was received, was not questioned about his meeting with Mr Sergeant detailed above. Mr Old stated that he knew both Mr Sergeant and Mr Nigel Baird-Orr as a result of his previous service in the RAN. Mr Old said that his first contact with ADI about the job was after he had been sent the invitation to quote. He assumed he received the invitation to quote as a result of his previous connections with the two men.[T3007, T3025-6]

10.88 Mr Old calls himself a Hose Doctor. The Hose Doctor franchise from Parker Enzed Technology Pty Ltd involved agreement with a Enzed network franchisee, Todd Hydraulics Pty Ltd trading as Enzed Fremantle (also trading as Enzed Kwinana).

10.89 According to the franchise documentation (with the Network franchisee being referred to as Franchisee) an Enzed Hose Doctor Franchise means:

...a retail business utilising mobile van units which provide on-site sales and servicing of hydraulic hose fittings and accessories to customers and which operates from the Franchisee's Enzed Service Centre which supplies the Hose Doctor with inventory, commissions, customer lists, marketing services and other services and information in conjunction with Enzed. The Hose Doctor also will utilise in the operation of its franchised business certain equipment which has been developed and manufactured by Enzed or its affiliates for the preparation of customised hydraulic hose fittings and related products to suit specific requirements of the customers serviced by the Hose Doctor.[E193 Tab 1]

10.90 Under the franchise agreement, the Enzed network franchisee is to provide the Hose Doctor with training. The Enzed network franchisee is also required to provide the Hose Doctor with technical advice and information. Mr Old completed this training in December 1997.[T3024] The franchise agreement provides that Mr Old is to use materials supplied by the network franchisee. Mr Todd sourced products from Parker Enzed Technology and other manufacturers.[T3024]

Provision of Lloyds list of approved hoses

10.91 Both Mr Sergeant and Mr Morland said they believed the Lloyds list of approved flexible hoses was attached to the invitation to quote. However, neither of them was personally involved in the despatch of the pro forma letter and the letter made no mention of that list.[T2605-2506] When questioned, Mr Morland stated he gave Mr Old another copy of the Lloyds list when Mr Old dropped in to the ADI Rockingham office with his quote.[T2638] Mr Old suggested this occurred when he asked for it after he had received the invitation to quote from ADI and had shown Mr Morland the samples, but before he submitted his quote.[T3030]

10.92 Mr Old gave evidence that the Lloyds list was not attached to the invitation to quote [T3026-3028] and it was not with the invitation to quote which Wartsila gave to the

Board. The documentary evidence suggests that the evidence of Mr Old on this issue should be preferred.

Conclusion

10.93 ADI did not send the Lloyds list of approved hoses with the invitation to quote.

Development of quote by the Hose Doctor

10.94 Mr Old said that after receipt of ADI's invitation to quote, he went to the ADI Rockingham office to get 'sizes, threads, working pressures, as much information as I could so to help me to prepare a quote'. [T3028] Mr Sergeant introduced him to Mr Morland. [T3008, T3027] Mr Morland told him that the required length was about 200mm, he did not know the threads and gave a ball park figure of around 4½ to 5½ bar working pressure. Mr Morland told Mr Old that the hose had to be tested at 1½ times the working pressure. He could not give Mr Old any indication of the internal diameter of the hose required. [T3029, T2639]

10.95 Mr Old had several meetings and conversations with Mr Morland. Mr Morland, he said, gave him the Lloyds list at some time in the course of those meetings. Mr Morland at no stage showed Mr Old the TM200, nor the fax of 8 January 1997 from Lloyds and did not tell him of the hose description given in the fax. [T3028-3029, E103 Tab 2] Mr Morland said that (at some unspecified point of time before the quote was submitted):-

I got talking to (Mr Old) about Lloyd's. It came up in passing. I said to him that everything had to be Lloyd's approved (mainly talking about hoses). He didn't respond in detail but simply said okay or something to that effect. [E179 para 18]

10.96 Mr Old asked Mr Brian Todd of Enzed Fremantle which hose he thought would be best. He could not remember whether he showed Mr Todd the Work Instruction and said 'I basically gave him the same information that I'd received from Mr Alan Morland'. [T3031] Mr Todd suggested Parker 221FR hose, which they later found on the Lloyds list, but which did not have outside braiding. [T3033]

10.97 Sometime before he submitted his quote to ADI, Mr Old stated that he showed Mr Morland a sample of Parker 221FR which does not have an external braid. Mr Morland told him that he wanted a hose with external braiding. Mr Old decided not to fit external braiding to the Parker 221FR as it would be purely cosmetic and too expensive. Mr Old then showed Mr Morland a sample of SST12 hose – a hose with an outer stainless steel braided cover and a teflon liner. [T3009] Mr Morland told him that he should use that type of hose. Mr Morland, for his part, denies ever seeing a sample of hose without external braiding. [T2676-2677]

10.98 At some point, Mr Morland told Mr Old that the ship had used a hose with external braid for its generators. Mr Old contacted Enzed Darwin and found that Parflex 919 hose had been used. [T3033] This gave him some confidence in choosing to quote on Parflex 919. He was probably unaware that the hose had been used for quite a different application on the generator (small bore lubricating oil piping). [T3034, T4183]

10.99 Mr Old gave evidence that he did not understand Mr Morland to be advising him that he must use a hose from the Lloyds list. Mr Old thought the Lloyds list was given to him to help him make a choice. Mr Old did not know what Lloyds was and was not familiar with Lloyds requirements, indeed, he said 'I was aware that Lloyd's was to do with insurance and that was about it.'[T3071] Mr Old did not tell Mr Morland that he was not familiar with Lloyds. Mr Old did not make any further enquiries of Lloyds.[T3031-3032, 3079-3084] Mr Old knew the SST12 hose was not on Lloyds list, but since Mr Morland had said it was OK, he assumed it was Lloyds approved. Mr Old did not ask Mr Morland if the hose was Lloyds approved.[Old T3008-3009]

10.100 Mr Old was not aware of the high pressure pulses which could be present in diesel engine fuel hoses as a result of the action of the injectors. Mr Old did not understand the concept of spill pulse when questioned about it.[T3069-3070]

Conclusions

10.101 The differences between Mr Old's account and Mr Morland's account concerning the choice of hose is noted and the Board considers that Mr Old's evidence is more reliable.

10.102 Mr Old, the Hose Doctor, failed:

- a. to supply a hose to Lloyd's approved standards.**
- b. to make any, let alone adequate, enquiries of Lloyds.**

Submission and acceptance of quote

10.103 Mr Old said he submitted his quote to ADI on 27 February 1998. The ADI document is stamped as having been received on 3 March 1998. The quote was for an SST hose, Parflex TFE919 in the sum of \$6,608.89, but included a quote for Parker 221FR in the sum of \$6,732.54 with this explanation:

A further quotation utilizing PARKER 221FR hose has also been included for future reference, this hose is listed in the LR Type Approved Products - Part 1 for Marine, Offshore and Industrial Equipment and has been allocated Certificate number DRAFT 97/8. As detailed in the Product Sheet, enclosed, this hose is fire resistant and has been designed for marine applications. The Work Instruction states that the hose to be used must have an external Wire braid, 221FR does not have an external steel braid but a high tensile steel braid is present directly below the fire resistant synthetic rubber cover. It is felt that if the requirement to have an outer cover of steel braid could be waived 221FR would be a most suitable alternative to PARFLEX 919.[E103 Tab 8]

10.104 The quote was on Enzed letterhead with details printed for the Service Centres at Fremantle and Kwinana. It was signed by Mr Old with the word Enzed typed below his name.[E103 Tab 8] The quote had attached to it product information sheets in respect of the two types of hose. It also covered the hose end fittings.

10.105 The product information sheet for Parker 221FR included a warning: -

!WARNING - FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED HEREIN

OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

This document and other information from Parker Hannifin Corporation, its subsidiaries and authorised distributors, provide product and/or system options for further investigation by users having technical expertise. It is important that you analyze all aspects of your application and review the information concerning the product or system in the current product catalog. Due to the variety of operating conditions and applications for these products or systems, the user, through his own analysis and testing, is solely responsible for making the final selection of the products and systems and assuring that all the performance, safety and warning requirements of the application are met...[E193 tab5]

10.106 There is no evidence that ADI or Mr Old paid any attention to this warning or conducted the recommended analysis and testing.

10.107 At the time he submitted the quote, Mr Old had not seen WESTRALIA's engines and had received inadequate information from ADI to provide a firm quote. ADI witnesses suggested that this was not unusual. Mr Sergeant stated that:

...it is standard practice for tenderers to submit quotes which may be indicative only and subject to confirmation...The proposed tenderers will generally be given the opportunity to vary their initial quotes after they have inspected the work... [E216 para 31-32]

10.108 Mr Morland gave similar evidence speaking of it as a 'generic' quote, one for 'basically what they thought was going to be costs from the work instruction', and one which would be 'reviewed'[T2639] and made the subject of a 'revised' quote. This situation may be understandable given that the ship was at sea at the time and these details were unavailable. Nevertheless, no revised quote was ever submitted by Mr Old or Enzed (although Mr Old did eventually submit an account for a revised figure to Mr Sergeant which account Mr Sergeant rejected.

10.109 ADI's evidence is that the Enzed quote was accepted after a tender evaluation process [Morland T2590, Sergeant E216 para 30, T3698-99] When consideration is given to the uncertainty of the basis of the quote it must be questioned how meaningful any such evaluation could have been. The matrix document used at this tender evaluation meeting noted the Enzed quote in the sum of \$6732.54. That figure was for the alternative, 'non-conforming' quote from Enzed for Parker 221FR hose.[E216 Tab 12]

10.110 In early March 1998, Mr Morland told Mr Old he had won the tender.[T3009]

10.111 On or about 12 March 1998, ADI sent to Mr Old a purchase order.[E103 Tab 10] The purchase order did not specify which hose type was being ordered but it was also in the amount of \$6732.54. Mr Old said he thought a SST (stainless steel teflon) hose was being accepted and Parker was an SST hose.[T3051-3052] ADI intended to accept the quote for Parker 919TFE hose.[Sergeant E216 para 53; Morland T2958-2959]

10.112 A computerised record, a MAXIMO Work Order no, 975991, was raised by ADI on 16 March 1998 with reference to Work Instruction A1161. This, too, referred to the sum of \$6,732.54, stipulating it to be for sub-contractor labour. It added to that figure ADI's on cost of \$336.63, making a total price of \$7069.17. A print copy of the Work

Order was signed by Mr Sergeant on behalf of ADI and by WO Jones on behalf of OAWA.[E103 Tab 11]

10.113 WMO did not get a copy of the quotation. WO Jones said he was able to sign off on the Work Order because he was 'relying on ADI's recommendation'. [T1986] He had no knowledge of the types of hose that had been quoted on or installed. [T1993] WO Jones' billet description details one of his job functions as ensuring cost effectiveness and efficiencies are being obtained whilst Commonwealth purchasing/contracting policies are being adhered to. [E130A Tab MRJ3]

10.114 In March 1998, after Mr Old had given a quote and it had been accepted, ADI prepared a contract and had this signed by Mr Old. [E103 Tab 20] The contract was evidently a standard form contract used by ADI and its terms were to apply to any work the contractor agreed to perform for ADI. The contractor was expressed to be 'Enzed (ACN 080 369 268)'. That number is the ACN of Jetrock Pty Ltd, Mr Old's company. The attestation and description beside Mr Old's signature on the contract is 'Signed for and on behalf of Enzed by Kel Old Hose Doctor 25 MAR 98'. [E103 Tab 20]

Conclusions

10.115 ADI paid insufficient attention to the Enzed quote, particularly in relation to the evidence which it contained suggesting that the quote was not for a hose which was 'to Lloyds approved standards'.

10.116 Approval of the work order was one of the critical checkpoints for the process of fitting the new flexible fuel hoses. WO Jones gave insufficient attention to the documentation supplied by ADI. WO Jones approved the work order for the fuel hoses without having seen an original quote. Had WO Jones seen the original quote, it is possible that he may have been alerted to the fact that the Parflex 919 hose quoted on by Mr Old was not Lloyds approved. WO Jones would then have been aware of the basis for the quote.

10.117 Mr Old presented himself to ADI as a representative of the Parker Enzed Technology organisation and this implied a depth of expertise and knowledge which Mr Old could not, and did not, provide.

Allocation of AMP work at pre-AMP meeting

10.118 A pre AMP meeting was held on 10 March 1998 at STIRLING. At the pre-AMP meeting, key issues regarding the conduct of the AMP including the work package, the schedule and OH&S are discussed. [T3274] There were in attendance various RAN personnel including CMDR Sippel, LCDR Crouch, WO Bottomley and WO Jones (who was the Chairman of the meeting) and ADI personnel including Messrs Bruce and Sergeant. The list of work to be attended to in the AMP was discussed and various jobs approved, in a financial sense. All evidence from those attending the meeting is that the fuel hoses were not discussed except that the title of the TM200 ('manufacture and install flexible fuel lines on both M/E's') was read out and the work approved. During that meeting, CMDR Sippel identified a number of configuration changes from the titles listed on the TM200s. He gave evidence that he pulled them off the work list and insisted that configuration change documentation be raised. [T4188]

10.119 After the pre AMP meeting, CMDR Sippel had a discussion with LCDR Crouch, the substance of which was the reinforcement by CMDR Sippel that TM200s were no longer to be used for configuration changes. The conversation did not mention the flexible fuel hoses or any specific items and CMDR Sippel explained, 'I was speaking more generically about the process, as opposed to specific items'.[T4195] LCDR Crouch agreed that such a conversation took place, and that the conversation was limited to configuration changes in general and that no mention was made of flexible fuel hoses or other specific items.[T4458]

MANUFACTURE AND INSTALLATION OF HOSES

Production of prototype fuel hoses and use of SST-12 hose

10.120 On 11 March 1998, Mr Old went to the ship to look at the job and receive a safety induction. Mr Morland and Mr Old inspected the engines and Mr Morland gave Mr Old a sample of the rigid fuel line. It became apparent to Mr Old that he had to cope with two details which were different from what was covered in his quote: the end fittings required a thread different from that on the fittings which he had included and the hose diameter was $\frac{3}{4}$ ' which was not a size in which 919TFE hose was produced.

10.121 Having discovered that the threads were different, Mr Old discussed options with Mr Todd. Mr Old decided to have Abonnel Precision Engineering (Abonnel) manufacture some sample tails. The sample tails were delivered on 12 March 1998.[T3010-3011]

10.122 To accommodate the different hose diameter, Mr Old used SST-12, another stainless steel hose supplied by Enzed Fremantle which he assumed was a Parker product. He understood that the SST-12 hose was equivalent in all respects to Parflex 919TFE hose but he referred to no product information sheet on it. He found out only after the fire, that the SST12 hose was manufactured by Astraflex Limited.[T3011-12]

10.123 Mr Brian Watts, the managing director of Parker Hannifin Australasia, explained to the Board that SST is a generic reference used for a variety of manufacturers' stainless steel teflon hoses stocked in the Parker Enzed Technology range. He explained that they bought SST hoses from several different manufacturers whose products might have slightly different specifications. Parker Enzed Technology accordingly specifies in its catalogue ratings for SST hoses which accommodated the lowest ratings for product they might acquire and market as part of their SST range. SST-12 was the Parker Enzed Technology generic reference for a $\frac{3}{4}$ inch diameter stainless steel teflon hose.[T3059]

10.124 Information in the form of a product sheet relating to the design of hose assemblies using Astraflex SST-12 should have been made available to Mr Old by Enzed Fremantle. Enzed Fremantle did not provide Mr Old with the Astraflex SST-12 product sheet which contained the following warning:

When selecting Astraflex hose it is very important that the following design considerations are taken into account:

Temperatures and Pressures: Whilst PTFE has a working temperature range between -60°C and 280°C (dependent upon the grade selected) as with all other types of hose, increased working temperatures require a reduction in maximum rated working or burst pressure. Whenever excessive flexing,

vibration, thermal fluctuations or rapid pressure impulsing [emphasis added] is in evidence, further caution should be exercised in reducing the maximum working pressure. See INFORMATION SHEET 6 - temperature derating curves.[E197]

10.125 This important warning was not available to any of the key personnel involved with the flexible fuel hoses.

10.126 Mr Old did not tell ADI that he would be supplying SST-12 instead of 919TFE.[T3041-3052] ADI did not become aware that SST-12 had been used in the flexible fuel hoses until after the Board of Inquiry commenced.[T2564]

Conclusion

10.127 The Board finds that Parker Enzed Technology:

- a. failed to give Mr Old sufficient assistance by way of training and product information to enable him to comply with contractual duties or other duties in respect of the flexible fuel hoses; and**
- b. failed to give Mr Old adequate product information concerning SST-12 for use by himself, ADI or Navy.**

First and second prototype

10.128 Mr Old prepared two prototypes of the flexible fuel hoses and gave these to Mr Morland.[T3011]

10.129 Mr Morland showed the first prototype fuel hose given to him by Mr Old to WO Bottomley in about March 1998.[T218] The first prototype had the end fittings from the existing fuel pipes in the ship on it.[T2690] WO Bottomley commented that the first prototype was not acceptable because this prototype would mean cutting up the existing fuel pipes and connections so that if the ship needed to reinstall them, it could not.[T219] Mr Morland advised that if the ship wished to retain the fixed fuel pipes with their existing connections, it would be necessary to fabricate new connections and have them connected to the flexible fuel hoses.[T219, T2690]

10.130 On 16 March 1998, Mr Old started removing the rigid fuel lines. Mr Old had previously told Mr Morland he wanted to use the old nuts to fit the hoses. Mr Morland told him that although the ship's staff liked the hoses, they did not want the rigid fuel lines to be destroyed.[T3012, T219]

10.131 Mr Old undertook to have new end fittings manufactured. He gave a second prototype fuel hose with specially manufactured end fittings, telling Mr Morland that it represented the fuel hoses he proposed installing in the ship.[T2691] This was about 19 March 1998.[T3011]

10.132 Mr Morland left it to Enzed to deal with the issue of Lloyd's approval. He gave evidence, however, that in March 1998, when they were discussing a prototype of the lines, WO Bottomley asked, 'Are they Lloyd's approved?' and he replied 'Yes.' He was questioned about this:-

HOW HOSES OF INADEQUATE DESIGN CAME TO BE FITTED

Yes. And you tell the Board that your understanding, the effect of which you communicated to WO Bottomley, was based on the fact that the instruction required Lloyd's approval, and the fact also that Enzed had submitted a quote?---That's correct.

So, you were leaving it to Enzed to ensure the matter of Lloyd's approval?---That's correct.

You knew that the 919 hose was not even referred to in the material from Lloyd's?---That's correct.

How did you think that Enzed would have secured Lloyd's approval?---I would leave that up to them.

Well, had you any idea what would be involved on their part in getting Lloyd's approval?---Not really; no.

Did you care?---At this stage, no, because I asked for it.[T2602]

10.133 Mr Morland said that he never asked Mr Old specifically if the hoses were Lloyds approved.[T2728] The only question Mr Morland asked of Mr Old was whether the hoses were suitable for fuel.[T2648] Mr Old denied that he was asked even that question.[T3106]

10.134 LCDR Crouch told Mr Morland that he would like to see the prototype before the work went ahead. WO Bottomley was handed a second prototype with end fittings by Mr Morland in Mr Morland's office.[T219] WO Bottomley took it away.[T2691] WO Bottomley's evidence was that the new line was also shown to LEUT Walters, the Assistant Marine Engineering Officer in WESTRALIA, before it was given to LCDR Crouch.[T1876, T220, T2831]

10.135 LCDR Crouch stated that he had asked Mr Morland to show him one of the hoses because he wanted 'to see one to get a feel for the quality of the hose and to see what they looked like'.[T2831] LCDR Crouch says that he asked Mr Morland what pressure the hoses would be tested to. Although he could not recall precisely, LCDR Crouch stated that Mr Morland's answer, 'satisfied me that the test pressure was to be far greater than the system would require. I think he mentioned something in the order of one and a half times the system's normal operating pressure.'[T2831] LCDR Crouch gave evidence that the extent of his responsibility in relation to the flexible fuel hoses was to make general enquiries including asking Mr Morland whether the hoses were to be pressure tested; what they would be pressured tested to; whether they were Lloyds approved and to examine the hose for quality e.g. broken braiding or broken strands; looking down the bore for holes.[T2892-2893]

10.136 When the second prototype was returned to Mr Morland by WO Bottomley [T2849], Mr Morland stated that he was told that the prototype was 'accepted'. [T2558] In giving evidence, he said that 'they came back and said they liked it' [T2689-2690] and that the 'Navy were happy with it.'[T2692] He made a diary entry, in relation to the flexible fuel hoses, in which he wrote that it was 'okay to proceed.'[T2733]

10.137 Mr Morland returned the second prototype to Mr Old on or about 23 March 1998 and said that 'ADI was happy with the prototype fuel line'. [T2692]

10.138 WO Bottomley denies giving approval. In his second supplementary statement WO Bottomley said:-

In paragraph 31 of his statement, Mr Morland asserts that I told him that the prototype was acceptable and that it was okay to go ahead with the installation of the flexible hoses. I do not have the authority to accept the hoses or to give any direction that work commence. I simply told Mr Morland that we were happy with the hose and thought that it looked good and would be a big improvement.[T3417]

10.139 When asked by Counsel for Parker Enzed Technology, who it was at Navy who consented to that second prototype and its suitability, WO Bottomley replied:-

We didn't get to say. We were only shown it. It wasn't given to us to approve or not to approve it.[T219]

Conclusion

10.140 Mr Old failed to advise ADI that he had not supplied Parflex 919 hose but another generically described SST hose product.

10.141 The prototype produced by Mr Old, simply involved the substitution of the rigid steel lines with flexible hoses. There is no evidence of any consideration of the different characteristics of the flexible fuel hoses and rigid steel lines or of good engineering practice.

10.142 It is extraordinary that ADI, via its employee Mr Morland, would give the ship an assurance that the flexible fuel hoses were Lloyds approved without carrying out even the most fundamental checks to ascertain whether that assurance was correct.

10.143 The Board finds that Mr Morland's action in assuring WO Bottomley that the flexible fuel hoses were Lloyds approved when they were not, eliminated a major safety check point. ADI's failure to ensure the flexible fuel hoses were Lloyds approved was a major contributing factor to the accident.

Contract Change Proposal

10.144 Mr Old obtained a quote from Abonnel for the manufacture of the new end fittings [E193] and faxed an Enzed quote to ADI on 23 March 1998 in the sum of \$4,038.52.[E103 Tab 16, T3014]

10.145 Mr Morland prepared a Contract Change Proposal (CCP) [E103 Tab 15] and Work Order 975991/01 [E103 Tab 14] to cover the manufacture and supply of the end fittings. These were for an additional amount of \$4,240.45 comprising the Enzed quoted figure together with an ADI on-cost of \$201.93. The Abonnel price to Enzed was ultimately \$3535.89.[E193 Tab 7, 12 and 17] The Work Order stipulated that it was for materials. It was approved by WMO.[T1952] Mr Morland informed Mr Old that ADI had approved the variation.[T2692] On 24 March 1998, Mr Old ordered the fittings.

10.146 This variation overlooked the fact that the original contract had included an amount of about \$3,000 for end fittings and that a credit should have been given by ADI for that amount when the variation was raised.[T3110] This situation was raised during the

hearing [T1952] and following that, ADI by letter dated 25 June 1998 gave credit for \$3,447.97.[E201] WO Jones said he was 'not conscious that an overpayment might have been made at the time (he) approved the contract change proposal'.[T1952] The relevance of this situation so far as the Board is concerned is that it further demonstrates inattention to documentation by ADI and WMO. Further relevance was raised by evidence from Mr Old [T3110 and E219] that he had become aware of the need for such a credit, that he delivered to Mr Sergeant an invoice for an amount less than the total prices in the quotes, and that Mr Sergeant rejected the invoice and told him to put in another for the full price, which Mr Old did.[E104 Tab 24] Mr Sergeant conceded this [T3698] This evidence is troubling to the Board.

Conclusion

10.147 The fact that Mr Sergeant directed Mr Old to increase the amount of his invoice seriously detracts from the acceptability of Mr Sergeant's evidence on the subject of the quotation and evaluation process. Although this is not within its terms of reference, the Board consequently feels concerned about the ADI RPLSS tendering practices.

Assembly, testing, installation and reinstallation

Assembly, installation and testing

10.148 On and between 7 and 10 April 1998, Mr Old assembled and pressured tested the hoses. The pressure testing was at 1000 kPa for 5 minutes. All supply hoses passed the test, but one return hose failed. In accordance with what he said was his ordinary practice, Mr Old destroyed that hose to prevent re-use, and made up a new one. The new hose passed the pressure test. Mr Old then completed the test certificates and tagged the hoses.[T3015,T3016, T3061, T3063]

10.149 The destruction of the hose without fully investigating and documenting the failure, and indeed the failure to inform ADI, suggests poor quality control procedures on the part of Mr Old. LCDR Crouch stated in evidence that if he had known about that one hose failure it would have caused him to question the integrity of all the hoses.[T2832] Mr Old did record the failure of the hose in his closing report. That report was not given to the ship before she sailed on 5 May 1998.[T229]

10.150 Mr Old installed the hoses between 8 and 10 April 1998. He made up and pressure tested the 8 spare hoses on 11 April 1998. Mr Old bagged the spare hoses for storage and gave them to Mr Morland.

Post installation leaks

10.151 Between 17 and 24 April 1998 tests were conducted on the main engines. None of the fuel hoses leaked but there were continuing leaks at fuel pumps and valves.[T2561, E199 para 71] During this period Mr Old attended to various of these leaks, removing blocks and placing or replacing washers.[T22] Mr Old was not present during the test, but Mr Morland told him about it. On 21 or 22 April 1998, Mr Old disconnected and then reconnected seven fuel hoses on the outboard side of the PME to enable the ship's crew to remove a leaking fuel rail.[T22]

10.152 On 24 April 1998, WO Bottomley accepted the flexible fuel hoses and signed off that the work was complete on behalf of the ship.[T206]

10.153 Continuing leaks were noticed during sea trials which took place 29 April – 1 May 1998. PO Hollis referred to them as ‘a series of minor leaks around the fuel lines’.[T1803]

The opening and closing report

10.154 On 30 April 1998, Mr Old delivered his unsigned opening and closing report to ADI.[E103 tab 22, T3018-19, E219 para 12] ADI did not give that report to the ship before she sailed on 5 May 1998. The report included notes that:

1. It needs to be stressed to all personnel that will be required to install/remove the new hoses that they will not tolerate:
 - a. twisting, or
 - b. excessive bending.
2. When removing or installing the assembly, care should be taken to ensure that it is not subjected to any of the above.

Leak rectification on 4 May 1998 by the Ship's Crew

10.155 On 4 May 1998, in accordance with instructions from WO Bottomley [T22], PO Hollis tasked LSMT Smith, LSMT Meek, AB Croasdale and AB Justice to attend to the leaks by replacing about 18-20 steel washers on both main engine fuel pump connection blocks.[T1803] He told them ‘not to bend the lines’. He explained:-

From my experience, I knew that flexible lines should not be bent or twisted. Nobody from ADI, Enzed or the ship's staff told me about this. I checked on them twice that morning and everything appeared to be going well.[T1803]

10.156 Each of the sailors who worked on the lines was questioned on how they handled the hoses. While giving evidence, LSMT Smith and AB Croasdale recalled having difficulty tightening the block on no. 10 cylinder PME and having to ask PO Hollis to assist. LSMT Smith cannot now find the list of which blocks were leaking. AB Justice remembers working on STBD 8 and 9 cylinders. The sailors seem to have been generally aware of the dangers of excessive bending or twisting of the hoses and to have acted accordingly.[PO Hollis T1811, 1815, 1818, 1827, 1846; LSMT Smith T1248-1250, 1254-1260; AB Croasdale T1390-1396, 1398-1400; AB Justice T4124-4126] AB Justice pointed out how difficult it was to get at the flexible hoses to see what was happening to them:-

...it's above my head and so it's really difficult because you're bent back and so I couldn't put it in because I couldn't see to line it up.[T4125]

10.157 ADI contends that damage was done to the hoses on 4 May 1998 reducing their resistance to fatigue.[T4374] Dr Goodwin has pointed out despite careful handling, installation was impossible without excessive bending, and twisting was a significant risk as a result of poor design.[T3500-T3506] He said that damage during installation may have reduced hoses' resistance to fatigue.[E214, T4232] Mr Bromley has expressed the

opinion in any event, that mechanical damage to hoses, particularly permanent sets and internal creases were not found to significantly affect the static burst strength.[E194 pp8, 25] Further, Mr Bromley's testing of sample hose 'D' particularly suggests that abuse in itself would not result in hose failure.[E194 para 3.13 and 4.1.3]

Conclusion

10.158 Because of design deficiencies, the hoses could not be installed without damage to them. Whether any damage done to hoses on 4 May 1998 was more significant than any damage done to hoses by when they were installed or otherwise handled before 4 May 1998, is impossible to say. Testing has, however, established that such damage was not relevant to the leaks in the hoses which occurred on 5 May 1998. In any event, susceptibility to damage under these circumstances would have demonstrated their unfitness for purpose.

PROCESS DEFICIENCIES AND OTHER FACTORS

Introduction

10.159 There were numerous process deficiencies and other factors which led to the installation of the defective flexible fuel hoses. The following paragraphs draw together, on an organisational basis the more significant process deficiencies and other factors. Matters directly relating to Quality Assurance are dealt with in Section 12.

NAVY

HMAS WESTRALIA

10.160 As noted in R10.50 and R10.51, notwithstanding that LCDR Crouch was led into error by oral advice from WO Jones, he should have himself instigated checks as to just what had occurred in relation to securing appropriate approval for the installation of the flexible fuel hoses.

OAWA

10.161 WO Jones misled LCDR Crouch and WO Bottomley into believing that circumstances had transpired which made the use of a TM200 the appropriate next step to be taken in relation to the flexible fuel hoses, as noted in R10.50.

10.162 At the stage of approval of the MAXIMO Work Order, WO Jones failed to view essential documentation, particularly the Enzed quotation.[R10.116] His inattention to documentation was in evidence again when he approved the Work Order for the variation in respect of the new end fittings, as set out in R10.144-10.146.

10.163 Against these deficiencies, however, the Board acknowledges that WMO has not been trained in contract administration and has only completed a 2-3 day financial training course and a basic 'purchasing' course.[T2154] Despite his extensive naval marine engineering background and knowledge of WESTRALIA, the WMO has not been trained to manage a complex maintenance contract such as RPLSS.

10.164 No one within the OAWA, let alone WMO, has received any training in matters pertaining to Lloyds Classification and the need to ensure that WESTRALIA remains as required, 'in class'. [T3324]

Conclusions

10.165 The Board finds that the WMO was not adequately trained for his role within the OAWA.

10.166 WMO failed to give attention to the documentation, to confirm that the job on the flexible fuel hoses was being done as requested by the ship.

10.167 WO Jones did explain that:

AMP 12 was a busy period for me, as my CPO was unavailable for one week due to his training commitments prior to transferring to the business office within OAWA at the completion of AMP12 activities. [T1946]

Recommendation

10.168 The WMO billet should be filled by a person who has, amongst other requirements, received appropriate training in contract administration, financial management and Lloyds Classification Society requirements.

ADI

10.169 Deficiencies in process on the part of ADI might be summarised as follows, and there is included at the end of each summary item a list of relevant conclusions expressed above:-

- a. ADI failed to give any adequate engineering consideration to the flexible fuel hoses. [R 9.93-4, R10.64, R10.71 and R10.143]
- b. ADI failed to adequately to specify or otherwise design the flexible fuel hoses. [R9.93-4, R10.64, R10.82, R10.143]
- c. ADI failed to supply flexible fuel hoses which were Lloyd's approved [R10.71, R10.141] and ADI assured WO Bottomley that the hoses were Lloyds approved when they were not. [R10.143]
- d. ADI failed to take adequate steps to ensure compliance by their subcontractor of compliance with the TM200. [R10.82, R10.115]
- e. ADI supplied flexible fuel hoses which were not fit for their intended purpose. [R9.94]

Occupational Health and Safety Legislation

10.170 In addition to those deficiencies, matters pertaining to ADI's obligations pursuant to the Occupational Health and Safety (Commonwealth Employment) Act 1991 (the 'Act') have been considered by the Board. Whilst the RPLSS contract does not

explicitly refer to obligations under to the Act, that omission does not relieve ADI of its responsibilities under the legislation. Current RAN policy, as outlined in ABR 6303 (RAN Safety Management Manual) is that any contract entered into by the RAN should include responsibilities placed on the RAN and the Contractor under the relevant occupational health and safety legislation.

10.171 ADI, as a supplier of goods, had an obligation under the Act to ensure that such goods at the time of supply were safe for use and without risk to the health of those who use the goods; additionally, the Act required ADI to carry out, or cause to be carried out, the research, testing and examination necessary in order to discover, and to eliminate or minimise, any risk associated with the goods being supplied.

Recommendations

10.172 Consideration should be given by an appropriate authority as to whether ADI failed to comply with the Act.

10.173 Care should be taken to ensure that all RAN contracts include explicit reference to occupational health and safety legislation as stipulated in ABR 6303 Chapter 4.

Parker Enzed Technology Organisation

10.174 The Board has concluded above that Mr Old failed to supply a hose “to Lloyd’s approved standards” (as it was referred to in the Work Instruction), failed to make any adequate enquiries of Lloyd’s Register [R10.102], and failed to alert ADI to his change to SST-12.[R10.140] It has also concluded that Mr Old presented himself to ADI as part of the Parker Enzed Technology organisation and this implied a depth of expertise and knowledge which Mr Old, could not, and did not, provide.[R10.117] In paragraph R10.127 the Board has further concluded to the effect that Parker Enzed Technology gave inadequate support to Mr Old in the obligations which he undertook as part of their organisation. The Board wishes to add a further conclusion, based on the whole of the evidence canvassed above.

Conclusion

10.175 The Parker Enzed Technology organisation apparently allowed Mr Old to present himself to ADI as representing the Parker Enzed Technology organisation thereby giving rise to an unwarranted expectation of the level expertise and knowledge he could provide.