Sergeant (AQMS)) level supervisors and there was a major pull from non-frontline requirements on the other supervisory ranks. For example, the formation of the Wildcat Fielding Team (WFT) required all posts to be filled from the extant Lynx Force; for 1 Regt AAC Wksp REME, this resulted in the loss of 1 x WO1 (Artificer Sergeant Major (ASM)) and 1 x SSgt (Tech). The Panel noted that the WO1 (ASM) was drawn from the front line Lynx unit despite there being an overall surplus of WO1 (ASM) elsewhere within REME (REME liability was for 17 x WO1 (ASM), there were actually 35 x WO1 (ASM) within the cadre) . Additionally, JHC had prioritised REME aviation manning to 5 Regt AAC, 657 Sqn and 8 Flt before any other AAC units, further compounding the manning shortfall and imbalance at some front-line units.

Exhibit 161
Witness 5
Exhibit 135

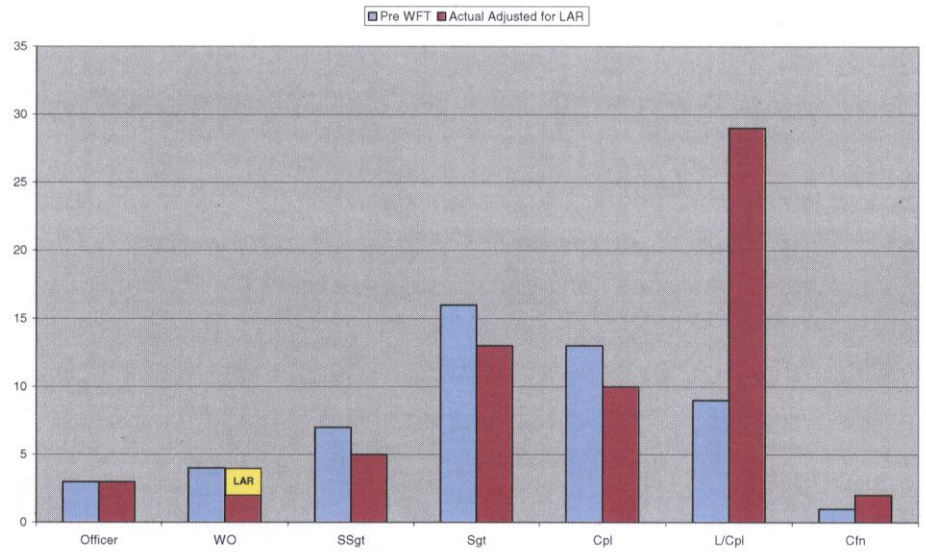

Exhibit 171 (derived from Exhibit 152 & Exhibit 160

Fig 34 – 1 Regt AAC Wksp REME Manning Jul-Dec 11 (By Rank and Adjusted for LAR)

1.4.160 The Panel reviewed the Wksp's 8005 (Establishment) against the actual manning provided by Army Personnel Centre (APC) Glasgow and the Wksp's assessment of the manning between Jul and Dec. Even with adjustments made using Local Acting Rank (LAR), as directed by DEME(A) Chief Air Engineer, discrepancies were noted between the Pre-WFT establishment manning figure and the actual manning experienced at the Wksp.

Exhibit 152
Exhibit 162
Exhibit 170
Exhibit 171

1.4.161 The Wksp was undermanned due to the influences of both the wider REME Avn shortfall in manning versus liability and the transitory position as the Force moved towards the future Wildcat force structure, which had an increased reliance on In-Barracks Equipment Support (IBES). This was essentially contractor support at Forward which enabled uniformed personnel numbers to be reduced through a compensating reduction in REME personnel. This meant that there had been a real-term reduction in REME Avn personnel for the Lynx Force ahead of Wildcat Introduction to Service.

1.4.162 While the Panel could find no evidence to suggest that under manning affected the outcome of this accident, it did conclude that the resultant symptoms observed had the potential to influence another accident. Under manning at 1 Regt AAC was therefore deemed to have been an **other factor (organisational influence)**.

1.4.163 **Supervisory Manpower Issues.** In addition to being undermanned, in the months preceding the accident 1 Regt AAC Wksp REME had been required to support flying in 3 locations concurrently (El Centro, Op HERRICK and Main Operating Base (MOB)); as a result, a large number of Wksp personnel were allocated to duties away from Gütersloh. Despite the number of personnel allocated to detachments, the Wksp also supported flying duties for those aircrew who remained on the base. The Panel

Annex A

considered whether the effect of under manning and the level of operational tasking had an adverse impact on supervision within the Wksp.

1.4.164 The challenge of supporting ac production with the limited manpower that remained at the MOB was further exacerbated by the need to support the on-the-job training (OJT) for the large number of UTs at the Wksp. In theory (8005/LUE) the ratio of Class 1 to Class 3 technicians should have been 5:1, but in reality it was 3:4. This was due to the Manpower Planning and Gapping Advice (MP&GA) from DEME(A) to APC Glasgow to allocate any surplus UTs to units other than Apache or SF Support Units, i.e. 1 & 9 Regt AAC Wksps REME. The Panel made the **observation** that this over-burdening of Class 1 technicians to provide OJT for Class 3 technicians had exceeded what the unit establishment was meant to support **(organisational influence)**. Exhibit 152 Exhibit 161

1.4.165 To off-set the manpower and personnel issues, Wksp management had made some staffing changes within the Wksp structure that had been outlined by the Establishment and RAR. With limited manpower to cover all of the positions, personnel used to fill some of the key Wksp management/supervisory posts (as shown in Fig 35) did not have either the most appropriate rank or experience: Exhibit 067

a. The ASM, a WO1 role was being filled by WO2 with only 2 years in rank; this was being done under LAR. Annex A

b. The Wksp AQMS had only been a WO2 for one year.

c. The Wksp Artificer post had been gapped until the month prior to the accident, potentially further increasing the workload and responsibility of the AQMS role.

d. The Crew Chief, a Sgt, was in a post that ideally should have been filled by a SSgt. Moving the Sgt into this post from the shop floor had created a gap within the Class 1 cadre, further compounding the UT to supervisory ratio problem.

e. The Tool Store was manned on an ad-hoc basis by Wksp personnel due to the lack of a dedicated Tool Store SNCO at the time of the accident. Witness 7

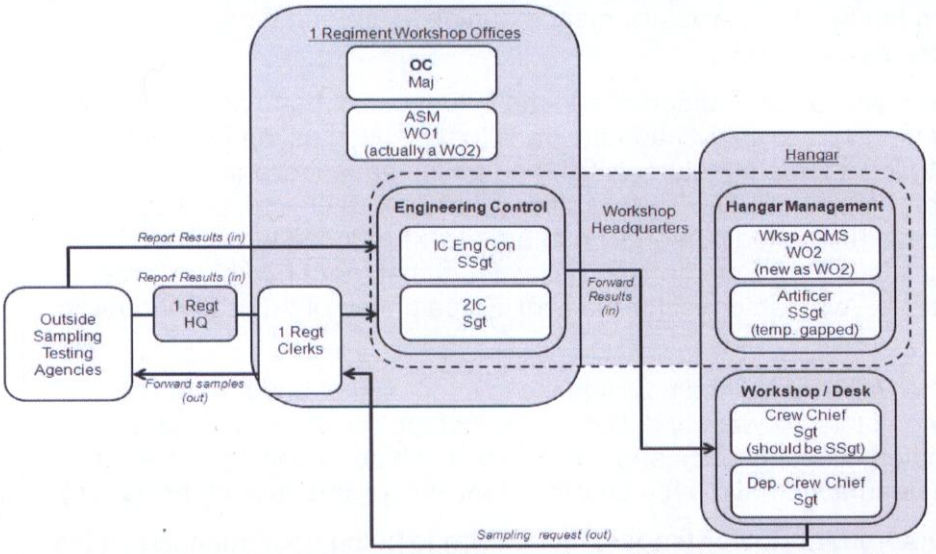

Fig 35 - 1 Regt AAC Wksp REME Supervisory Manning Organisation

1.4.166 The Panel found that the organisational requirements were not necessarily supported by sufficient resources in terms of on-base Wksp supervisors. Specifically, Wksp management were trying to maintain output but with manpower and experience limitations (**organisational influence**). This impacted on workload and management Annex A

effectiveness, which may have increased the probability of on-task distraction and/or knowledge, skill and other supervisory errors. Although this was not judged to have had a direct influence on this accident, the lack of suitably qualified and experienced personnel in some key positions was deemed to have been an **other factor**.

1.4.167 **On Ac Engineering Tasks.** Being aware of the supervisory manning limitations, and that the No2 ECU had recently been changed as part of the B1 servicing on XZ210, the Panel considered whether any servicing errors may have befallen the engine installation. As part of this line of enquiry, a review of engineering authorisations for 1 Regt AAC Wksp REME personnel was carried out; no issues were found. Additionally, there was no evidence to suggest that the engine was not fitted in accordance with the relevant engineering instruction. Therefore, the Panel found that the recent installation of the No2 ECU was **not a factor**. Exhibit 197 Exhibit 088 Exhibit 089 Exhibit 090 Exhibit 091 Exhibit 092 Exhibit 093 Exhibit 095

1.4.168 **Management of the 1 Regt AAC Wksp REME Manning Risk**. The Panel reviewed the 1 Regt AAC Wksp REME Risk Register which was used to record hazards, including those related to manpower and personnel. Noting that the manning risk was identified on the register, the Panel considered how it had been managed at Wksp level and whether it had been escalated to higher authorities. Exhibit 068

1.4.169 **1 Regt AAC**. The manning risk identified within 1 Regt AAC Wksp REME was focused on the risk to operational output of the Regt rather than on the safety implications of under-manning. As already noted, OC Wksp had written directly to JHC Lynx Force to highlight that the operational risk was also becoming a flight safety issue, and he stopped ac production in Nov 11 to catch up on routine engineering admin and assurance tasks. Risks were then escalated as appropriate through the Quarterly Unit Aviation Reports (QUAvR) process to JHC HQ. Exhibit 120 Exhibit 216 Exhibit 172 Witness 5 Exhibit 244

1.4.170 **JHC HQ QUAvR and Risk Registers.** The JHC HQ QUAvR was introduced for each platform in Q4 FY09/10 to capture statistical data on the JHC's performance, risks and potential capability and to monitor JHC units' progress towards meeting set performance targets. To align and simplify risk reporting, Forces/Units were required to submit Air Safety, Objective (outputs), SHE Risks and Issues, designed around the MAA Air Safety Risk Register, as part of the QUAvR submission. Exhibit 230

1.4.171 JHC HQ established the UASRR, Unified Objective Risk Register (UORR) and Unified Issues Register (UIR) to combine all Force/Unit risks and issues into pan-platform documents in Nov 11. Units were directed to summarise changes to the UASRR, UORR and the UIR on a quarterly basis through the QUAvR. Exhibit 230 Exhibit 244

1.4.172 From Aug 11 the priority for risk management remained the Air Safety Risks, managed by the JHC Safety branch. The priority afforded to Air Safety Risk management, combined with significant gapping in the J3/5 Capability Management (Cap Man) area, meant that the development of the objective risk management within JHC HQ was not taken forward. As a result, DComd JHC issued direction in Nov 11 to all Force Comds and COs stating: Exhibit 230

> *"[T]hose Forces/Units affected by the J3[/]5 Cap Man gapping, particularly the Lx and AH Force, must take ownership of their own QUAvR, UORR and UIR and progress the management of issues and risks appropriately".*

Following policy changes to the Army HQ performance and risk reporting requirements, the QUAvR and the UORR/UIR were suspended in Q1 FY12/13 pending review. The UASRR continued as a requirement to satisfy MAA policy.

1.4.173 **JHC Risk Awareness.** The Panel reviewed the Lynx Force Air Safety and Objective Risk Registers within the JHC Unified versions of the aforementioned (UASRR and UORR). There was no manning risk entry on the UASRR, but there was an entry for 1 Regt AAC Wksp REME Manning on the Lynx Force element of the Exhibit 192 Exhibit 221

UORR, an extract of which is at Fig 36 below.

1.4.174 The Wksp Manning risk was initially raised on the Q4 FY10/11 QUAvR and remained on the Lynx Force QUAvR entries up to and including Q1 FY11/12. The Panel noted that 1 Regt AAC had assessed the post mitigation risk as LOW and therefore no further JHC HQ action was taken. When the UORR 'went live', all extant risks were transferred into the new spreadsheet by J3/5 Cap Man, including the 1 Regt AAC Manning Risk. While there was evidence to suggest that the risk was being managed within the Wksp, the UORR listed JHC as the Owner and Manager, although it was not allocated to a specific post. In addition, the Wksp had highlighted the supervisory manning shortfall as part of the JHC Techeval process in May 11, as well as through various communications with the Lx Force staff within JHC HQ and DEME(A) staff. Exhibit 230 Exhibit 120 Exhibit 216

1.4.175 There was no evidence to suggest that the risk was being actively managed from the J3/5 area, this was due to the assessment of the risk being categorised as LOW and the manning shortage in the J3/5 area. Exhibit 230

Risk Title	Wksp 8005
Keywords	Workshop manning
Detailed Description (Summary of Risk)	Risk to op cap due to lack of suitable engineer support. Reduction in the manning of Wksp due to Wildcat drawdown and the revised 8005 has reduced the levels of supervision within the Wksp. This could lead to errors occurring within the engr processes. For ops Regt require increased augmentation from 7Bn REME. This reduces overall competency level as 7Bn individuals to do regularly operate on Lx. TSS manning halved leading to a constraint for HO/TO periods that could have a direct impact on operations.
Effect	Impact on ops
Risk Owner Post Current Mitigation = DH	**JHC**
Risk Manager Post Mitigation = Officer Responsible for Managing this Risk	**JHC**
Management and Mitigation Strategies & Controls to Achieve ALARP State	Treat. Issues widely raised – with DEME(A), JHC and MCM. Manage at Unit level by close monitoring of activity – stop- activity if risk increases above ALARP. Ensure close liaison with 7Bn. In addition continue to influence 8005 review to ensure no further reduction. JHC J35 – Noted. **SO1 J35 Cap Man, 27 Jul 11 – J4 AM Uty to comment.**

Fig 36 – Extract of 1 Regt AAC Wksp REME Manning Risk from Lynx Force UORR

1.4.176 **DEME(A) Risk Awareness.** The RAR stated that: Exhibit 133

"the increased overstretch within REME Avn presents a risk to engineering flight safety and a detriment to quality of life for REME soldiers".

In addition to the REME-wide view, OC Wksp stated that he had also informed his "various Colonels"[20] and the item appeared at the Command Engineering Support (Avn) meeting in Jul 11. Following the accident, work was undertaken by the JHC Lynx Force Witness 5 Exhibit 216 Exhibit 170

[20] OC Wksp had a complex reporting chain. The direct CoC was through CO 1 Regt AAC; however, there was a functional CoC through DEME(A) and an operating CoC via JHC (including the Lynx Fce and A4 AM Attack/Utility).

to understand the manning risk at 1 Regt AAC, including advisory and inspection visits. As a result, it was determined that Lynx Force staff would seek to increase manning levels at 1 Regt AAC Wksp REME through JHC HQ. In addition, DEME(A) engaged with APC Glasgow in order to increase manning levels across the Lynx Force. Exhibit 222

1.4.177 The Panel made the **observation** that the 1 Regt AAC Wksp REME correctly identified, managed and highlighted the manning risk in accordance with JHC instructions. However, there were some miscommunications and assumptions made that allowed the risk to endure:

a. Although the Wksp was managing the day-to-day issues that had manifested, there was an assumption that the risk was owned and being managed by JHC. This assumption was based on the unit following the JHC instructions and the correspondence relating to the manning shortfall and that the risk appeared on the UORR as a JHC owned/managed risk. The Wksp management believed that this risk was also understood by JHC HQ and that higher level treatment was being managed at that level. Exhibit 220 Exhibit 244

b. The direction sent out in Nov 11 by DComd JHC clearly placed the management and onward progression of the risk at unit level; therefore, JHC believed that is was being managed at unit level.

c. There was no evidence that JHC HQ formally took ownership or managed the objective risk. The fact that the risk was assessed as low meant that it would not have been accepted automatically by JHC, and the wording of the mitigation stated that the Wksp were managing the risk at their level.

d. There was no feedback to the unit to inform them whether the risk had been accepted (the Unit had placed ownership as JHC, but JHC had never formally responded that they had noted the ownership and were the responsible authority, contrary to direction set out in RA 1210, Annex C [21]).

Early Failure Detection (EFD)

1.4.178 As part of the initial investigation into the history of XZ210's No2 engine (ECU Ser No A63169), 1710 NAS (MIG) were requested to provide the recent sampling results since the engine's installation. Following engine installation on XZ210 in Sep 11, 7 x MDP inspections were carried out prior to the accident. Of the 7 inspections, 3 samples showed evidence of bearing steel from either the No9 or No10 bearing (MDP No4); this resulted in 1710 NAS (MIG) issuing recommendations to instigate reduced sampling for that engine. These recommendations were sent by signal to the unit, but there was no evidence that the engine that eventually failed was ever placed on a reduced sampling regime. Faced with evidence of EFD process failings that might have been directly relevant to the accident, the Panel considered whether these influenced the outcome. Exhibit 066 Exhibit 129

1.4.179 **EFD Rationale**. EFD was used to provide engineering staff with a management tool which, when used correctly, would provide information on the condition, or 'health' of ac propulsion system components and ac hydraulic systems. It described the process of periodically checking the mechanical integrity of an oil lubricated system by means of examining oil samples and / or metallic debris entrapped Exhibit 190

[21] Para 4.b.(2). "Once escalated, the superior level DH must provide formal feedback to the lower level DH on the treatment and outcome of the subject risk. It is the responsibility of the accepting DH to ensure that the Risk Register is annotated accordingly and to establish a review process to monitor the risk and associated mitigating action."

by collection devices such as magnetic plugs and filters. The aim of these examinations was to identify whether the monitored system was exhibiting normal or abnormal wear. Such examinations would allow decisions to be made as to what corrective actions, if any, were warranted to ensure the continued operational integrity of the system.

1.4.180 **1710 NAS (MIG).** The task of 1710 NAS (MIG) was to analyse, record and monitor evidence sampled from ac components and then to advise unit engineering management on the apparent condition/serviceability of the components or systems. 1710 NAS (MIG) were responsible for the wear debris policy applied by all 3 services and were the sponsor for the higher level policy relating to EFD (MAP-01, Chapter 11.4 – Wear Debris Monitoring (WDM)). The Panel noted that whilst the advice was theoretically advisory, recipients reported that 1710 NAS (MIG) output was treated as direction. Exhibit 190

1.4.181 **EFD Procedures.** MAP-01, Chapter 11.4 defined the responsibilities for all those involved in the process; however, the policy varied for all 3 services, with service specific elements throughout. For the Army and Navy, the policy directed that the samples were taken at the Unit and then sent directly to MIG for analysis and reporting; however, the RAF had an additional 'monitoring' layer at MOBs in the form of EFD Centres (EFDC). In all cases, 1710 NAS (MIG) would receive samples from units, process them and issue a return signal, either detailing a satisfactory sample (i.e. continue with routine sampling) or advice (i.e. implement reduced sampling regime or replace item)[22]. 1710 NAS (MIG) recommendations for the investigation of suspect equipment, instigation of more detailed checks or rejections of suspect equipment were detailed on the same signal as satisfactory results. Exhibit 190

1.4.182 **EFD for Gem Engine.** The Support Policy Statement for the Gem engine defined the EFD policy for the engine. The Ac Maintenance Manual set out the periodicity for the inspection of the MDP used in the WDM process for the Gem engine, which was every 12.5 flying hrs (+/- 2.5 hrs). At each interval, the Unit would undertake the inspection of the 6 x MDPs on each engine and dispatch the sample to 1710 NAS (MIG). Exhibit 167 Exhibit 168

1.4.183 **1710 NAS (MIG) Sample/Result Monitoring.** While the Panel found that the processes within 1710 NAS (MIG) for the monitoring and analysis of samples were robust, there was no feedback loop from units to acknowledge when EFD advice had been received and actioned. Exhibit 173

1.4.184 In all 3 Services, the Oil Replenishment/Sampling Record (MF737) within the MF700 ac documentation pack was annotated when a sample was taken; however, the Panel made the **observation** that each service took a different approach to recording when a corresponding result was received: Exhibit 174

a. **Navy**. Used the 'Clearance' column on the MF737 to register when a results signal was received, but no acknowledgement was sent to 1710 NAS (MIG) to acknowledge receipt of advice.

b. **RAF**. Used an EFDC Analysis Return (RAF F7158A) to inform the engineering unit of the results from 1710 NAS (MIG) to clear any satisfactory samples on the MF737 and an EFDC Report (RAF F7158) to detail any unsatisfactory results. The RAF F7158 required the engineering unit concerned to return a receipt slip to the EFDC acknowledging any Exhibit 175

[22] The results (including signals) were also available on the Wear Debris Management System (WDMS), which was a web-based application that allows for the submission and monitoring of all EFD samples and was the best practice method for registering samples with 1710 NAS (MIG) as detailed in the MAP01 Chapter 11.4.

recommendations from MIG to ensure compliance.

c. **Army**. Only annotated the MF737 to indicate when an oil sample had been taken and no record was made of the result, even those that were considered unsatisfactory.

1.4.185 The Panel made the **observation** that the differing approach to EFD process by the 3 services continued to endure due to the lack of a single joint EFD policy; other than cultural legacy, there was no obvious reason why such differences existed. The Panel also made the **observation** that the absence of any requirement to acknowledge EFD advice meant that 1710 NAS (MIG) were unaware whether recipients actually heeded their recommendations.

1.4.186 **1710 NAS (MIG) EFD Analysis**. The MIG examiners' experience of what constituted normal and abnormal wear for the type of assembly being examined was of crucial importance; as was access to and comparison with previous debris records which provided indications as to whether the type and amounts of wear had changed since a system was last sampled.

1.4.187 During the last servicing of A63169, the engine's Module 7 (containing the FPT assembly) was replaced with one that had been re-conditioned. The re-conditioning of the replacement Module 7, carried out in Jan 11, included changing the No9 bearing but the No10 was not changed. Exhibit 176

1.4.188 1710 NAS (MIG)'s understanding of the work carried out at the ERS during a Module 7 reconditioning differed from reality. The MIG analyst inspecting the samples from A63169 taken from the area of the No9 and No10 bearings (MDP 4) believed that they were from reconditioned bearings, when in fact the No10 bearing was in excess of 1500 hrs old. Although the engine was placed on reduced monitoring (5-hourly) as a precaution, the assumption was that the component had only done approx 50 hrs since overhaul and was therefore not deemed to have been a significant concern. Exhibit 177 Exhibit 131 Exhibit 176

1.4.189 The Panel made the **observation** that 1710 NAS (MIG)'s misunderstanding of the Module 7 reconditioning process was a **mistake** on the basis that it was a deficiency in judgement based on flawed comprehension of the Gem reconditioning process; however, this misunderstanding did not affect the resultant action. The recommendation for reduced sampling would have been the same regardless of bearing age. Therefore, the Panel found that 1710 NAS (MIG)'s analysis was **not a factor**.

1 Regt AAC Wksp REME EFD Process Issues

1.4.190 **EFD for XZ210 No2 Engine (ECU Ser No A63169)**. There was no evidence to suggest that the MDP inspection task was carried out incorrectly; however, there was evidence of 4 failings within the EFD process within 1 Regt AAC Wksp REME once the samples had been taken:

a. Undue delay in the dispatch of samples.

b. Mishandling of signal traffic.

c. Monitoring of EFD samples/results.

d. Failure to apply 1710 NAS (MIG) advice to XZ210.

1.4.191 **Undue delay in the dispatch of samples.** Following the installation of A63169 onto XZ210 in Sep 11, 7 MDP inspections were carried out; Fig 37 below shows a summary of the associated EFD signals between 1 Regt AAC and 1710 NAS (MIG). On occasions, there was a significant delay between samples being taken and receipt by MIG, e.g. sample 3 took 25 days when the typical time for routine mail to

reach UK from Germany was no longer than 7 days. Although this sample was deemed satisfactory, it was an indication that there was a process flaw within 1 Regt AAC Wksp REME in terms of monitoring the dispatch of samples and receipt of results. This undue delay was contrary to the direction in MAP 01 Chp 11.4, which detailed the requirement that samples *"should be sent by the quickest possible means to 1710 NAS MIG".*

1.4.192 While the delay in dispatching the EFD samples (**breached defence)** was not found to have influenced the outcome of this accident, the Panel felt that such practice had potential to be detrimental to ac safety and as such was classed as an **other factor**. Exhibit 190

Exhibit 066

Signal	Reason	AF Hrs	Date of Sample	Received by MIG	Signal Comments
1	Post Fit EGR	6748.20	23/09/11	03/10/11	SATISFACTORY
2	Post first flight	6749.05	28/09/11	06/10/11	1. SMALL FRAGMENT OF WIRE EVIDENT ON PLUG FIVE ANALYSED AS MSRR6522 STAINLESS STEEL. 2. DEBRIS NOT CONSIDERED CRITICAL AT THIS TIME, CONTINUE NORMAL SAMPLING.
3	Routine	6758.25	01/10/11	26/10/11	SATISFACTORY
4	Routine	6771.35	25/10/11	02/11/11	1. ANALYSIS SHOWS SMALL AMOUNT OF MSRR6015 BEARING STEEL ON PROBE FOUR. 2. POSSIBLE SOURCES ARE ROLLING ELEMENTS OF BEARING NINE AND TEN. 3. RECOMMEND COMMENCE THREE BY FIVE HOURLY SAMPLING TO MONITOR.
5	Routine	6781.30	31/10/11	07/11/11	SATISFACTORY
6	Routine	6792.05	03/11/11	09/11/11	1. ANALYSIS OF DEBRIS PRESENT ON PLUG FOUR SHOWS CONTINUED GENERATION OF MSRR6031 BEARING STEEL. 2. SUSPECT CONTINUED WEAR TO NUMBER NINE OR TEN BEARINGS, MODULE SEVEN. 3. RECOMMEND COMMENCE THREE BY FIVE HOURLY SAMPLING.
7	Routine	6798.15	08/11/11	17/11/11	1. FIRST OF THREE BY FIVE HOURLY SAMPLES RECEIVED SHOWS CONTINUED GENERATION OF MSRR6031 BEARING STEEL ON PLUG FOUR. 2. RECOMMEND CONTINUE FIVE HOURLY SAMPLING.

Fig 37 – XZ210 EFD Signal Traffic

1.4.193 **Mishandling of signal traffic at 1 Regt AAC.** Although EFD results in the UK continued to be transmitted and distributed as signals through COMMCENs, in Germany (where there was only one COMMCEN) the signal traffic was converted into e-mail to expedite the onward transmission of information to the various units. Having been converted into email by the COMMCEN, it was viewed electronically by the recipient using Microsoft Outlook. Exhibit 278

1.4.194 There was no policy for the handling of signal traffic in 1 Regt AAC and no endorsed distribution list. Therefore, it was unclear as to whether these EFD e-mails should be printed and sent by internal mail within the Unit, or forwarded using the e-mail system. At the Wksp level, there was no Ac Engineering Standing Order (AESO) for the handling/reporting process for EFD results. The only mention of EFD results Exhibit 127

was found in AESO 2-1-1 Annex L Para 2.11, which detailed that the results should be held in the ac history file.

1.4.195 In the absence of policy for the handling of EFD results, the Panel looked at the training provided to the two key roles within the Wksp EFD chain:

a. **Engineering Control (Eng Con) Sgt**. Although there was no formal handling process in place, the Eng Con SSgt reported that the sampling results were always sent to the Crew Chief via email. If the result was unsatisfactory, the SSgt stated that the email would be followed up with a telephone call to ensure the Crew Chief had received and read it. The SSgt was responsible for training the Eng Con Sgt; however, there was no evidence of any formal training given to the new incumbent in handling EFD sampling results. The Sgt reported having had limited experience of handling unsatisfactory results. On those occasions when it had occurred, the forwarding of the related email would not be followed up with a confirmatory phone call. The lack of formal training meant the Sgt had a conflicting mental model compared with the SSgt of the results handling process. Annex A

b. **Crew Chief**. The responsibility of sample handling was not documented in the Crew Chief's TORs and as a result it was not briefed as part of the formal hand-over process, nor was it formally trained. Although the Crew Chief was aware of his duty, this lack of formalised responsibility and training may have influenced his focus on monitoring the sampling process. HF interviews indicated that results were often only briefly scanned by the Crew Chief and were not logged in the MF700. Exhibit 252 Annex A

1.4.196 Although the Panel felt that the principles underpinning the EFD sample process were sound, the system was undermined by the lack of a formal process and associated training for those involved in the handling of the airworthiness information at 1 Regt AAC. Importantly, there was little evidence of being able to trace and/or close the loop for the 'sample and result' traffic, even when the results were unsatisfactory and action was required. Accordingly, the Panel found that the lack of process and training for the handling of EFD signals at 1 Regt AAC was an **organisational influence.** In this accident, it did not affect the eventual outcome, but there was potential for it to contribute to another accident in the future and hence was found to have been an **other factor**. Annex A

1.4.197 **Monitoring of EFD Samples/Results.** 3 signals from 1710 NAS (MIG) relating to the requirement for a reduced sampling regime on XZ210 were sent to the 1 Regt AAC HQ for action by the Wksp during Nov 11 (shown as signals 4, 6 and 7 on Fig 37). While there was evidence that all 3 e-mailed signals reached the Unit, inspection of the relevant e-mail account backups could only prove that one of these reached the Crew Chief, who was responsible for enacting the recommendations. Exhibit 136

Action / Signal	1 Regt AAC HQ	Wksp Eng Con	Wksp Crew Chief
4 021238Z	Signal received. No evidence of further	No trace	No trace

Exhibit 140

NOV 11	action being taken		
6 **091532Z** **NOV 11**	Signal received and forwarded to Sgt Eng Con on 10 Nov 11	Signal received and forwarded to Crew Chief and D/Crew Chief on 10 Nov 11	Signal received by Crew Chief and D/Crew Chief. No evidence of further action being taken.
7 **171525Z** **NOV 11**	Signal received and forwarded to Sgt Eng Con on 18 Nov 11	Signal received and forwarded to Crew Chief on 18 Nov 11	No trace

Exhibit 083

Exhibit 084

Fig 38 – XZ210 EFD Signal Tracking

1.4.198 Two of the signals were shown to have reached Eng Con and both of these were forwarded to the Wksp Crew Chief. As part of 1 Regt AAC AESOs (AESO 1-1-3 Annex H and I), it was the responsibility of Eng Con to manage liaison with outside agencies on all ac technical matters and to ensure that the ac history files were kept up-to-date with any information that would not be contained in the ac's MF700 document set. However, neither of the 2 signals that were known to have been received by Eng Con were recorded in the XZ210 ac history file.

Exhibit 259
Exhibit 260
Exhibit 258

1.4.199 Although there was evidence to show that Eng Con forwarded 2 of the e-mails (Signal 6 & 7), only one was recovered following analysis of email records of the intended recipient. The Signal 6 was received by the Wksp Crew Chief on 10 Nov 11 and was subsequently deleted; additionally, the deleted items file was emptied on 2 Dec 11, the day after the accident. Had it not been possible to recover the deleted files, the audit trail for the whole series of signals would have been lost. Although there was a register for the dispatch of EFD samples to 1710 NAS (MIG), the document was rarely updated with details of the receipt of any results. In addition, the ac history files were not auditable documents and there was no control measure in place to ensure they were kept up-to-date. The lack of process for collecting the samples, sending off the samples, receiving the results, recording the results or following the results up meant that Eng Con were unaware that the Crew Chief had not dealt with any unsatisfactory result. This lack of a feedback loop was judged to have reduced the probability that an omission by the Crew Chief would have been detected.

Exhibit 136

Exhibit 085

1.4.200 The lack of a closed loop process relating to the dispatch and receipt of samples and results within the Wksp was an **organisational influence**. On this occasion, the Panel found that this did not affect the eventual outcome; however, there was potential for this to contribute to a future accident and was therefore found to have been a **other factor**. The Panel made the **observation** that the failure to keep a record of EFD analysis signals was a **lapse** by Eng Con which hindered the ability to trace relevant EFD information.

1.4.201 **Failure to Apply 1710 NAS (MIG) Advice to XZ210.** The Crew Chief only recalled receiving and reading the EFD Signal 6 (full text shown at Fig 39). He did not believe that it had contained anything other than satisfactory results and therefore deleted the email without any further action or record being made. The 1710 NAS (MIG) signal was in a computer-generated standardised format for EFD samples, such that the first information listed related to a series of satisfactory results; notification of the unsatisfactory result and advice placing XZ210 on reduced sampling was listed at the bottom. When viewed in the MS Outlook reading pane on the Crew Chief's computer during the subsequent investigation, none of the information relating to reduced sampling for XZ210 was visible as shown in Fig 40.

Witness 10
Exhibit 047

Exhibit 047

091532zNov11

P R 091532Z NOV 11
FM 1710 SQN
TO 1 AACREGT GUTERSLOH
INFO DES YEOVILTON
BT
R E S T R I C T E D
SIC HEH
1 AACREGT GUTERSLOH FOR WORKSHOPS
DES YEOVILTON FOR GEM EA
DEBRIS/SOAP READ IN THREE COLUMNS

A/C No.	SER NO	SAMPLE NO
LYNX		
XZ179	TGB ADU7230	24446
XZ179	IGB TAB7326	24447
XZ179	MGB ABM3219	24448
XZ182	IGB AFG0259	24449
XZ182	MGB ACH2039	24450
XZ182	TGB ABX7282	24451
XZ210	ECU A68304	6792:05
ALL SATISFACTORY		
XZ210	ECU A63169	6792:05

1. ANALYSIS OF DEBRIS PRESENT ON PLUG FOUR SHOWS CONTINUED GENERATION OF MSRR6031 BEARING STEEL.
2. SUSPECT CONTINUED WEAR TO NUMBER NINE OR TEN BEARINGS, MODULE SEVEN.
3. RECOMMEND COMMENCE THREE BY FIVE HOURLY SAMPLING.
BT

NNNN

Fig 39 – EFD Signal (9 Nov 11) in Full

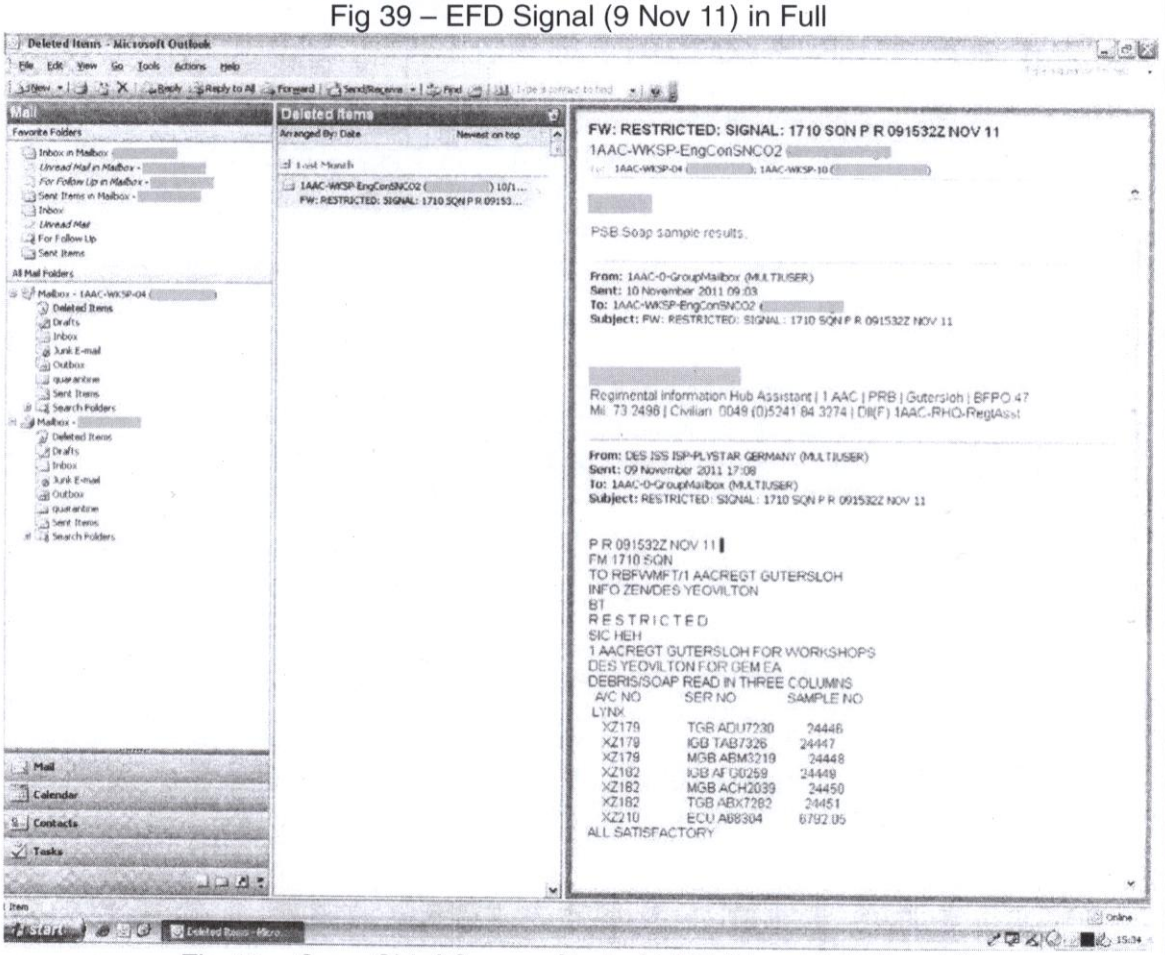

Fig 40 – Crew Chief Screen Shot of EFD Signal 6 (9 Nov 11)