operated at MPC and in the Falklands environment; identifying any additional risks to their platforms due to operating at MPC and in the Falklands environment; and offering additional intelligent comment on platform Duty Holders' risk analyses and mitigations. CO 905's TORs explicitly include responsibility for briefing risks to Duty Holders. In terms of presenting risks from the airfield to Duty Holders at the time of the incident, there was no formal arrangement with any Duty Holder. However, staff at MPC believe that between COS, CO 905 EAW and CO JFLU, they would together have ensured the relevant Duty Holder was notified of anything that was recognized as a Duty Holder matter (ie an Air Safety risk to life). In practice, CO JFLU would tend to lead on raising airworthiness matters to the Duty Holder (via the appropriate Chief Air Engineer) and CO 905 would tend to lead on raising operating risks to the Duty Holder (via the appropriate Senior Operator). At the time of the Inquiry, risk analysis was being formalised with the establishment of Aviation Safety Risk Working Group. The Inquiry anticipates that the Group will formally address the issues outlined above, as the TORs (**Annex EEEE**) have established the group to:

> '… manage Air Safety risks inherent in MPC's air operations - by implementing Duty Holder-directed risk mitigation measures, commenting on Duty Holder risk registers, aligning MPC practices with MOB and fleet practices, and identifying new candidate risks to refer to the Duty Holder - in order to support both the Duty Holder and CBFSAI. It will consider both operating risks inherent in the MPC environment and operational risks arising from tasks to meet CBFSAI's mission. By both reviewing HQ 1 and 2 Group's risk registers and examining locally identified risks it seeks to assure CBFSAI and the FEs' Duty Holders that risks to life associated with BFSAI's air operations are managed to a Tolerable and As Low as Reasonably Practicable (ALARP) level. These TORs are coherent with MAA RI/02/11 (DG) - Air Safety: Risk Management, which mandates the management framework to support Duty Holder decision making.'

365. There is also a BFSAI Air Safety Risk Register, encompassing general operating risks (such as the lack of alternate airfields on the Falklands) and specific risks for 1312 Flt (VC10 and C130J), 1435 Flt (Typhoon), 1564 Flt (Sea King), 303SU (ADGE), Resident Rapier Battery, Meteorology and Fire. This risk register was in development at the time of the fuel contamination incident. The use of the British Forces South Atlantic Air Safety Risk Register is now covered by MPC Aviation Safety Risk Working Group (ASRWG).

Practicalities of risk management at MPC

366. It is important to acknowledge that the Inquiry found no connection between the management structure, the management of risk and the contamination incident. Indeed, it was clear that there was a great deal of management attention on the risks posed by the fuels infrastructure. The poor spill history of the MPC fuels operation (43,000 litres in 2003, 29,000 litres in 2005, 42,000 litres in 2009) had focussed CO JFLU's mind on confirming spill response capability in late 2010 and early 2011. The damning annual Inspection of Fuel Facilities and Flammable Dangerous Goods Stores ("Task 249 Report") in Mar 11 and the 2011 DSEAR inspection report had also focussed JFLU's attention as the fuels system Operating Authority on the risks arising from the inability to provide safe and compliant fuels infrastructure.

367. Unsurprisingly, the focus of the risks analysed are on the safe operation of a plant and the impact of any one element failing. PJHQ's concern in the risk is principally in the availability of the plant and the subsequent impact on operations. Other than with the benefit of hindsight, the Inquiry and staff at MPC feel that it was unlikely that this might ever be considered a risk to the Duty Holder that the Duty Holder facing organisation might be providing a service that could compromise the quality of fuel. The differences are subtle and if a trite analogy can be forgiven, if the MT minibus is on its last legs, the MT section might consider the risk of it not starting or leaking

oil all over the car park. The HQ might consider a risk that the minibus might not be available for a forthcoming evolution. But it would be a tenuous connection to inform all potential minibus users that there is a risk that the minibus might pose a threat to passengers. However, a formalised relationship with the Duty Holder where the Duty Holder facing organisation seeks to expose and discuss risks to his ability to provide services may encourage wider consideration of the issues. This might not alter resource allocation to mitigate any such risk, particularly when there are likely to much more significant risks with greater operational impact. But it may serve to add context to issues and change perceptions. If the reader will forgive the continued tortured metaphor, the minibus users may view it differently if they were told they could still use it, but it had failed its MOT and needed 4 new tyres. The Inquiry noted that work ongoing at 1 Group to establish a total safety model acknowledged this and was seeking to close the perceived information gap.

Best practice in the commercial world

368. In considering the risks posed from airfield services to operators, the Inquiry considered the IATA Fuel Quality Pool (IFQP), discussed at the chapter on civil aviation associations. Whilst the IFQP offers an elegant solution for commercial operators, it would be less effective amongst the military community. Principally, the bar taut resources of a single source supply system means that there is no market force to improve safety as a result of a poor audit. However, the system still offers appreciable benefits, particularly in sharing audit results with operators to enable them to consider the potential issues of operations at any location. The IFQP Control of Fuel Quality and Fuelling Safety Standards represents a comprehensive audit system for fuel supplies at the airfield and is at **Annex FFFF**, together with the audit schedule developed from it.

369. The Inquiry believes an adapted MOD Fuel supplies assurance process could offer a similar sharing of information to operators. Work is ongoing to draw the suitable elements of the IFQP audit process in to the Fuel Safety Assurance Assessment, (at **Annex GGGG**)which is currently based on the requirements in JSP 317, which in turn is exactly the same as the Joint Inspection Group's assessment of quality assurance in fuel systems. However, the MOD's FSAA is predicated on the manpower provided by Land and Air Command after the EQA process was ended and involves 4 inspectors assessing 230 sites. Sixty class one sites are inspected every year, and one third of the remaining sites; the remainder are self assessed. Whilst this achieves a rolling coverage in a 2 to 3 year period, it does not allow much scope for an increased audit requirement that the IFQP process would require.

CONCLUSIONS

370. The complexity of the operation at MPC is compounded by the lack of a traditional command structure at an airfield. Despite this and although MARP RA 1020 does not explicitly include airfield service providers as such, MPC staff had appreciated the need to engage as a 'Duty Holder Facing Organisation' and were beginning to do so. The establishment of an air safety register and the MPC ASWRG are clear evidence of a proactive approach to risk management. Whilst the Inquiry accepts that the fuel contamination incident was an unlikely scenario for any risk management structure to have appreciated, a more collegiate approach to risk management and communication of those risks to operators can only help establish a context for operating authorities to better appreciate the risks from the airfield services.

371. Part of that collegiate approach may usefully draw on the work of the fuel system assurance process to establish a greater appreciation in the operator community of the quality and risks faced in operating in differing MOD sites.

372. The inquiry is aware that work is ongoing within FGSR to investigate the development of a common, customer focussed audit system for airfield fuel supplies that provides result sharing with operators, similar to that provided by the IFQP and fully supports this endeavour.

RECOMMENDATIONS

- 1.5.49
- 1.5.50
- 1.5.51
- 1.5.52

Letter of air safety responsibility for key aviation support roles

INTRODUCTION

373. As already discussed in the chapter on logistics training, there is a need to address the cultural gap between safety regimes. The MOD has successfully engendered a culture of FOD awareness across the Services but more general air safety concerns have less precedence. Supporting services to airfields need to improve their understanding of the role they play in air safety.

374. After the test report was received from Intertek on 7 Jul 11, detailing the fuel was within the STANAG 1110 limits, and prior to the grounding of aircraft on 5 Aug 11, the management focus was on ascertaining the route cause of the issue and maintaining operational capability for the SAI as there was no perceived threat to air safety. Witness testimony (**Witness Statements 1, 2 and 3)** highlighted that there was misunderstanding amongst the various organisations involved as to who was the authority for the fuel and who had authorised the fuel as 'fit for use' during this period – there was no consideration of an appropriate airworthiness authority's view. Subsequently, up to the point when the contamination was confirmed, there was no formal safety assessment on the potential risks or a decision made by a delegated air safety holder to allow aircraft to continue to fly.

FINDINGS

375. The level of effort to identify the cause of the problem with the fuel has already been considered in the section entitled cloudy fuel. OC F&L certainly demonstrated diligence in his pursuit of trying to discover the cause of the issue and indeed his unwillingness to accept the perceived wisdom of water ingress was instrumental in the steps that led to the discovery of EG in the fuel.

376. Despite this, during the initial assessment phase, the only position that had any delegated airworthiness responsibilities was CO JFLU who provided managerial supervision. CO JFLU was not asked to make an air safety decision on whether to use the fuel. The brief composed by OC S&AMS (**Exhibit 25**), on the back of the report received from Intertek and the actions outlined by FS F&L (**Exhibit 11**), presented that all issues were being dealt with, that the fuel was 'fit for use' and thus there was no air safety risk to mitigate.

377. Within the engineering structure at MPC there was a complete architecture set-up to define, manage and implement airworthiness. PTs provided the high level airworthiness assurance, working closely with OEMs and engineer officers on units, and held formal airworthiness delegations and were personally accountable for their decisions and actions. The engineering officers also held delegated airworthiness responsibilities and were similarly accountable for their decisions and actions. In both areas, this was supported by individual assurance that requires accreditation, demonstrable competence and experience with the unit's aircraft type. Indeed, EngOs in the Falkland Islands must have completed a tour as a JEngO first in the UK before being deployed. Fundamentally, the areas did not work in isolation and there was a continuous dialogue to ensure issues were dealt with, risks analysed and offered to the appropriate duty holder or operating authority. In particular, the personal responsibility held by individuals encouraged a more questioning culture and lent weight to their decisions simply from the Truman principle that the buck stopped with them.

378. With the newly established Duty Holder construct and Delivery Duty Holders now being held formally responsible for air safety at front line airbases, it was assessed by the Inquiry that this approach could be better supported by service providers. Work is ongoing in 1 Group to develop

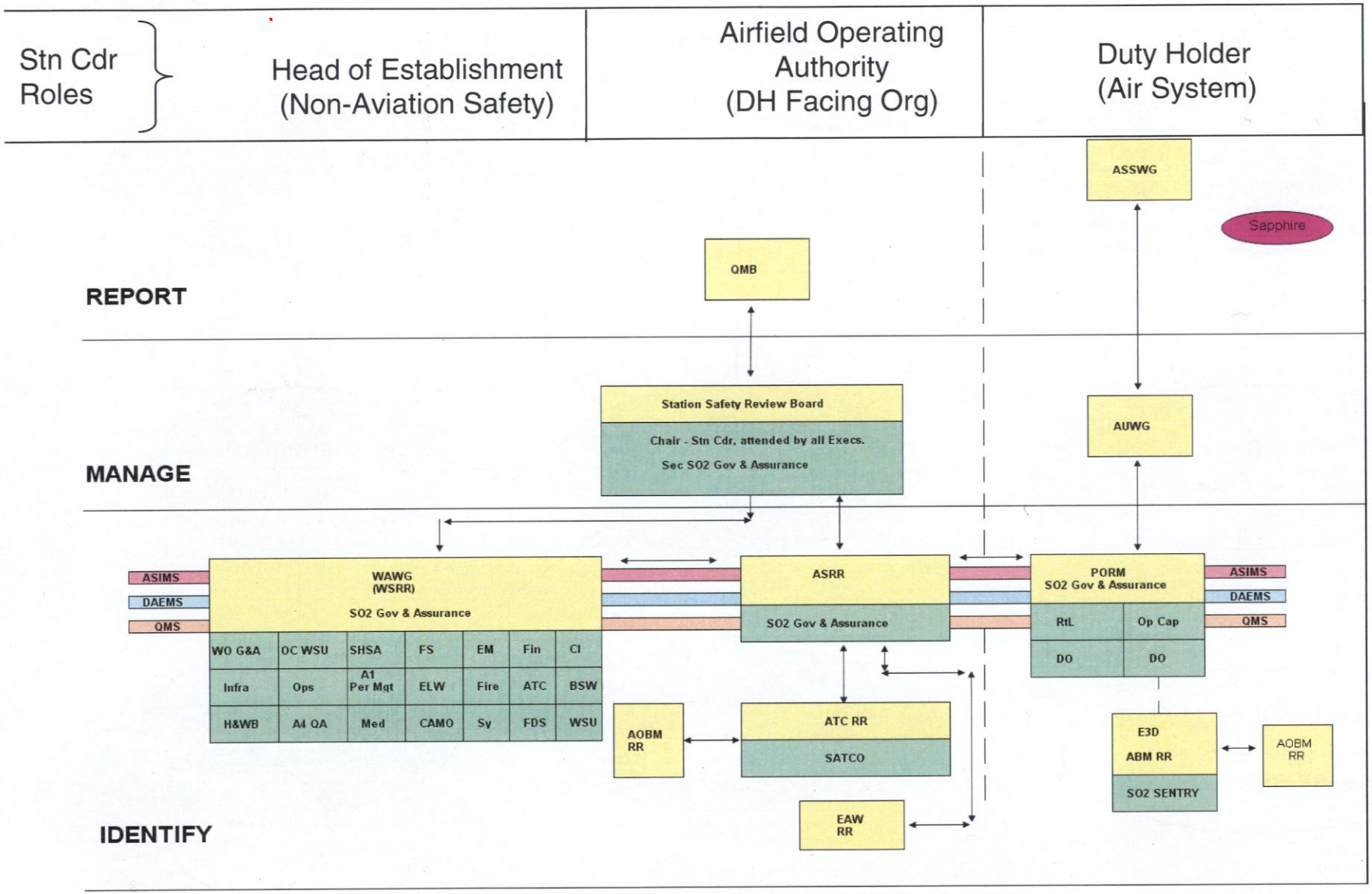
the concept of an Airfield Operating Authority within the wider construct of duty holder facing organisations. This recognises the need to bring greater clarity to risk management and appreciation across the air station and from those airfield services that may have previously been below the radar. For illustration purposes, the developing model is at **figure 14**; the Inquiry wholeheartedly supports this approach.

379. POL products that are used in aircraft are equally fundamental to air safety as any aircraft part. Whilst the engineering architecture for assurance would be excessive for the contracting, supply and management of POL products, it is the SI team's assessment that if at least some of these practices been in place, then the release of the contaminated fuel on 7 Jul 11 might not have occurred. The Falkland Islands are no different to any other operating base with respect to briefing superior officers on issues and their solutions, especially over air safety issues. However, it is post these discussions that it must be clear who is the authorised individual making the air safety related decision. This would mirror the engineering side where specific delegations are given to key roles to sign against airworthiness decisions.

380. Had OC F&L's post been formally authorised and accountable, as the only trained fuel specialist officer, and understanding that DF&FS only provide advice, it is possible that the extent of the tests might have been questioned, more analysis might have been conducted or at the very least a safety case assessing the risks been made before releasing the fuel. OC F&L was clearly unhappy with the persistent cloud and a lack of evidence of where the water was getting in – had he been personally responsible for releasing the fuel to aircraft, the Inquiry feels he may have felt more empowered to maintain the quarantine.

381. In considering the development of a position responsible to the operating authority for the quality of the fuel, the Inquiry noted that the delivery of fuel to the skin of the aircraft is not overseen by any one person. Most organisations have a common set up, with the fuels team responsible for the quality of the fuel delivered to the bowser, the MT section responsible for the bowser and the connection and fuelling operation overseen by the engineering section. This is not to suggest the system is flawed or unsafe but the priorities and safety culture of one section do not necessarily reflect those of the next, as argued elsewhere in the report. Furthermore, there is no authoritative handover to the operators that the fuel is fit for use, unlike the formal handover from the engineering section to the operators as the aircraft is signed for. Accordingly, the Inquiry view the development of a letter of authority should be supported by the formal development of functional lines of authority to OC Fuels over MT personnel for the maintenance of the quality of the fuel. This is not to suggest OC Fuels should be present at every aircraft fuelling! However, he should seek to satisfy himself that personnel delivering his fuel are trained and competent to do so and understand their responsibilities in the delivery of an air safety related product and the maintenance of its quality.

Figure 14 – Total Safety Model



WHAT HAVE YOU DONE FOR STATION SAFETY TODAY?

CONCLUSION

382. The misperception of authority outlined earlier in earlier sections meant that once the test results from Intertek were received, there was no further consideration of the risk before the fuel was released for use in aircraft. OC F&L was the only fuel technically qualified officer but had no formal air safety training and had no fuels experience prior to being deployed in the Falkland Islands. Whilst CO JFLU had the managerial competence, engineering experience and air safety appreciation to review the cloudy fuel situation he had no experience or technical qualification in fuel. Therefore, there was no clear boundary to who owned what air safety responsibility, or who had authority to make air safety decisions and the ability to assess information obtained from third parties as advice or authority. This represented a **latent weakness** in the **system defences**.

383. Other than the engineering community, airfield service providers are not formally or personally responsible to the Delivery Duty Holder for air safety aspects of their work. The introduction of an element of personal responsibility for air safety through a letter of authority could redress this and may extend the awareness and culture of air safety beyond the immediacy of the airfield perimeter. The Inquiry considered the lack of this accountability as a **latent weakness** and **error provoking condition** in not encouraging personnel to be personally responsible.

384. The Panel considers that the development of the airfield operating authority model, supported by letters of air safety responsibility and with appropriate risk communication to operating authorities will go some way to developing a maturing approach to risk management that will be able to consider risks as they occur across the boundaries of responsibility. The investigation saw many areas where risks were appreciated and mitigated in isolation and believes the next iteration of safety management systems should engender a more holistic approach, as suggested in the model at **figure 15**.

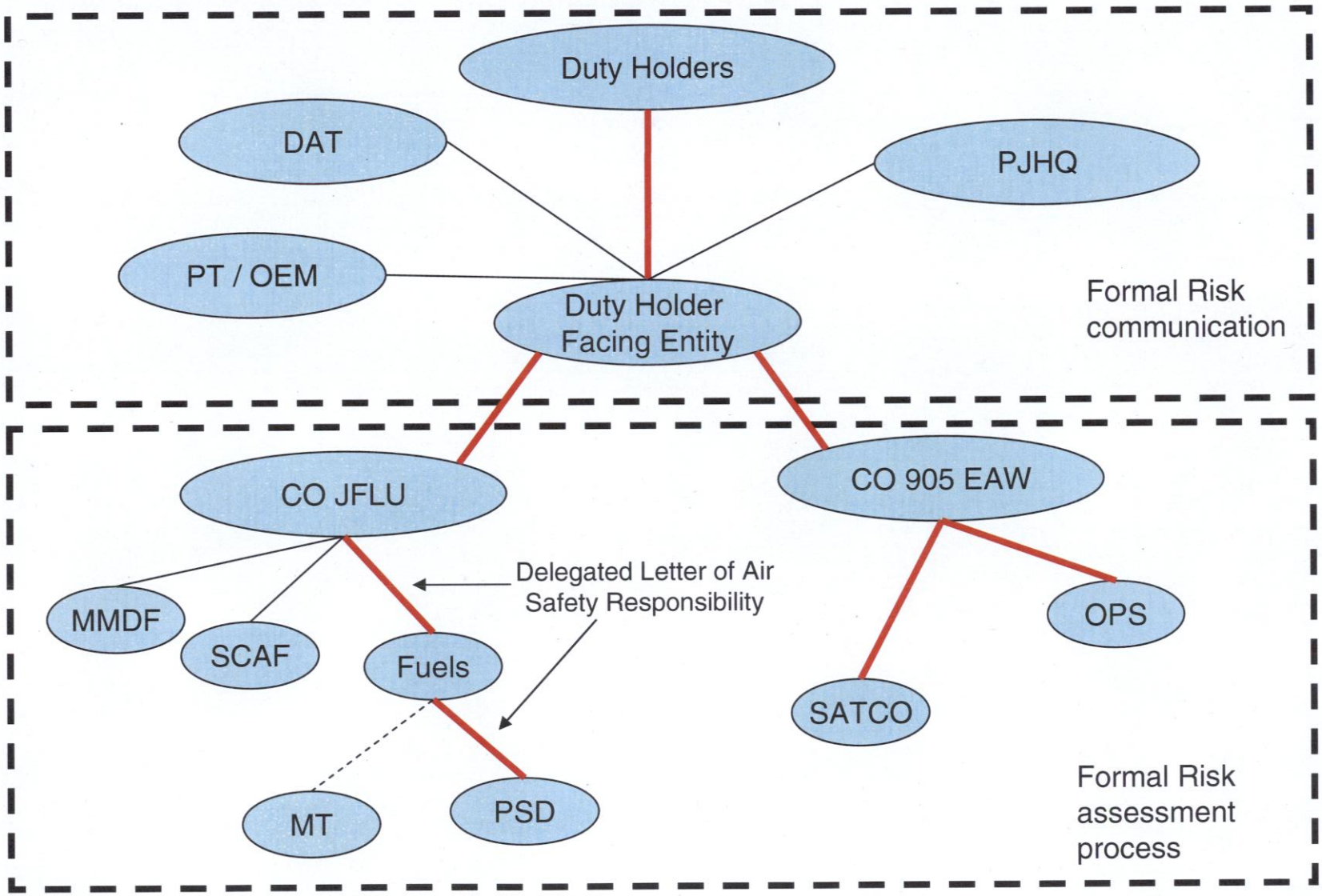
385. The Panel fully supports the development of the concept of an Airfield Operating Authority as a Duty Holder Facing Organisation. The Panel believes that this should be supported by the concurrent development of a letter of Air Safety Responsibility that is delegated down the chain of command to key positions. This personal accountability will support risk management and engender a greater air safety aware culture.

386. The delegation of letters of air safety responsibility should only be given when an individual has proven to have the required experience and competence, up to this point the air safety decisions must be held by a senior delegated position. Furthermore, this responsibility should be supported by the position being given formal functional authority over all elements of the supporting services that provide a link in the chain to the skin of the aircraft. Specifically, the position should seek to establish competence and air safety awareness where the delivery of the service is not completely under their own command. To illustrate the point, OC F&L in BFSAI should have functional authority over MT operatives to allow him to satisfy himself that they understand their role in delivering a quality product to the skin of the aircraft. The delegated responsibility should also seek to mandate a formal handover of risks to successive post holders.

RECOMMENDATIONS

- 1.5.53

Figure 15 – Airfield Assurance Model



SECTION 7 - CLOSING REMARKS

387. Our ability in the future to better appreciate the risks involved depends on several strands of work. The logistics supply chain must take firm control of a product moving through the chain and ensure it is delivered to an appropriate receiving officer who is able to assess whether they have the right product and the paperwork that guarantees the quality of what the supplier set out to provide. Air safety related products require a much more holistic approach to their management within DE&S and the development of a safety case to assure their air worthiness. We must engage individuals within the chain and empower them to be guardians of airworthiness, even when they might operate at a distance from the airfield. Their risks must be exposed, through the appropriate channels to the operating authority, such that he can consider not just the operational and flying associated risks of his business, but the risks posed by the environment he is working within and the services he is provided.

388. The risks may be low, or tolerable or simply below the radar in view of the range of other contemporary issues but they still need to be declared to the operating authority for them to be accepted. The Inquiry acknowledges that this places an additional burden on the duty holders but a better informed authority makes better risk-based decisions. By way of example, on 11 Aug 11, with known problems over fuel supplies and the partial suspension of SAR helicopter operations, CO 905 EAW decided to cancel a Typhoon training sortie; a sound decision based on a good understanding of the risks. The growing maturity and understanding of risk management was demonstrated when he went on to recommend that the Resident Infantry Company's live firing at Onion Range should also be postponed.

389. There is no single silver bullet that will solve the issues exposed by this investigation in to the contamination events in the Falkland Islands. In the detail of the paperwork chain, the identification of glycols, or the blending and testing of thousands of litres of fuel it is easy to lose sight of the fact that a Hercules C130-J was sprayed with contaminated de-icer, the runway at MPC was sprayed with contaminated anti-icing and aircraft were supplied fuel with de-icer in it. Greater concentrations or a different product may have had a very different outcome; C130 J Hercules ZH 884 failing to take off on 25 Jun 11 because of ice build up on the wings; a plane crashing on the unprotected runway during cold weather on 26 Jul 11; or the first aircraft that was fuelled with the contaminated F-34 suffering an engine failure, resulting in the loss of the Air Seychelles Airbus on 13 Jul 11, carrying 136 personnel. Luck should have no part to play in airworthiness.

List of Annexes

GG	Reason, J, Human Error: models and management, BMJ Vol 320 18 March 2000.
HH	RAF CAM Human Factors report **(double referenced as HH in 1.4)**
II	JSCS Bicester Distribution work based instruction dated Nov 09
JJ	SNCO Av Fuels brief on AL-41 dated 27 Mar 11
KK	MOD Form 600Ks and print-outs from MJDI record for glycol accounting from SCAF
LL	Copy of the Direct Supply register from SCAF
MM	British Forces Cyprus JESO work instruction for receipting AL-41 and Al-61
NN	EJ880 RTS, Issue 1 dated Dec 97, Table IV - Fuel Contamination Ref 3.7.3.3.2
OO	JFLU organisation
PP	JFLU representative organisational diagram
QQ	PJHQ's 20110922_BFSAI_Fuel_Management_Review-R dated Oct 11.
RR	Inspection of fuel facilities and flammable dangerous goods stores (249 report) dated Mar 2011
SS	SNCO Av Fuel's MPC/SUP/4405/01 Update on suspect fuel contamination at BFI 2 Tank B302 (Particulate contamination) dated 27 Jul 11
TT	OC F&L's JFLU/SAMS_HQ/Execs/Fuel_Contamination_Archive After action report on Particulate contamination dated 5 Oct 11
UU	Email 12 Aug 11 Wings 24 to SO2 J4 E&S – MPC Fuel Contamination Notification and Airworthiness Implications
VV	Defence Flight Safety Occurrence Report dated 11 Oct 11
WW	CO JFLU's Email MPC 20110809 MPC_Fuel_Contamination_Update_and_Airworthiness_ Implications_and_Actions_COJFLU-R' to various inc British International Helicopters (Mount Pleasant) - Chief Engineer (thro' email BFSAI-FLK 905EAW BritInt Capt) dated 9 Aug 11 (**double referenced as WW in 1.4**)
XX	OC F&L's draft contamination SOP dated 29 Aug 11
YY	DE&S's Hazard Initial reporting form
ZZ	Dow Chemicals – Product Safety Assessment – Diethylene Glycol MonoMethyl Ether
AAA	Univar Safety Data Sheet 2-(2-MethOxyEthOxy) Ethanol
BBB	DE&S Safety Data Sheet – AL-41
CCC	DF&FS email to OC S&AMS AL-34 fit for use, dated 31 Aug 11
DDD	Intertek report 2384 – analysis of AL34 dated 30 Aug 11
EEE	DF&FS email to OC S&AMS – AL 34 contamination analysis dated 13 Sep 11
FFF	Email From 1710NAS-MIG CCHSL (Mishon, Matt C1) Sent: 15 September 2011 18:29 Subject: RE: AL 34 Usage
GGG	MPC AL-34 issue log
HHH	OPA GPSS map
III	Misterton PSD local work procedures
JJJ	CAA CAP 748 Aircraft Fuelling and Fuel Installation Management
KKK	British Airways ATP E11146 Section 2 (Draft 1st October 2011) Fuel Manual Aircraft Fuelling
LLL	IATA Fuel Quality Pool (IFQP) scheme
MMM	Energy Institute's "New developments in global aviation fuel handling equipment standards" dated 9 June 2010
NNN	DF&FS internal Email on ICA Purity and Additives, dated 9 Aug 11
OOO	GE Aviation's Email to Brintel 'RE: Fuel Contamination' from garry.welch@ge.com to Robert Richerby dated 10 Aug 11
PPP	CO JFLU's Email 'MPC Fuel Contamination – Further Data On Contamination Levels' from CO JFLU to various inc British International Helicopters (Mount Pleasant) - Chief Engineer (thro' email BFSAI-FLK 905EAW BritInt Capt) dated 19 Aug 11

QQQ	SENGO 905's Email 'Briefing On BFSAI Staff Discussions with British International Helicopters During Period Following Fuel Contamination Incident', ref HQ905EAW/4002/J4 from SEngO 905 EAW, dated 11 Sep 11
RRR	CBFSAI's letter HQBFSAI-J4-Contaminated_Fuel to DES DSA 'Mount Pleasant Complex Fuel Contamination- Local Sale of Proposal Business Case' dated 21 Nov 11
SSS	Intertek test 2353 Sullage tank test results dated 8 Aug 11.
TTT	Email from Larry Cauchi Rolls-Royce Service Desk Manager to Sqn Ldr Blackie 'MPC Fuel Contamination' dated 27 Mar 2012
UUU	JSP 418 Volume 2 leaflet 19
VVV	Univar Product Guide for ICA
WWW	Logisticians air safety training guide
XXX	Kilfrost bulk tanker loading instruction
YYY	Air Commodities PT Team Leader Letter of Delegation dated 14 Dec 10
ZZZ	Air Commodities PT Internal Business Agreement (IBA) dated 8 Apr 11
AAAA	Air Commodities PT Safety Case for Fire Extinguishers v1 dated Sep 06
BBBB	COS BFSAI TORs dated Nov 11
CCCC	CO JFLU TORs dated Nov 11
DDDD	CO 905 EAW TORs dated Nov 11
EEEE	MPC Air Safety Risk Working Group TORs dated 14 Jul 11
FFFF	IFQP control of fuel quality and fuelling safety standards 7th edition and audit checklist
GGGG	DSEA Fuel Safety Assurance Assessment checklist dated Jan 12