51S/402/1/1/ENG

12 Feb 08

See Distribution

POTENTIAL FIRE IGNITION SOURCES MEETING 11 FEB 08

Attendees:

XXXXXXXX S.40	OC FSW, RAF Waddington
XXXXXXXXX S.40	NIM(ES)AWS(AV), Nimrod IPT
XXXXXXXXX S.40	JEngO B, 51 Sqn
XXXXXXXXX S.40	Air Eng, 51 Sqn
XXXXXXXXX S.40	BAES
XXXXXXXXXX S.40	BAES
XXXXXXXXX S.40	BAES
XXXXXXXXX S.40	BAES
XXXXXXXX S.40	QinetiQ
XXXXXXXXX S.40	EWAD
XXXXXXXXX S.40	EWAD

1. The team's focus was to assess the No 3 Pannier Bay for potential ignition sources other than the cross-feed ducting. The analysis covered 3 potential types of ignition source: Mechanical, electrical and chemical.

SCOPE OF ANALYSIS

POTENTIAL MECHANICAL SOURCES

2. Heat Source. As analysed over the last 2 weeks, the air-start cross-feed ducting remains a potential ignition source due to the hot air flow through it on engine starts. However, recent analysis shows that, during normal operation, pipe surface temperature is <180°C, while the auto-ignition point of AVTUR or OX87 is thought to be >240°C and >300°C respectively.

3. High Energy Rotors. No evidence of this, further supported by the lack of any physical damage in the area.

4. Mechanical Spark. No evidence of sparking or of any mechanical failures, which would be required to generate sparking.

POTENTIAL CHEMICAL SOURCES

5. In air accidents on other platforms, it has been known for a silver sulphide compound to form and ignite. The creation of silver sulphide generally requires silver to be submerged in AVTUR. Whilst there are silver electrical components within the Bay, their dispersal makes formation of the compound very unlikely. Additionally, there was no evidence of chemical heating.

POTENTIAL ELECTRICAL SOURCES

6. XX . All XXXXXXXX XXXX located in the No 3 Pannier Bay has been electrically S.26 inhibited since early-Dec 07. Therefore, no XXXXXXXX from this area could have occurred. S.26

7. Static. There is an integral electrical bonding on the cross-feed ducting components due to the metal-to-metal contacts, which is earthed at the airframe mounting points. Therefore, an ignition from a static spark is very unlikely.

8. Circuit Fault. No concerns were raised by EWAD, since all supplementary power supplies to the No 3 Pannier Bay were inhibited at the time of the incident. The lower strobe light, slightly forward of the No 3 Pannier Bay, was also isolated at this time.

9. External Short. The possibility of sparks from a cable chafe or a short circuit caused through FOD was considered. However, several thorough examinations of electrical cabling and connectors within the Bay have revealed no evidence of chafes. Additionally, there have been no electrical faults reported or discovered on systems within this Bay.

CONCLUSION

10. The team concluded that no credible alternative ignition sources could be identified in the No3 Pannier Bay. Therefore, the only realistic source of ignition is the high surface temperature of the air-start cross-feed ducting.

ADDITIONAL DISCOVERY

11. During inspection of the air-start cross-feed ducting clamp assembly (see Figure 1), it was noted that:

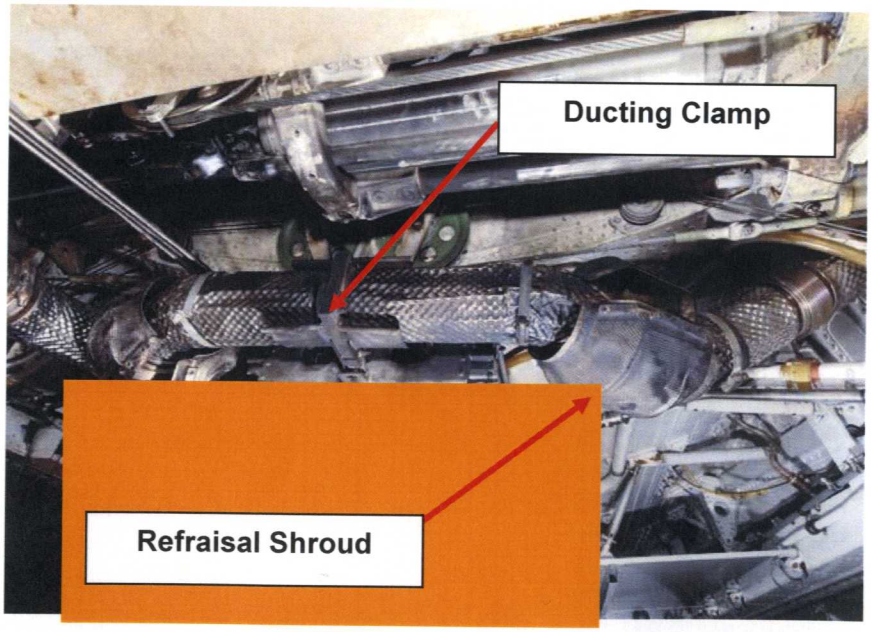
a. There was a pungent smell of fuel on the upper half of the clamp.

b. There was delamination of the clamp material (the clamp is manufactured from asbestos plys with rubber bonding).

c. There was heavy sooting directly above clamp location within the Bay.

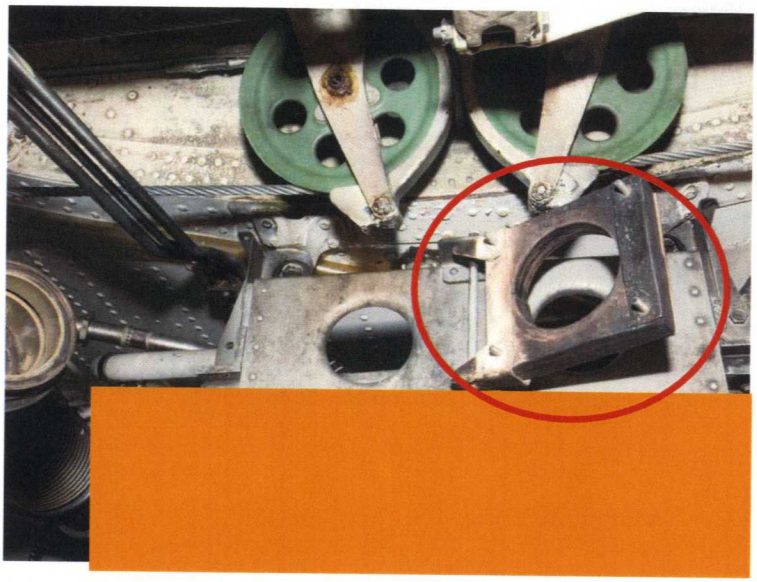
d. There were burn marks and heavy sooting on stbd side of clamp – the side facing away from the refraisal shroud, as shown in Figure 2 with the ducting removed.

Figure 1 – Overview of Air-Start Cross-Feed Ducting Assembly



PICTURE PARTIAL REDACTION 5.26

Figure 2 – Stbd Face of Ducting Clamp (note – surrounding area has had soot removed)



PICTURE PARTIAL REDACTION S.26

12. The evidence of heavy sooting in these locations, which were shielded from the refraisal shroud, implies that there could have been a fire in proximity to the clamp. The hypothesis is that a fuel-impregnated clamp, mounted against the ducting, could have ignited and created a small flame. This flame would have then, in turn, ignited the vapour of boiling OX87 held within the refraisal shroud (as previously hypothesised); this would have given the soot indications evident post-incident and described in previous reports.

13. The delamination of the clamp would have allowed a "wicking" effect, drawing fuel into it and the fire's accelerant could be a combination of the AVTUR and the rubber bonding. The belief is that the rubber bonding may have changed composition after prolonged heat exposure from the ducting during normal usage, potentially changing its auto-ignition temperature.

FURTHER INVESTIGATION

14. BAES will analyse the ducting clamp to confirm that there is fire damage, rather than sooting.

15. BAES will investigate the auto-ignition temperature of the AVTUR / rubber bonding mix on a ducting clamp impregnated with AVTUR.

16. BAES will investigate the ignition temperature of fuel and hydraulic fluid vapour.

17. BAES will continue to investigate the auto-ignition temperature of the residues on the refraisal shroud.

CONCLUSION

18. The hypothesis that the AVTUR-impregnated clamp may have been the initial source of the fire still does not provide an explanation of the ignition source; the pipe temperature as measured is still below the auto-ignition point of AVTUR or OX87. The further investigation may identify if the AVTUR and rubber bonding combination has a lower auto-ignition temperature.

19. At this stage, it is clear that there is no credible alternative ignition source other than the heat generated from the air-start cross-feed ducting.

[Original Signed]

XXXXX 5.40
Flt Lt
JEngO B 51 Sqn
95771XXX 5.40

Distribution:

AO ISTAR*

Copy to:

Gp Capt Support 2 Gp*
NIM IPTL*
Stn Cdr RAF Kinloss*
Stn Cdr RAF Waddington*
DES CofM Air-MA1*
OC 51 Sqn*
OC FSW RAF Waddington*
NIM(ES)AWS(AV)*
SEngO 51 Sqn*