

Research Update for 06 June 2007 OIAC HLG:

Note: Item numbers correspond to the joint industry HSRMC research programme (see attached chart).

(1). HUMS

Current work comprises an in-service demonstration of an Artificial Intelligence (AI) based anomaly detection and diagnostic system to enhance the performance of current HUMS. A demonstration system covering all 35 shafts in the Super Puma main rotor, accessory, intermediate and tail rotor gearboxes has been developed and tested using all available IHUMS data up to March 2006. The in-service trial of the system at Bristow Helicopters started in May 2006 and concluded in November 2006. Overall, the performance of the system was very impressive. A number of defects were identified which the current system (IHUMS) did not pick up, including instrumentation defects. The trial concluded in November 2006, but there is a fixed price contract option to extend the trial by six months. The first drafts of the interim report and the report on the 6 month in-service trial have been received and reviewed.

Further enhancements to the system have been identified, the majority of which FAA have agreed to fund. The four tasks needing to be completed prior to the start of the 6 month trial extension have been contracted and work is in progress. The remaining two tasks will be contracted when the FAA funding is confirmed. The trial extension is presently expected to start in July 2007. The system is still in use at Bristows in the meantime. A presentation on the project was given at the 04 June UKOOA ASTG Aviation Seminar, and the work is to feature in a one-day joint CAA/FAA/EASA HUMS symposium at Aviation House, Gatwick on 27 June 2007.

NB: The trial system is being implemented for the AW139 under Smiths Aerospace funding. CHC Scotia have agreed to support the activity with the supply of data. Initial development is expected to be completed by end July 2007.

(2). Side-floating helicopters

The response to EASA's initial invitation to tender for the helicopter type-specific design study was disappointing. EASA advised on 16th March that they have re-tendered the work and that interest has been shown by Westland Helicopters, Eurocopter, QinetiQ and FPT. The closing date for bids was 11 May 2007.

EBS is considered to have the potential to mitigate the safety risk associated with water impact/post ditching capsize in the short to medium term pending availability of side-floating emergency flotation systems, and/or in the long term in the event that retrofit of the side-floating scheme is judged to be impractical. CAA internal approval for the production of a specification for emergency breathing systems (EBS) appears likely. If approved, work on developing the example draft technical standard contained in CAA Paper 2003/13 into a full specification will likely start mid to late 2007, depending on the costs and availability of funding.

(3). Operations to moving decks

The vessel motion data collection exercises on Alliance and Schiehallion have been completed and formulation of the motion severity index (MSI) finalised. It has been concluded that the MSI measure (i.e. not the helicopter limit) will need to be vessel

dependant. It is envisaged that the equipment will be programmed to start with a conservative, default value and will 'learn' the vessel motion characteristics and relax the value over time. The equipment will need to be reset and the learning process repeated if conditions change, e.g. if the vessel changes location or changes its mooring arrangements. Alternatively, there may be other ways of continuously adapting the MSI to the vessel configuration and sea climate - this will be discussed with the motion sensing system manufacturers.

The review and documentation of the computer model for determining operating limits is complete, and the model has been used to generate initial statistically based limits. This exercise has led to the model being reconstructed in a simpler and more robust form in MathCad (was in Excel). It is expected that operating limits for the S.Puma and S-76 will be available in time for in-service trials to be conducted during winter 2007/8.

A joint UK/Norwegian approach was agreed at the 13 December 2005 meeting - Norway will implement UK MSI/WSI criterion covering on deck stability; UK and Norway will implement a common heave rate-based criterion covering the landing. The setting of the heave rate criterion has been informed by the data collection and analysis exercise performed for the MSI. The last joint UK/Norway industry project review meeting was held on 18 September. The next meeting will likely be held in autumn 2007.

(4). Helideck lighting

The AGI Stage 2 lighting system (green perimeter lights as per Stage 1 plus replacement of floodlighting with lit aiming circle and 'H' marking) was installed on the ExxonMobil Thames A platform in the southern North Sea at the beginning of February 2007. Initial feedback from CHC Scotia has produced an enthusiastic report from one pilot but a lukewarm response from another - it is still expected that the overall response will be favourable. Two dedicated flights to the Thames A are being organised to view the AGI system - one for UK industry representatives, hopefully during June 2007, and a second for members of the ICAO VAP on 18 July 2007.

The Techspan system has been delayed by late delivery of the LED strips from the Canadian supplier but, hopefully, will eventually be installed on the BP Miller platform in the northern North Sea. A meeting with Techspan and BP was held on 12 December 2006. Although no evaluation during winter 2006/7 has been possible, it is hoped that some evaluation of the system can be performed by the resident SAR helicopter as soon as it has been installed.

Full in-service trial trials of both systems will now take place during winter 2007/8. The purpose of these trials is to validate the specification for the Stage 2 lighting. The trials at Norwich Airport which generated the specification have been reported in CAA Paper 2006/03.

(5). HOMP

Progress on the provision of a measure of low airspeed still awaits a suitable weather window to conduct the trials needed to generate a database to train the neural network being used. Bond have kindly offered the use of their offshore-based

SAR aircraft for these trials, and an initial meeting between Bond, Bristows and CAA was held on 05 June 2007 to discuss how best to take advantage of the offer and move the project forward.

(6). Offshore approaches

Current work comprises a three-phase hazard analysis covering en-route navigation, WXR overlay approaches and GPS approaches.

The first phase (en-route navigation) is essentially complete. The results of the hazard analysis have formed the basis for the CAA specification (No.22) that has been used as the vehicle for promulgating the required operating procedures. Still outstanding is the trial to demonstrate the feasibility of monitoring RAIM availability (as required by Spec. 22) on a continuous basis using HOMP, and to obtain data on the current level of RAIM availability. The 'frame stripper' needed was installed on the aircraft mid November 2006 but, unfortunately, does not appear to be working. Bristows are investigating.

Work on second phase (GPS enhanced WXR approaches) is essentially complete. A modified approach procedure has been developed and evaluated by Bristow Helicopters and CHC Scotia on the Bristow flight simulator at Aberdeen.

The hazard analysis of the present WXR approaches (Phase 3a) is well advanced. Unsurprisingly, the results indicate weather radar approaches to be unacceptable. It is now proposed that the Phase 2 work be incorporated with this study to demonstrate how a number of the hazards could be mitigated using existing GPS equipment fits with a modified approach procedure.

The EU 6th Framework GIANT project work (Phase 3b) has been accepted and the project launch meeting was held on 27 November 2006. The study comprises:

- data collection and analysis to establish the suitability of EGNOS for the offshore helicopter application,
- joint UK/Norway design of a 'full' GPS approach,
- hazard analysis of the 'full' GPS approach,
- simulator trials of the 'full' GPS approach at Eurocopter.

The start of the EGNOS data collection and analysis has been delayed partly due to GPS receiver certification issues, and partly due to the late start-up of the GIANT project. Data collection via a dedicated non-revenue flight trial rather than during normal service is now proposed. The meeting with Bristows engineering scheduled for 27 April 2007 is to be re-arranged. The design of the GPS approach is well advanced and the simulator trials planning meeting was held on 25 April 2007. The simulator trials are expected to be conducted during the summer of 2007. Work on the hazard analysis will start once the design of the approach is sufficiently mature.

(7). Helideck friction

A programme of work comprising a review of the current helideck friction criterion and the requirement for landing nets in CAP 437, and the establishment of a new criterion for aluminium helideck surfaces is to be commissioned.

The ITT was issued to five companies but only two bids were received. Meetings with the two bidders were held during w/c 21 May 2007; the final selection will be

made mid June and work is to start early July 2007. Costs are somewhat higher than had been anticipated and it will likely be necessary to, initially at least, reduce the scope of work unless and until additional external funding is forthcoming.

(8). Turbulence criterion

All work on validating the turbulence criterion has been completed and the second draft of the final report has been received and is under review. The overall conclusion is that the algorithm used to measure workload is well correlated with turbulence, but the initial value of the turbulence criterion should be lowered from 2.4m/s to 1.75m/s standard deviation of the vertical component. The provisional turbulence criterion in Chapter 3 para. 2.3.5 of CAP 437 will be modified and confirmed at the next update. The final report will recommend that helicopter operational monitoring (HOMP) data be routinely collected and analysed to monitor the turbulence environments around offshore platforms, providing quantitative feedback for improvement and refinement of the HLL and, possibly, further tuning of the criterion. A presentation to HCA and the helicopter operators to promote this use of HOMP data was given in Aberdeen on 07 November 2006 and was well received.

As regards the review of the 0.9 m/s vertical wind component criterion in CAP 437, analysis of HOMP data on maximum torque and maximum 2-second change in torque has not identified any evidence of any problems other than those caused by turbulence and/or hot gas plume encounters. Wind tunnel data available for platforms included in the HOMP data archive has been analysed to establish the nature and extent of any adverse wind flow phenomena other than turbulence. This has demonstrated good correlation with the HOMP data and, interestingly, no platform met the current vertical flow criterion for all wind speeds and directions. A wind tunnel study to attempt to establish whether the present 0.9 m/s vertical flow criterion in CAP 437 can be deleted now that the turbulence criterion is in place has been completed. The initial findings are that the 0.9 m/s vertical flow criterion can be deleted provided that the turbulence criterion is applied. This will be discussed with the helicopter operators and HCA before any action is taken to remove the criterion.

(9). Extension of HUMS to rotors

The work on extending HUMS to rotors comprises a review of all relevant work (to include earlier HSRMC-funded studies) in order to form a consolidated view of the state of the art of the application of VHM techniques to the detection of rotor system potentially catastrophic failures (PCFs). The overall results are:

- the review of accidents and incidents shows a steady decline in the occurrence rates from the early 1990's; the majority of occurrences related to the main rotor and the majority of these related to hub (rather than blade) defects;
- there is no evidence that vibration health monitoring (VHM) would be effective in providing adequate advance warning of main rotor faults; there is some evidence that VHM could help with tail rotor faults; other health monitoring technologies (e.g. strain gauges) might offer benefits;
- the direction of the earlier research is not considered optimal in the context of current knowledge and experience.

Despite the somewhat negative findings of the initial study, further work judged to be worthy of consideration has been identified and a proposal is being drafted. The strategy currently proposed is to adopt the following two complementary approaches:

- The first is to continue to develop a fundamental understanding of the rotor vibration behaviour using current rotorcraft modelling techniques to determine, theoretically, which rotor faults are manifested in the vibration and how these might be detected. This is expected to take the form of a three year university PhD project.
- The second is to apply the anomaly modelling techniques developed on the transmission HUMS research (see item 1 above) to in-service rotor HUMS data (i.e. a data driven approach) to provide a better understanding of in-service data behaviour and the effects of various maintenance actions.

Costed proposals for the further work are expected to be presented at the 24 July HSRMC meeting.

(10). Tail rotor failures

A feasibility study on the provision of a tail rotor strike warning system is included in the joint industry HSRMC work programme, but insufficient funding is available to proceed at present.

(11). TCAS

A programme of work has been proposed comprising in-service trials of TCAS II equipment on a North Sea helicopter to establish the feasibility and likely benefits of fleet-wide implementation. A separate trial is already being progressed by Bristow Helicopters. Efforts are being made to co-ordinate activities in this area and, hopefully, eliminate the need to run two trials.

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**PROPOSED HSRMC RESEARCH PROGRAMME – FUNDING STATUS AS AT
06 JUNE 2007 OIAC HLG MEETING.**

Item	CAA Project Code	Title	Funding Status
1. ONGOING WORK			
1	5.1	HUMS - advanced analysis of HUMS data.	Sufficient funding available to complete all work currently identified.
2	5.3	Ditching/Water Impact - side floating helicopter + EBS specification.	Side-floating helicopter study progressing outwith HSRMC at EASA. EBS spec. pending internal CAA approval.
3	5.10	Operations to Moving Helidecks – generation of MSI/WSI operating limits and in-service trials.	Sufficient funding available to complete current work.
4	8.2	Helideck Lighting - in-service trials of new scheme (circle & 'H' lighting).	Sufficient funding available to complete all work presently anticipated.
5	14.3	HOMP - extension to low airspeed regime.	Sufficient funding available to complete identified work.
2. EXTENSIONS TO EXISTING PROGRAMMES			
6	5.7	Offshore Approaches – development and simulator evaluation of 'full' GPS approach + EGNOS reception study.	Sufficient funding available to complete work underway. Future funding will be required for prototype equipment development and in-service trials.
7	8.1	Helideck Friction - review of CAP 437 criterion and development of new criterion for aluminium decks.	Sufficient funding available for only part of the identified work - bids received exceed estimated costs.
8	8.5	Helideck Environment - review of CAP 437 vertical wind component criterion.	Sufficient funding available to complete identified work.
3. NEW PROJECTS			
9	-	HUMS – preliminary study on extension to rotor systems.	Sufficient funding available to complete preliminary study only.
10	5.16	Tail Rotor Strike Warning.	Insufficient funding to proceed at present.
11	-	TCAS - in-service trials.	Trials presently progressing outwith HSRMC at Bristow Helicopters.