

## **Research Update for 30 January 2008 HSRMC Meeting:**

Note: Item numbers correspond to the joint industry HSRMC research programme.

### **(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 interim report and the report on the 6 month in-service trial have been completed and accepted.

Further enhancements to the system have been identified, the majority of which FAA have agreed to fund. The first four tasks needed to be completed prior to the start of the second 6 month trial. This work has been completed and reported and the second six month trial started in December 2007. Following confirmation of the FAA funding, the remaining two tasks have been contracted. The next progress meeting with GE Aviation is to take place on 31 January 2008.

Discussions are underway at the Oil & Gas UK ASTG on implementation of the new analysis system. A proposal based on a rate per flying hour charge is to be presented to the 11 March 2008 ASTG for consideration. A presentation on the project is also to be given at the 11/12 June 2008 RAeS Maritime Operations of Rotorcraft conference.

### **(2). Side-floating helicopters**

The contract for the helicopter type-specific design study for side-floating helicopters has been let by EASA to Eurocopter and Aer Azur. The first progress meeting took place at Eurocopter in Marseilles on 23 November 2007. UK CAA (D Howson) attended the meeting and presented the background to the work. The project is scheduled to be completed by end 2008 latest.

EBS is considered to have the potential to mitigate the safety risk associated with water impact/post ditching capsizing 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 Paper 2003/13 contained an example draft technical standard for EBS and it is considered desirable to develop this into a full specification to ensure that any EBS voluntarily deployed truly represents a net safety benefit. Dr Susan Coleshaw (the author of the study reported in CAA Paper 2003/13) has been contracted to perform this work, and the project launch meeting is to take place on 12 February 2008.

### **(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. A specification for the vessel motion sensing equipment is being developed jointly with the equipment manufacturers. The specification will be used to define the prototype equipment necessary for the sea trials and, once validated by the sea trials, will be added to the joint UK/Norway guidance material. A meeting was held with the

equipment manufacturers on 24 January 2008 to conduct a detailed review of the first draft of the specification. A second draft is being prepared for circulation and further comment.

The computer model for determining operating limits is complete, has been verified and validated, and has been used to generate statistically based limits for the S.Puma and S-76. The limits are more restrictive than would have been preferred, and a sensitivity analysis has been performed to identify where efforts must be focussed in order to further refine the limits. It has been established that all problems could be resolved by shutting the rotors down while on deck, but the operators say that this is impractical. The next most significant aspect is the relative wind direction and efforts are in hand to identify ways of keeping the helicopter better aligned with the wind. The third most significant issue is the movement of the cyclic control while on deck; better data on this aspect is to be collected during the in-service trials to be commenced later in 2008. Several equipment manufacturers, vessel operators and all the helicopter operators have indicated their willingness to participate in the trials.

This project remains a joint UK/Norwegian initiative; the last joint industry meeting was held on 07 December 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. A demonstration flight was conducted for the benefit of members of the ICAO VAP on 18 July 2007. Overall the lighting system was well received, but the aiming circle was considered to be too dim by both the observers and the pilots. Photometric testing of the panels has revealed that the vertical light distribution is non compliant with the specification; in particular, the light output at low elevations is significantly reduced. This has been corrected in the second system and Perenco, the operators of the Thames A, have agreed to the system being replaced prior to start of the in-service trials. A second demonstration flight for UK industry will be performed once the new system has been installed.

Due to delays and difficulties with the contractor, the Techspan system is now to be replaced with another AGI system. It is still expected that this system will be installed at the BP platform which is to host the offshore-based SAR aircraft, although there remains some uncertainty regarding which platform this will be.

In connection with helideck status lights, the review of flashing light test methods by the National Physical Laboratory (NPL) has been completed and the report circulated for comment. The report confirms CAA's existing Blondel-Rey test technique for flashing lights emitting square-pulses, and recommends use of the Modified Allard technique for other pulse shapes; it recommends that any reference to the so-called 'steady burning' technique be removed. The comment period concluded on 25 January 2008 and no significant input was received. The final version will be included in a new CAA paper containing an updated helideck status light specification that will supersede CAA Paper 2003/06.

#### **(5). HOMP**

The remaining HOMP research is the provision of a measure of low airspeed for use in the ground-based analysis system. The original programme of work had reached a point where, in order to make progress, flight trials were needed to generate a new, more accurate database to train the neural network being used. This exercise was to be performed by Bristows but had not progressed due to logistical difficulties. At the

November 2006 HMLC Bond kindly offered the use of one of their aircraft for these trials, and an initial meeting between Bond and CAA was held on 05 June 2007 to discuss how best to take advantage of the offer and move the project forward.

At this point CAA became aware of staff changes at Westland Helicopters which cast doubt over their ability to complete the work. Advantage was taken of this opportunity to have GE Aviation (formerly Smiths Aerospace) to review the work completed to date. GE have raised a number of points and there is the possibility that better results may be obtainable from the existing data set. GE have been asked to provide a costed proposal for a small feasibility study. It is suggested that this be considered before moving ahead with any further flight trials.

#### **(6). Offshore approaches**

All work on the three-phase hazard analysis covering en-route navigation, WXR approaches and GPS enhanced WXR approaches has been completed and a final summary report has been produced for publication in the public domain as a CAA paper. The first draft has been circulated for comment and a meeting to discuss the report with the helicopter operators was held on 06 December 2007. This matter was discussed further at a full project meeting on 08 January 2008 and a second draft is now being prepared.

The trial to demonstrate the feasibility of monitoring RAIM availability (as required by CAA Spec. 22) on a continuous basis using HOMP, and to obtain data on the current level of RAIM availability is still outstanding. The 'frame stripper' needed was installed on a Bristows S.Puma in mid November 2006 but did not produce the data as expected. Investigations revealed that the Free Flight GPS receiver does not output a RAIM available 'flag' at all; the receiver documentation was misleading. Bristows are now investigating whether the information required is available from the Marconi GPS receivers installed on their EC225 aircraft.

The EU 6th Framework GIANT project work was launched in November 2006 and 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 EGNOS data collection exercise was scheduled for early November with Bond Helicopters but had to be postponed due to aircraft unavailability. These trials are now expected to be performed by CHC Scotia. The design of the GPS approach has been finalised following analysis of the simulator trials performed at Eurocopter in October 2007, and subsequent discussions during the 08 January 2008 project meeting. Work on the hazard analysis can now be launched.

#### **(7). Helideck friction**

The contract for a programme of work comprising a review of the current helideck friction criterion and the requirement for landing nets in CAP 437, has been let to NLR in Holland. The establishment of a new criterion for aluminium helideck surfaces forms a fixed price contract option, and will be added once sufficient external funding is confirmed. The first project progress meeting took place on 29 October 2007. An HCA representative is participating in the monitoring and direction of the project. The experimental work is expected to be completed by early 2008, and a meeting to review the results has been scheduled for 18 March 2008.

## **(8). Turbulence criterion**

All work on validating the turbulence criterion has been completed and the final report has been completed and accepted. 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 recommends 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. All information necessary to implement the algorithm in HOMP has been provided to the helicopter operators and their HOMP system suppliers.

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 has been undertaken to investigate the implications of deletion of the present 0.9 m/s vertical flow criterion and addition of the turbulence criterion on helideck air gap. The study has found that the effect on air gap is minimal and that the 0.9 m/s vertical flow criterion can be deleted provided that the turbulence criterion is applied. All of this work was presented to the helicopter operators and HCA on 05 December 2007 and then discussed. It was agreed to remove the 0.9 m/s vertical wind component criterion in CAP 437.

## **(9). Extension of HUMS to rotors**

The initial study on extending HUMS to rotors comprised a review of all relevant work (including the 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 final report has recently been completed and delivered for review and acceptance. 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.

Once reviewed and accepted, the final report will be published in the public domain in the form of a CAA paper.

Despite the somewhat negative findings of the initial study, further work judged to be worthy of consideration has been identified and a proposal drafted. The strategy essentially comprises the application of the anomaly modelling techniques developed on the transmission HUMS research (see item 1 above) to in-service rotor HUMS data to provide a better understanding of in-service data behaviour and the effects of various maintenance actions. The scope of this study has been reduced to cover tail rotors only due to uncertainty over the external funding that will be available in 2008. Other work under consideration is a PhD-based theoretical study of how rotor defects should manifest themselves and how and where this could be measured.

#### **(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. It is understood that some work is being performed in this area by Bell Helicopter in USA.

#### **(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.

Bristow Helicopters have completed dedicated flight trials utilising a BAE 146 'intruder' aircraft, and have agreed to provide CAA with a copy of the associated data and documentation. Commencement of in-service trials currently awaits approval of the aircraft modification which has been subcontracted to CAA by EASA.

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**30 January 2008**

**PROPOSED HSRMC RESEARCH PROGRAMME – FUNDING STATUS AS AT  
30 JANUARY 2008 HSRMC MEETING.**

Item	CAA Project Code	Title	Funding Status
<b>1. ONGOING WORK</b>			
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 design study.	Contract let to Eurocopter / Aer Azur by EASA.
		Ditching/Water Impact - EBS specification.	EBS spec. pending agreement of full costed proposal - sufficient funding expected to be available.
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.
<b>2. EXTENSIONS TO EXISTING PROGRAMMES</b>			
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 test/monitoring techniques.	Sufficient funding available to complete identified work.
		Helideck Friction - development of new criterion for aluminium decks.	Insufficient funding to proceed at present.
8	8.5	Helideck Environment - review of CAP 437 vertical wind component criterion.	Sufficient funding available to complete identified work.
<b>3. NEW PROJECTS</b>			
9	-	HUMS – preliminary study on extension to rotor systems.	Sufficient funding available to complete identified work.
		HUMS - application of advanced data analysis techniques to HUMS rotor data.	Sufficient funding for reduced scope of work only at present.
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.