

## **Research Update for 28 November 2007 OIAC HLG:**

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 trial concluded in November 2006, but there is a fixed price contract option to extend the trial by six months. The interim report and the report on the 6 month in-service trial have been completed.

Further enhancements to the system have been identified, the majority of which FAA have agreed to fund. Work on the four tasks needing to be completed prior to the start of the 6 month trial extension has been completed and the 6 month trial extension started on 01 November 2007. Following confirmation of the FAA funding, the remaining two tasks are being contracted. 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 also featured 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.

### **(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. CAA internal approval for the production of a specification for emergency breathing systems (EBS) has been obtained (see Safety Plan 2007 Update), and an outline proposal has been solicited and received from Dr Susan Coleshaw (the author of the study reported in CAA Paper 2003/13). Following review by the 17 July 2007 HSRMC, a full costed proposal is being prepared by Dr Coleshaw. It is expected that the work will be contracted before end 2007.

### **(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. The contractor (Atkins) is being tasked with producing a specification for the vessel motion sensing equipment 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.

The computer model for determining operating limits is complete, and has been used to generate statistically based limits for the S.Puma and S-76. It is likely that the limits will be viewed as unduly restrictive and tasking is in hand to undertake a sensitivity analysis to identify where efforts must be focussed in order to further refine the limits. Alternative means of improving operability will also need to be reviewed jointly with the industry. The contractor is also being tasked with verifying the computer model and validating it against existing trials data, and data from the West Navion accident.

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 2006. The next meeting will be 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. Unfortunately the Miller platform is not to be developed and is consequently unavailable for the trial. However, the offshore-based SAR aircraft will be relocated to a different platform and BP have indicated that the stage 2 lighting will be included in the 'package' that goes with the aircraft. As the new home for the SAR helicopter has yet to be identified, the additional AGI system will not be installed in time for in-service trials during winter 2007/8. However, it will hopefully be possible for the SAR aircraft to evaluate the system year round.

In connection with helideck status lights, the review of flashing light test methods by the National Physical Laboratory (NPL) is nearing completion. It is expected that this will provide a definitive, up to date and well-founded test technique that is internationally consistent. The test technique will be circulated to interested parties for comment. 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 is being 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 has been arranged for 06 December.

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. The design of the GPS approach has been completed as far as possible; completion awaits the analysis of the results of the simulator trials performed at Eurocopter during the first half of October 2007. Work on the hazard analysis will start once the design of the approach is sufficiently mature. The next project meeting has been scheduled for 08 January 2008.

### **(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 11 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 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 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. This will be discussed with the helicopter operators and HCA on 05 December 2007 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 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. This work will not proceed unless sufficient external funding can be made available.

### **(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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26 November 2007

**PROPOSED HSRMC RESEARCH PROGRAMME – FUNDING STATUS AS AT  
28 NOVEMBER 2007 OIAC HLG 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.	Insufficient funding to proceed 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.