

Research Update for 31 January 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.

Further enhancements to the system have been identified, the majority of which FAA have agreed to fund. This work is presently being added to the contract as and when funding is confirmed. The trial extension already included as a contract option will be delayed until the key sections of this work have been completed in order to maximise the benefit of the trial.

(2). Side-floating helicopters

A presentation of all the research on ditching and water impact, summarised in CAA Paper 2005/06, was given to EASA on 5th July 2006. EASA subsequently committed to progressing the final work item of the helicopter type-specific design study, and an invitation to tender for the work has been issued.

Following agreement at the 26 April 2006 HSRMC meeting and subsequent confirmation at the 16 November meeting, subject to internal CAA approval the example draft technical standard for emergency breathing systems (EBS) contained in CAA Paper 2003/13 is to be developed into a full specification. 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.

(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 proposed 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.

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. Further HOMP data on the positioning of the cyclic (lateral) and pedals while on deck is required before final limits can be produced - this is the most significant factor affecting the setting of the helicopter MSI limits and it is important that the data input to the model is correct. This activity is ongoing with Bristow Helicopters.

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 UK and Norwegian helicopter operators and HCA met on 12 September 2006 to discuss the heave rate-based landing limits and the second joint UK/Norway industry project review meeting was held on 18 September.

(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) has very recently been installed on the ExxonMobil Thames A platform in the southern North Sea. A dedicated flight to the Thames A is to be organised to view the AGI system and some in-service evaluation should be possible during February and March 2007.

The Techspan system has been delayed by late delivery of the LED strips from the Canadian supplier but 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 will be 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 kindly offered the use of their offshore-based SAR aircraft for these trials at the 21 November HMLC meeting. This is to be followed up with Westland Helicopters and Bristow Helicopters, the two research contractors involved with the project.

(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 trial has initially been limited to one Bristow Helicopters S.Puma, and requires the use of a 'frame stripper' to extract the 'flag' required from an ARINC 429 data stream. The frame stripper was installed mid November 2006 and it is believed that data collection has commenced.

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 project leaders (INNECO of Spain) have agreed to proceed with the North Sea helicopter application. The study will comprise:

- 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 - currently awaiting approval of the change of scope from the GIANT project team. The launch meeting for the GIANT project took place on 27 November 2006, and a workshop to discuss the 'full' GPS approach procedure was held on 23 January 2007. Good agreement was achieved on the approach design. The simulator trial planning meeting is scheduled for 20 March 2007.

(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. Discussions with the two bidders are ongoing. Costs are somewhat higher than had been anticipated and it will likely be necessary to reduce the scope of work unless additional external funding is forthcoming. It is hoped that work can be started in March 2007.

(8). Turbulence criterion

All work on validating the turbulence criterion has been completed and the first draft of the final report is under review. The overall conclusion is that the algorithm used to measure workload is well correlated with turbulence, and that the turbulence criterion itself is set at about the right level. The provisional turbulence criterion in Chapter 3 para. 2.3.5 of CAP 437 will be 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. 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 commissioned. The results of the work to date were presented to the 16 Nov 2006 HSRMC meeting.

(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 work is nearly complete and the results to date were presented to the 16 November 2006 HSRMC meeting. 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.

The current work will be completed and reported to the HSRMC. 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. This work is expected to include an analytical study to establish what rotor parameters need to be monitored and where (e.g. on the rotor or in the fuselage), small scale physical rotor model testing to demonstrate proof of concept, and work on anomaly detection using existing data. Any proposals for further work will be discussed at the next HSRMC meeting on 15 May 2007.

(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
53rd HSRMC MEETING (16 NOVEMBER 2006).**

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 to complete identified work, assuming bids within 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.