

Research Update for 27 November 2008 OIAC HLG 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 first six-month in-service trial of the system at Bristow Helicopters was completed in November 2006 and was very successful. Further enhancements to the system were identified, developed and implemented in the trials system, largely under FAA funding, and a further six-month in-service trial undertaken which was completed in June 2008. The results of this trial demonstrated further improvement. The last progress meeting with GE Aviation took place on 10 September 2008; the next is scheduled for 15 January 2009.

Presentations on this work were given by GE Aviation at the 10 June 2008 Oil & Gas UK ASTG Symposium and at the 11/12 June 2008 RAeS Maritime Operations of Rotorcraft conference. A paper proposing full implementation of the research was presented to the Oil & Gas UK Board on 15 October 2008 and approved. GE Aviation will be progressing implementation via OEMs for aircraft with OEM supplied HUMS. GE Aviation will deal with helicopter operators direct for 'legacy' HUMS. It has been suggested that GE Aviation hold a seminar in Aberdeen to launch implementation.

(2). Side-floating helicopters

The contract for the helicopter type-specific design study for side-floating helicopters was let by EASA to Eurocopter and Aer Azur. The work has been completed and two drafts of the final report received and reviewed by EASA and by CAA (D.Howson). A number of weaknesses in the final report remain, however, and it is uncertain whether these can now be addressed. Nevertheless, the study found the side-floating concept to be practical and effective. The main problem is that the report recommends a symmetric system (without any convincing justification), which leads to unduly pessimistic outcomes in terms of weight, cost and drag. Disappointingly, systems aspects such as deployment have only been superficially addressed and, in a number of areas, the study has not moved the concept forwards very far. It remains to be seen whether and, if so, how EASA will progress the concept.

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. The example draft technical standard for EBS contained in CAA Paper 2003/13 is being developed 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. The project launch meeting took place on 12 February 2008, the last progress meeting was held on 13 June 2008. The trials are presently being planned for autumn 2008 and will involve compressed air, re-breather only and hybrid EBS. Ethical approval for the 'warm' water trials at Falck-Nutec has been granted; scheduling of the trials presently awaits sourcing of PSTASS compressed air EBS. The cold water trials are being progressed in parallel at Portsmouth University. A presentation on this project was given at the 11/12 June 2008 RAeS Maritime Operations of Rotorcraft conference.

(3). Operations to moving decks

A specification for the vessel motion sensing equipment has been developed jointly with the industry. 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 has been

produced and circulated and no significant comments received. The specification is being 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 (Norsok Standard).

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, but a sensitivity analysis has been performed and has identified 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 helicopter 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. Another significant aspect is the phasing of the maximum values of the MSI and WSI; currently, it is assumed that these will be concurrent. This is arguably over-conservative, but additional analytical work will be required to address this aspect which will be considered following completion of the sea trials.

The contract amendment for the sea trials has been let and the launch meeting held with the contractor (Atkins) on 01 September 2008. The first progress meeting was held on 03 November 2008. Two suitable vessels, the Technip-Coflexip Alliance DSV and the Maersk Global Producer III FPSO, have been co-opted along with their motion sensing system providers Kongsberg and Miros. Detailed planning for the two trials is now in progress.

This project remains a joint UK/Norwegian initiative; the last joint industry meeting was held on 07 December 2007. A presentation on this project was given at the 11/12 June 2008 RAeS Maritime Operations of Rotorcraft conference.

(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 been installed on the Perenco Thames A platform in the southern North Sea ready for in-service trials during the winter 2008/9 night flying season. This system was demonstrated to members of the ICAO Visual Aid Panel (VAP) and was well received. Due to delays and difficulties with the contractor, the Techspan system has been replaced with a second AGI system. Following a meeting of all interested parties on 18 September 2008, Centrica have agreed to host this system on the AP1 platform in Morecambe Bay. The specification for the Stage 2 lighting scheme is being added as an appendix to the 6th edition of CAP 437 by way of advance information. A presentation on this project was given at the 11/12 June 2008 RAeS Maritime Operations of Rotorcraft conference. NB: The AAIB report on the accident to G-BLUN in Morecambe Bay (7/2008) published on 17 October 2008 notes that the new helideck lighting may have prevented that accident.

In connection with helideck status lights, all work on the testing of flashing lights has been completed and a new helideck status light specification has been published in CAA Paper 2008/01. This supersedes CAA Paper 2003/06 and will be referenced from CAP 437 in the 6th Edition. IMT have now redesigned their helideck status light; it has been independently tested against CAA Paper 2008/01 and confirmed to be compliant.

(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 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. The first task of recovering the original data from tape to CD has been successfully completed. The second task of replaying the data has also been successfully completed and a sample has been sent to GE Aviation for review. The costed proposal for the feasibility study is now awaited from GE Aviation.

(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. Following review with the helicopter operators, a second draft of the report has been produced and was circulated to the industry for comment by end September 2008. No comments were received and the document is now to be published in the public domain as a CAA paper. The main conclusions are:

- there are no hazards/conflict scenarios worse than TOLERABLE for use of GPS for en-route navigation,
- several UNACCEPTABLE hazards/conflict scenarios remain for the unaided weather radar approach, but
- there are no hazards/conflict scenarios worse than TOLERABLE for the 'new' weather radar approach underpinned by use of existing GPS.

There is a CAA Safety Plan action to implement the revised offshore approach procedure with a target date of end December 2008 which will be progressed by CAA Flt Ops with the helicopter operators. A presentation of the new GPS assisted weather radar approach is to be given at the 12 November HMLC meeting.

The work on RAIM availability monitoring has been concluded. In the event it was found that the Free Flight GPS receiver used by Bristows does not output the data required. It is possible that this data might be available on the receivers fitted to newer aircraft but adding the data to the FDR/HOMP data frame would require a software modification. It has consequently been concluded that RAIM availability monitoring is not practical at this time. The study will be written up in a short report which will be added to the three-phase hazard analysis summary report as an addendum. NB: It is likely that RAIM availability monitoring will not be required when helicopters are equipped with EGNOS (SBAS) GPS receivers.

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 conducted by CHC Scotia during September 2008 and some interesting results obtained. Unexpectedly, the worst reception of the EGNOS signal was obtained while the helicopter was flying East/West where no signal blockage was expected; this is presently thought to be due to the high gain roll-off at low elevations with the current antenna fit. The contractor is confident that this problem can be resolved but modification of the antenna installations will be required. 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 review meeting. Work on the hazard analysis is underway at Helios, the prime contractor for this project. Completion of this exercise should lead to solution for the various outstanding issues such as detection of uncharted obstacles (currently considering use of AIS as primary means with weather radar as back-up), control of the vertical approach profile (currently considering addition of helideck height to database entries and use of EGNOS for vertical guidance with rad alt /AVAD as independent safety net), control of offset distance (currently considering addition of obstacle radius to database entries). A presentation on this project was given at the 11/12 June 2008 RAeS Maritime Operations of Rotorcraft conference.

The next stage of the work will be to produce a demonstration system. Helios Technology have bid for EU 7th Framework funding for this work. As a small/medium enterprise (SME), if successful the work will be 75% funded by the EU.

(7). Helideck friction

The contract for a programme of work comprising a review of the current helideck friction criterion in CAP 437 and a review of a range of friction measuring devices, was let to NLR in Holland in October 2007. An HCA representative is participating in the monitoring and direction of the project. The experimental work was started in April 2008, some of which was witnessed by CAA and HCA representatives, and has now been completed. Interim reports covering two of the four friction testers being evaluated have been received and commented on. The full final report is now overdue and NLR are being pressed to progress this work.

The establishment of a new criterion for aluminium helideck surfaces forms a fixed price contract option, and will be added once the current work has been completed.

(8). Turbulence criterion

All work on the development of the turbulence criterion and the review of the present CAP 437 0.9 m/s vertical wind component criterion has been completed and reported. Following consultation with the industry, the turbulence criterion will be added to CAP 437 in the 6th Edition, and the 0.9 m/s vertical wind component criterion will be removed. The final reports on the HOMP validation of the turbulence criterion and the review of the 0.9 m/s criterion are presently being published in a single CAA paper (CAA Paper 2008/02). The helideck design guidance material published in CAA Paper 2004/02 is being updated to take account of the results of this work, and will be republished in CAA Paper 2008/03. This document will be referenced from the 6th edition of CAP 437. A presentation on this project was given at the 11/12 June 2008 RAeS Maritime Operations of Rotorcraft conference. No further research on helideck environmental issues is currently anticipated.

The final report on the validation of the turbulence criterion 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. A further presentation was given at the 16 April 2008 HMLC meeting, and this was repeated at an ad-hoc CAA/CHC meeting held on 07 November 2008.

(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 study has been completed and 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 final report has been reviewed and accepted, and is being published in the public domain in the form of a CAA paper (CAA Paper 2008/05). Proof 1 of the CAA paper has been produced and checked.

Further work entailing the application of the anomaly modelling techniques developed on the transmission HUMS research (see item 1 above) to in-service tail rotor HUMS data has been contracted to GE Aviation and is under way. As regards main rotor health monitoring, a scope of work is being produced for a three-year PhD-based theoretical study of how main rotor defects should manifest themselves and how and where this could be measured. A proposal will be tabled at the 18 December 2008 joint industry HSRMC meeting. If agreed, it is anticipated that the work would start in autumn 2009.

(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 Sikorsky 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.

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. A presentation of the work at Bristows was given to the 54th HSRMC meeting on 30 January 2008, and at the 16-19 September 2008 European Rotorcraft Forum in Liverpool. The in-service trials commenced in April 2008.

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**PROPOSED HSRMC RESEARCH PROGRAMME – FUNDING STATUS AS AT
27 NOVEMBER 2008 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 design study.	Contract let to Eurocopter / Aer Azur by EASA.
		Ditching/Water Impact - EBS specification.	Sufficient funding available to complete all work currently identified.
3	5.10	Operations to Moving Helidecks – generation of MSI / WSI operating limits and in-service trials.	Sufficient funding available to cover sea trials. Additional funding will be required for further work on the operating limits following completion of the trials.
4	8.2	Helideck Lighting - in-service trials of new scheme (circle & 'H' lighting).	Sufficient funding available to complete all work currently identified.
5	14.3	HOMP - extension to low airspeed regime.	Sufficient funding expected to be available to complete all work currently identified.
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 demonstrator trials.
7	8.1	Helideck Friction - review of CAP 437 criterion and test/monitoring techniques.	Sufficient funding available to complete all work currently identified.
		Helideck Friction - development of new criterion for aluminium decks.	Sufficient funding available to complete all work currently identified.
8	8.5	Helideck Environment - review of CAP 437 vertical wind component criterion.	All identified work completed.
3. NEW PROJECTS			
9	-	HUMS – preliminary study on extension to rotor systems.	Study completed.
		HUMS - application of advanced data analysis techniques to HUMS tail rotor data.	Sufficient funding available to complete all work currently identified.
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.