

Research Update for 16 May 2012 HSRMC Meeting:

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

1 HUMS

All work on the advanced HUMS VHM data analysis using Advanced Anomaly Detection (AAD) techniques has been completed, and the overall final project report delivered and accepted. The CAA version of the final report has been completed and will shortly be published on CAA's website as CAA Paper 2011/01. The summary of the HSRMC-funded S61 and S.Puma MRGB seeded defect testing will be produced and published separately in due course.

Overall the project has been very successful and Oil & Gas UK are progressing implementation. AgustaWestlands have licensed the GE system for the AW139; CHC and Bond are close to signing up. Eurocopter is developing its own version of AAD initially for implementation on MARMS HUMS on the EC225 and EC175; a presentation was given at the Oil & Gas UK ASTG meeting on 14 December 2011. Discussions between Eurocopter and GE regarding implementation of the GE system on Eurocopter aircraft fitted with EUROHUMS are ongoing. Sikorsky is developing an equivalent system for the S92.

2 Side-Floating Helicopters

Ditching, Water Impact and Survivability: EASA will be reviewing the regulations and advisory material on ditching and water impact starting mid-2012 (Rule-making task ref. RMT.0120(27&29.008)). A workshop was held on 5/6 December 2011 in preparation for this exercise at which the HSRMC funded research on helicopter ditching and water impact summarised in CAA Paper 2005/06 was presented. An internal meeting was held at EASA on 23 April to define the rulemaking TORs which was attended by the CAA. The current aim is to complete the exercise by May 2014.

As a result of the March 2009 Cougar S92 fatal water impact accident, C-NLOPB are progressing the side-floating concept and have let an initial scoping study to Oceanic Consulting Corporation in Newfoundland. The UK CAA visited C-NLOPB in March 2012 and participated in a progress meeting on this project. Further CAA involvement is anticipated.

EBS Specification: The example draft technical standard for EBS contained in CAA Paper 2003/13 has been developed into a full specification to ensure that any EBS deployed truly represents a net safety benefit. This will be published as a CAA Paper for voluntary use by industry and will also be offered to EASA for development into an ETSO. EBS will be considered by EASA under the forthcoming rulemaking task (see above). The TSB in Canada has recommended that EBS be mandated for overwater flights in its Aviation Investigation Report (A09A0016) on the March 2009 S92 fatal accident; compressed air-type EBS has now been introduced.

All work has been completed and the overall project report was circulated to the Industry on 30 March for comment by end April 2012. A modest amount of feedback has been received; no major issues have emerged. A response document will be

produced and circulated in due course. Presentations on the work have been given at the 11 May HSRMC meeting, the 8 June 2011 Oil & Gas Aviation Symposium and the 5/6 December 2011 EASA workshop.

3 Operations to Moving Decks

A specification for the vessel motion sensing equipment has been developed jointly with the industry. The specification has been used to define the prototype equipment necessary for the sea trials and, once validated by the sea trials and finalised, will be added to CAP 437 and the joint UK/Norway guidance material (formerly the Norsok Standard).

The sea trials on the Maersk Global Producer III FPSO, equipped with a Miros motion sensing system and served primarily by Bond Offshore Helicopters S.Pumas, are ongoing and are progressing well as follows:

- 1) Phase 1 - Data collection and analysis: About a year's worth of helideck motion data has been collected; Atkins have been tasked with undertaking a 'pilot' study to scope the analysis of this data.
- 2) Phase 2 - Installation and commissioning of new motion sensing system and deck motion status repeater lights: This has been completed.
- 3) Phase 3 - Sea trials of new motion sensing system: The sea trials commenced on 13 February 2012 and are ongoing. As at end April 2012, just over 30 landings had been completed. The data is being analysed and a report produced for review with trials participants and other key industry representatives in July. Modifications to the system will be agreed and, ideally, implemented in time for further trials during winter 2012/13.

The current plan is to launch an initial advisory only system following completion of the in-service trials. This will likely contain a generic, lower bound MSI/WSI limit 'curve' to cover all helicopter types with wheeled undercarriages including a nose wheel. Work on producing a tool to enable helicopter manufacturers to produce helicopter type-specific limits will then be undertaken. Type-specific limits will then be added (by internet up-link on most HMS) and used as and when they become available.

By way of a 'spin-off' to the development of the MSI/WSI, advice has been provided to HCA on the measurement of heave rate in support of the recent move to standardise on heave rate across UK and Norway. Introduction of the new measure, Significant Heave Rate (SHR), was temporarily suspended due to insufficient 'smoothing' for which a solution has been developed and tested on helideck motions data. A technical note has been produced and was circulated to HCA and the helicopter operators on 30 April 2012. It is presently planned to add the new scheme to the GP III trials for in-service evaluation prior to full implementation.

The HELIOS Joint Industry Project (JIP) on operations to moving decks has been established by MARIN in the Netherlands and was launched at the FPSO Research Forum on 22 March 2011. The CAA has joined the JIP and future MSI/WSI work is being coordinated with that programme to benefit from the significant 'gearing' on resources. Atkins has been contracted by the CAA to provide technical support to its input to the JIP. The last project steering group meeting was held in Oosterbeek in the Netherlands on 8 May 2012. The main sponsors are MARIN, NLR and the Dutch Government. AgustaWestland, Amarcon, Petrobras and Cramm HLS have joined the JIP.

A presentation on the HELIOS JIP was given by MARIN at the 11 May 2010 HSRMC meeting. Presentations on this work have been given by Atkins at the Oil & Gas Aviation Seminar in September 2010, and by the CAA at the EASA Rotorcraft Forum in December 2010.

4 Helideck Lighting

The first production version of the 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 Centrica CPC-1 platform in Morecambe Bay at the end of October 2011. Unfortunately several problems were experienced with the system and it had to be removed without it being activated and evaluated by either the Bond pilots or by the CAA. Solutions to the problems were identified and agreed at a meeting of all interested parties on 19 January 2012, and are being progressed with a view to the installations on the Centrica CPC-1 and BP Miller platforms taking place as soon as possible after upgraded equipment is available in June 2012.

The update to CAP 437 in the 7th Edition is going ahead during 2012 as planned, supported by the publication of CAA Paper 2012/03 which covers the development of the specification and includes the current version of the specification. This document was circulated to industry for comment and a response to the industry feedback issued. The CAA Paper will be updated and re-issued once the production version of the system has been installed and evaluated by the CAA. The CAA will write to the industry recommending implementation of the new lighting once the specification has been fully validated and at least one viable production system is available for installation.

Presentations on this project have been given by the CAA at the 10 June 2008 Oil & Gas UK Aviation Symposium, the 11/12 June 2008 RAeS Maritime Operations of Rotorcraft conference, the 22-24 March 2010 CHC Safety & Quality Summit, and the 21/22 September 2010 OGP Aviation Sub-Committee.

5 HOMP

The remaining HOMP research is the provision of a measure of low airspeed for use in the ground-based analysis system. This work has been using a database of Bristow S.Puma data including low airspeed as measured by a HADS. As a result of the work completed to date, it has now been established that this data is unreliable due to the HADS sticking. Although it is now clear that flight trials will need to be performed to generate a new database, the more recent analysis performed by GE Aviation has demonstrated significant potential of the concept. The final report on the GE work has been completed and accepted. Bond Helicopters have agreed to support the trials and the next step will be to arrange a meeting between GE, Bond and the CAA. This is presently on hold due to the workload at GE related to the implementation of AAD (see item 1 above).

6 Offshore Approaches

Work completed and reported to date comprises:

- Trials of Differential GPS (DGPS) guided offshore approaches – see CAA Paper 2000/05.
- Follow-on studies to DGPS trials - see CAA Paper 2003/02.
- Effect of helicopter rotors on GPS reception; data collection trials and analysis – see CAA paper 2003/07.

- Three-phase hazard analysis covering en-route navigation, WXR approaches and GPS enhanced WXR approaches - see CAA Paper 2009/06.
- The EU 6th Framework GIANT work including the design, hazard analysis and simulator trials of the SBAS Offshore Approach Procedure (SOAP), and EGNOS reception trials – see CAA Paper 2010/01.

The current stage of the project, called HEDGE, forms part of an EU 7th Framework project. The work essentially comprises the production and trials of a demonstrator SOAP system and the following additions to the project have been identified:

- integration of AIS into the navigation display;
- demonstration of the integration of SOAP with the enhanced helideck lighting;
- safety assessment of the visual segment; and
- addition of RNAV guidance to assist shuttling.

The AIS work package (first bullet above) and the demonstration of the integration of SOAP with the enhanced helideck lighting (second bullet above) have both been contracted. Work on the safety assessment of the visual segment (third bullet above) is being addressed by a PhD student at Imperial College; a presentation on Felipe Nascimento's work was given at the 11 May 2010 HSRMC meeting.

The first set of flight trials were performed over the weekend of 29/30 January 2011; the CAA were briefed on the results on 7 March. Of particular note, the AIS was well received by the pilots and found to be very helpful in improving situational awareness. Some refinements to the trials system were identified and implemented for the second set of daylight trials which took place over the weekend of 12/13 November 2011. An interim report covering the two sets of daylight trials has been drafted and reviewed, and an updated version produced which is currently under review. Night trials will be considered when a helideck fitted with the new lighting system (see item 4 above) is available in the North Sea, probably the BP Miller platform.

Discussions with Eurocopter were held on 26 October concerning the design of an interim approach guidance system. This scheme included many features of SOAP and would pave the way for the future implementation of SOAP. Sikorsky are known to have developed a similar system for the S-92.

Presentations on this project have been given by Helios at the 10 June 2008 Oil & Gas UK ASTG Symposium and at the 11/12 June 2008 RAeS Maritime Operations of Rotorcraft conference, and by the CAA at the 2-3 December 2009 EASA Rotorcraft Symposium and the 22-24 March 2010 CHC Safety & Quality Summit.

7 Helideck Friction

The programme of work comprising a review of the current helideck friction measuring techniques has been completed by NLR. In essence, the work confirms that devices like the Finlay Irvine GripTester are the most appropriate type of device for measuring helideck friction. The main problem with these devices is their portability but, while the research was being conducted, a smaller more portable friction tester employing the same measurement principle as the GripTester was identified (T2GO, manufactured by ASFT in Sweden). Finlay Irvine has also produced a 'Micro GripTester' which was demonstrated to the CAA on 24 September 2009. It is understood that this will replace the current GripTester. The final report was circulated with a CAA foreword for industry comment/consultation and all responses have been answered. The report will be published as a CAA paper

together with the ongoing work on aluminium decks and helideck nets when this has been completed in 2012.

The contract with NLR was extended to add the work on establishing a new test criterion for aluminium helideck surfaces. This involved full scale testing of five different types of aluminium deck surface using actual S61 and S76 wheels mounted on a test rig. All variables expected to be relevant were exercised. The work has been completed and the report received and reviewed; an updated version is presently awaited. The results indicate that none of the aluminium decks tested meet the minimum μ value of 0.65 stipulated in CAP 437.

Current practice in the event of a helideck not meeting the minimum CAP 437 μ value of 0.65 is to fit a helideck net. However, the effectiveness of helideck nets has never been confirmed experimentally and has been further called into question following the move from the 'standard' 20 mm sisal rope nets to the low profile FricTape nets. The contract with NLR was extended to investigate the feasibility of conducting full scale tests on helideck nets. The feasibility study has been completed and reported and a costed proposal for a limited test programme has been received. Extension of the contract with NLR to add this work awaits confirmation of funding from HSE.

8 Helideck Environmental Research

All research has been completed and reported and, where applicable, incorporated in CAP 437. Attention is presently being focussed on the use of helicopter FDM to map and monitor the environments around offshore platforms.

Turbulence:

The final report on the validation of the turbulence criterion (CAA Paper 2008/02) recommends that helicopter FDM 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 7 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 7 November 2008.

Disappointingly, virtually no progress in implementing this scheme has been made by the helicopter operators, despite its value and importance being emphasised by the findings of an audit of HCA by the CAA. It appears that few flow studies are being commissioned by the industry and no flow study results are being received by HCA, and this situation is being exacerbated by poor reporting by flight crews; very few turbulence report forms are ever received.

NB: Information has recently been received suggesting that some progress on environmental mapping using FDM data has been made at CHC. This is being followed up.

Turbine Exhaust Plumes:

The final report on the visualisation of offshore gas turbine exhaust plumes (CAA Paper 2007/02) recommends that helicopter FDM data be routinely collected and analysed to identify 'problem' platforms for consideration for installation of a plume visualisation system. The importance of this hazard was highlighted by the issue of

Sikorsky Safety Advisory SSA-S92-10-002 in April 2010 concerning flight through high temperature exhaust plumes.

More recently, some issues regarding the modelling of turbine exhaust plumes have been raised by Peutz in the Netherlands. In essence, the suitability of CFD for these exercises has been called into question.

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 has been published in the public domain as CAA Paper 2008/05.

Further work entailing the application of the Advanced Anomaly Detection (AAD) techniques developed on the transmission HUMS research (see item 1 above) to in-service tail rotor HUMS data was contracted to GE Aviation and has been completed. The slightly mixed results of this work were presented at the 7 December 2009 HSRMC meeting. Whereas it seems possible to detect faults prior to the start of the last flight (provided that both axial and radial vibration data are available), on-board analysis would be required to provide timely warnings. The main problems are the 'noisy' nature of the data and, in the case of the S.Puma study, the lack of axial vibration data. The final report on this work has been completed and accepted, and will be published as a CAA Paper in 2012.

As regards main rotor health monitoring, following extensive negotiations the CAA and AgustaWestlands (AW) have agreed a Non-Disclosure Agreement (NDA) which will enable the CAA to participate in the AW Rotorcraft Technology Validation Programme (RTVP). This major programme includes significant work on rotor HUMS. A meeting between the CAA and AgustaWestlands was held on 1 February 2012 at which GE Aviation presented the work on the application on AAD to tail rotor VHM data. A further meeting is anticipated during 2012. It is hoped that EASA will be able to participate but that seems unlikely at present due to lack of resources.

10 Tail Rotor Strike Warning

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 has already been performed by Bristow Helicopters.

Bristow Helicopters have completed dedicated flight trials utilising a BAE 146 'intruder' aircraft, and provided the 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, at the 16-19 September 2008 European Rotorcraft Forum in Liverpool, and at the 2-3 December 2009 EASA Rotorcraft Symposium. The in-service trials commenced in April 2008. Bristow Helicopters have committed to fleet wide implementation of TCAS II. Bond and CHC are also fitting TCAS to their North Sea fleets.

12 EGPWS Warning Envelopes

This project comprises the development of improved 'Classic Mode' EGPWS warning envelopes for offshore helicopter operations, and effectively addresses a number of AAIB Safety Recommendations made in the report on the accident to G-REDU in February 2009 near the ETAP platform.

Eurocopter EC225 flight data from Bristow Helicopters' Flight Data Monitoring (FDM) programme has been used to establish the limits of normal operations. This has enabled the Classic Mode warning envelopes and their associated input parameters to be refined, and has also allowed new warning envelopes to be developed. The revised and new warning envelopes have been tested using the available data from four accidents and have demonstrated a worthwhile improvement in performance in terms of warning time. An interim report covering all work to date has been produced and was circulated to relevant industry contacts on 20 February 2012.

The contract has been amended to extend the work to cover a second, dissimilar helicopter type (Sikorsky S76) to test the new warning envelopes on aircraft which are expected to exhibit greater variability than the EC225 in terms of their flight paths. From an EGPWS design perspective, this data effectively represents the 'worst case'. Nevertheless, the results to date indicate that only modest changes to the new warning envelopes are necessary to maintain an acceptable nuisance alert rate. The interim report will be updated when the S76 data analysis has been completed.

Further work on warning types is being considered, together with simulator trials of the new envelopes. This project was proposed by Bristow Helicopters and Shell Aircraft and is being jointly funded by Bristow Helicopters, OGP, Shell Aircraft and BP.

Presentations on the work to date were given to the 28/29 September 2011 OGP Aviation Safety Committee, the 8 November HSRMC meeting and the 7/8 December 2011 EASA Rotorcraft Symposium.

13 Triggered Lightning Strike Forecasting

A programme of work to investigate and demonstrate the feasibility of forecasting/predicting triggered lightning strikes to helicopters has been undertaken in response to requests from industry. The work is being performed by the UK Met Office and has been funded by Oil & Gas UK, CAA Norway and five individual oil/gas companies.

The programme of work initially contracted was completed in June 2011 and, following agreement to fund from Conoco Phillips, Perenco, Apache, Centrica Energy, CAA Norway and BP, the contract was extended to conduct an in-service evaluation of the system on OHWeb during the 2011/12 lightning season. The trial commenced on 1 October 2011 but was suspended at the beginning of January 2012 due to problems with the 'volatility' of the display. Good feedback was received from the helicopter operators and fixes have been worked up by the Met Office. These were reviewed jointly with the helicopter operators at the 12 March 2012 HMLC meeting, and some further refinement is now taking place.

A second trial during winter 2012/13 is now needed to evaluate the revised system for which funding is presently being sought. Note that if the trials system performs satisfactorily, it will be left running on OHWeb going forwards.

A presentation on this work was given at the 8 June 2011 Oil & Gas UK Aviation Symposium. An update has been scheduled for the 13 June 2012 Oil & Gas UK Aviation Symposium.

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10 May 2012

Nomenclature

AAD	Advanced Anomaly Detection
CAA	Civil Aviation Authority (UK)
C-NLOPB	Canadian Newfoundland and Labrador Offshore Petroleum Board
DGPS	Differential GPS
EASA	European Aviation Safety Agency
EBS	Emergency Breathing System
EGPWS	Enhanced Ground Proximity Warning System
EHEST	European Helicopter Safety Team
FDM	Flight Data Monitoring
FPSO	Floating Production Storage & Offloading
GE	General Electric
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
HADS	Helicopter Air Data System
HCA	Helideck Certification Agency
HLL	Helideck Limitations List
HMS	Helideck Motion System
HOMP	Helicopter Operations Monitoring Programme
HSRMC	Helicopter Safety Research Management Committee
H-TAWS	Helicopter Terrain Awareness Warning System
HUMS	Heath & Usage Monitoring System
JIP	Joint Industry Project
MOR	Mandatory Occurrence Report
MRGB	Main Rotor Gear Box
MSI	Motion Severity Index
OGP	International Oil & Gas Producers Association
OGUK	Oil & Gas UK
PCF	Potentially Catastrophic Failure
RTVP	Rotorcraft Technology Validation Programme
SBAS	Space-Based Augmentation System
SHR	Significant Heave Rate
SOAP	SBAS Offshore Approach Procedure
TAWS	Terrain Awareness Warning System
TCAS	Traffic Alert & Collision Avoidance System
VHM	Vibration Health Monitoring
WSI	Wind Severity Index
WXR	Weather Radar

Proposed HSRMC Research Programme – Funding Status as at 16 May 2012

Item	CAA Project Code	Title	Funding Status
1. ONGOING WORK			
1	5.1	HUMS - advanced analysis of HUMS data.	Study completed. Final report being published in CAA Paper 2011/01.
2	5.3	Ditching/Water Impact - side floating helicopter design study.	Study completed by Eurocopter/Aer Azur under contract to EASA. Final report published on EASA's website.
		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 complete all work currently identified.
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.	Project on hold.
2. EXTENSIONS TO EXISTING PROGRAMMES			
6	5.7	Offshore Approaches (GIANT) – development and simulator evaluation of 'full' GPS approach + EGNOS reception study.	Study completed. Final report published in CAA Paper 2010/01.
		Offshore Approaches (HEDGE) – demonstration of the integration of the SOAP procedure with the enhanced helideck lighting, safety assessment of the visual segment, integration of AIS into the navigation display, addition of RNAV guidance to assist shuttling.	Sufficient funding available for AIS receiver integration and flight demonstration of integration with helideck lighting only.

Item	CAA Project Code	Title	Funding Status
7	8.1	Helideck Friction - review of measuring techniques.	Study completed. Final report to be published as a CAA paper.
		Helideck Friction – testing of aluminium decks and development of pass/fail criterion.	Sufficient funding available to complete all work currently identified.
		Helideck Friction – effect on resistance to sliding of landing nets.	Sufficient funding available for initial feasibility study only.
8	8.5	Helideck Environment - review of CAP 437 vertical wind component criterion.	Study completed. Final reports published in CAA Papers 2008/02 and 2008/03.
3. NEW PROJECTS			
9	-	HUMS – preliminary study on extension to rotor systems.	Study completed. Final report published in CAA Paper 2008/05.
		HUMS - application of advanced data analysis techniques to HUMS tail rotor data.	Study completed. Final report to be published in a CAA paper in 2012.
		HUMS – AgustaWestlands Rotorcraft Technology Validation Programme (RTVP).	No funding required at this time.
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.
12	-	EGPWS Warning Envelopes.	Sufficient funding available to complete all work currently identified.
13	-	Triggered Lightning Strike Forecasting.	Funding required for second in-service trial.