

Research Update for 8 November 2011 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 anomaly detection techniques has been completed, and the overall final project report delivered and accepted. The CAA version of the final report is currently being produced for publication as CAA Paper 2011/01 which is on target for publication by end 2011. The summary of the HSRMC-funded S61 and S.Puma MRGB seeded defect testing will now be published separately in order not to delay publication of the GE Aviation final report on the AAD work.

Overall the project has been very successful and Oil & Gas UK (OGUK) are progressing implementation. AgustaWestlands are backing the system and a 'try & buy' trial has been running with CHC on their AW139 fleet which has now closed. An industry workshop was held at GE Aviation on 11 November 2010 to review the status of the implementation programme. OGUK met with the helicopter operators' senior management on 3 March 2011 to press for early implementation. Due to ongoing technical reservations, the CAA met with the helicopter operators' technical staff on 14 March 2011. Commercial proposals for AAD implementation on AW139 fleets have now been produced by the helicopter operators but, at close to \$30 per flight hour, the costs are higher than expected. Oil companies are now considering the proposals. In addition, Eurocopter are developing their own version of AAD initially for implementation on the EC225. A briefing was held in Aberdeen on 19 July 2011 and a presentation and demonstration is scheduled to follow the Aviation Safety Technical Group (ASTG) meeting on 14 December.

2 Side-Floating Helicopters

Helicopter type-specific design study: 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 the final report has been placed on EASA's website. EASA presently propose to review the regulations and advisory material on ditching and water impact starting in January 2012. A workshop will be held on 5/6 December 2011 in preparation for this exercise; the HSRMC-funded research on helicopter ditching and water impact summarised in CAA Paper 2005/06 will be presented. This area has also been identified as a priority item for attention by the European Helicopter Safety Team (EHEST) initiative.

Representatives from C-NLOPB and Transport Canada attended the 25 May 2011 HSRMC meeting to discuss the lessons learned from the March 2009 Cougar S92 fatal water impact accident. C-NLOPB repeated their presentation at the 8 June 2011 OGUK Aviation Symposium. C-NLOPB expressed significant interest in progressing the side-floating concept; discussions with Sikorsky, the UK CAA and research establishments in Canada are under way. Further discussions will be held around the 8 November 2011 HSRMC meeting. C-NLOPB also propose to attend the December 2011 EASA workshop.

EBS Specification: EBS is considered to have the potential to mitigate the safety risk associated with water impact/post ditching capsizes in the short to medium term pending availability of side-floating emergency flotation systems, and 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. Note that Transport Safety Board (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.

All work has been completed and the overall project report is being finalised prior to circulation to the industry in advance of a consultation workshop being considered for early 2012. Presentations on the work have been given at the 11 May HSRMC meeting and the 8 June 2011 Oil & Gas Aviation Symposium. This work will be presented at the 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, will be added to CAP 437 and the joint UK/Norway guidance material (formerly the Norsok Standard) once it has been finalised.

The next phase of the project is to conduct sea trials to evaluate the use of the equipment by pilots and deck crew and to collect data to enable the present, conservative, MSI/WSI limits to be refined. The trials are being hosted by Maersk on their Global Producer III FPSO, equipped with a Miros motion sensing system and served primarily by Bond Offshore Helicopters S.Pumas. A three-phase approach is being adopted:

- 1) Phase 1 - Data collection and analysis.
- 2) Phase 2a - Installation and commissioning of new motion sensing system and deck motion lights.
- 3) Phase 2b - Evaluation of deck motion lights, driven by current P/R/Inc and HR limits only. This phase will not involve using any new or modified limits or operating procedures.
- 4) Phase 3 - New motion sensing system is live, and helideck motion lights driven by current P/R/Inc/HR, MSI/WSI and relative wind limits. MSI/WSI out of limits will give amber status only (i.e. not red) for the trial, prompting the pilot and deck crew to adopt modified procedures or abandon the landing as appropriate. Pilot and deck crew procedures completed during this phase.

Phase 1 is well advanced and over a year's worth of data collected; the analysis of the data is being specified. Regarding Phase 2a, the deck motion lights and the new motion sensing system have been installed but the new software necessary to implement the MSI/WSI and drive the motion lights is awaited. Commissioning and Phase 2b will follow when the software has been installed, with Phase 3 expected to start shortly afterwards using an improved limit curve for the S.Puma which has been produced. The second draft of the interim project report has been received and reviewed. Further work on the MSI/WSI operating limits will be needed on completion of the sea trials, but it is presently anticipated that an interim advisory-only system will be rolled out on completion of the in-service trials in 2012.

By way of a 'spin-off' to the development of the MSI/WSI, advice has been provided to the HCA on the measurement of heave rate in support of the recent move to

standardise on heave rate across UK and Norway. A technical note has been produced and delivered to the HCA and the helicopter operators. Roll-out of the new measure has been temporarily suspended while some 'fine tuning' of the specification is performed following feedback from early in-service experience.

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 will be integrated with that programme to benefit from the significant 'gearing' on resources. Atkins has been contracted by the CAA to provide technical support to the JIP. Technical meetings between the key participants of MARIN, NLR, the CAA and Atkins have been held on 5/6 April and 6 July 2011, and a general project progress meeting was held on 22 September 2011. The main sponsors are MARIN, NLR and the Dutch Government. Further sponsors are being sought and it is expected that AgustaWestlands will join 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) has recently been installed on the Centrica CPC-1 platform in Morecambe Bay. Unfortunately there have been problems with the attachment of the lighting to the helideck surface and the system will very likely have to be removed and re-installed at a later date. This will necessarily delay the CAA evaluation of the system, but the update to CAP 437 will go ahead during late 2011/early 2012 as planned.

The draft specification for the Stage 2 lighting scheme was included in the 6th Edition of CAP 437 as an Appendix by way of advance information. This has been refined following discussions with the manufacturers, AGI and Orga, and an interim (pending completion of the evaluation of the production version) report has been produced which includes the updated specification. This document has been circulated to industry for comment and a response to the industry feedback issued. Presentations from the CAA and AGI/Orga were given at the 21/22 September 2010 OGP Aviation Sub Committee meeting and an updated version of the report circulated to industry for comment. The interim report will be finalised and published once the production version of the system has been installed and evaluated by the CAA.

It is planned to extend the proposed demonstration flights for the GPS guided offshore approaches (see item 6 below) to include flights to a platform equipped with the new helideck lighting to show how the two schemes combine to form an integrated solution. The contract for the offshore approach trials has been extended and BP has been approached with a view to hosting the new lighting system on one of their installations. Discussions are ongoing with a view to installing a second system on the BP Miller platform hopefully during early 2012.

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

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 a 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

The final summary report on the three-phase hazard analysis covering en-route navigation, WXR approaches and GPS enhanced WXR approaches has been produced and published as CAA Paper 2009/06.

The EU 6th Framework GIANT project work was launched in November 2006 and comprised:

- 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; and
- simulator trials of the 'full' GPS approach at Eurocopter.

All of this work has been completed and the final project report was published in the public domain as CAA Paper 2010/01 in May 2010.

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

- integration of Automatic Identification System (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 batch of flight trials were performed over the weekend of 29/30 January 2011; the CAA were briefed on the results on 7 March. Some refinements to the system have been identified and will be implemented prior to the next set of daylight trials, which are presently scheduled for the weekend of 12/13 November 2011. In addition, some new guidance displays are to be prototyped and reviewed for possible inclusion. Night trials will be considered when a helideck fitted with the new lighting system (see item 4 above) is available in the North Sea.

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.

Presentations on this project have been given by Helios at the 10 June 2008 OGUK 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 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 has been extended to investigate the feasibility of conducting full scale tests on helideck nets.

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, this is only now just starting to be implemented by the helicopter operators, and its value and importance has been emphasised by the findings of a recent 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.

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.

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 anomaly detection 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 received and reviewed and is presently being revised; it 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 was launched in late 2010 and includes significant work on rotor HUMS. All rotor HUMS work to date will be fed into this programme and it is expected to be possible to provide agreed briefings as the work progresses. It is hoped that EASA will also be able to participate.

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

Controlled Flight Into Terrain (CFIT) is a significant cause of aviation accidents. Offshore helicopters are presently equipped with AVAD, but this simple device is ineffective for all accident scenarios apart from a slow, inadvertent descent. Terrain Awareness Warning Systems (TAWS) have been used to address the CFIT problem with some success in fixed-wing operations.

Currently the only Class A Helicopter TAWS (H-TAWS) installed on any helicopters is the Honeywell Enhanced Ground Proximity Warning System (EGPWS) Mk XXII. Unfortunately the Enhanced or Mode has proven not to be very effective for offshore operations, partly due to the need to constantly update the obstacle database to keep track of mobile installations and partly due to the relatively low resolution of the database which has resulted in a large number of nuisance warnings and a move to delete the offshore obstacle database. Due to the absence of any 'terrain' during offshore operations, the Enhanced Mode provides nothing that could not be achieved by modifying the warning envelopes of the Classic Modes and may not represent the best compromise between warning time and nuisance alert rate.

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 accidents and have demonstrated a worthwhile improvement in performance in terms of warning time. An interim report covering all work to date is presently being drafted and will be circulated when completed and agreed.

The contract has been amended to extend the work to cover a second, dissimilar helicopter type, probably the S76. Just over half of the funding for this work has been secured (thanks to Shell Aircraft); work may have to be suspended if confirmation of the remainder is not received in time. The objective of this work is to test the new warning envelopes on aircraft which are expected to exhibit greater variability than the EC225 in terms of their flight paths and, from an EGPWS design perspective, effectively represent the 'worst case'. The next progress meeting has been scheduled for 18 January 2012. This project was proposed by Bristow Helicopters and Shell Aircraft and is being jointly funded by Bristow Helicopters, OGP and Shell Aircraft.

A presentation on the work to date was given to the 28/29 September 2011 OGP Aviation Safety Committee and will be presented at 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 OGUK and CAA Norway.

The programme of work initially contracted has been completed. The results obtained are very promising - the detection rate for the 11 reported (MOR) helicopter lightning strikes for which sufficient data was available was just under 80%. It also correctly detected (time and location) eight of the nine 'natural' lightning strikes that occurred during winter 2010/11. Although further improvements/refinements are possible, the view of the team is that the next sensible step would be to move to an in-service trial, with further work being considered on conclusion of the trial. The final report has been completed and accepted; publication awaits completion of the follow-on in-service trials

Following agreement to fund from Conoco Phillips, Perenco, Apache, Centrica Energy, CAA Norway and BP, the contract was extended to have a trials system in place on OHWeb in time for the start of the 2011/12 lightning season (i.e. by 1 October). This was achieved and the trial is underway. If the trials system performs satisfactorily, it will be left running on OHWeb going forwards, i.e. a permanent fix (or something reasonably close to it) for this problem could be up and running by autumn 2011 and at relatively modest cost.

A presentation on this work was given at the 8 June 2011 OGUK Aviation Symposium.

David Howson
Flight Operations Research Manager
UK CAA
dave.howson@caa.co.uk

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Nomenclature

AAD	Advanced Anomaly Detection
AIS	Automatic Identification System
ASTG	Aviation Safety Technical Group
CAA	Civil Aviation Authority (UK)
CFIT	Controlled Flight Into Terrain
C-NLOPB	Canadian Newfoundland and Labrador Offshore Petroleum Board
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
HADS	Helicopter Air Data System
HCA	Helideck Certification Agency
HLL	Helideck Limitations List
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	Oil & Gas Producers Association
OGUK	Oil & Gas UK
PCF	Potentially Catastrophic Failure
RTVP	Rotorcraft Technology Validation Programme
SBAS	Space-Based Augmentation System
SOAP	SBAS Offshore Approach Procedure
TAWS	Terrain Awareness Warning System
TCAS	Traffic Alert & Collision Avoidance System
TSB	Transport Safety Board
VHM	Vibration Health Monitoring
WSI	Wind Severity Index
	WXR Weather Radar

**PROPOSED HSRMC RESEARCH PROGRAMME –
FUNDING STATUS AS AT 8 NOVEMBER 2011**

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 as a CAA paper.
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.	Some CAA funding available but costs presently unknown.
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) – <ul style="list-style-type: none"> 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; and addition of RNAV guidance to assist shuttling. 	Sufficient funding available for AIS receiver integration and flight demonstration of integration with helideck lighting only.
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.

Item	CAA Project Code	Title	Funding Status
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.	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.
12	-	EGPWS Warning Envelopes.	Remainder of funding required for extension to include a second helicopter type not yet secured.
13	-	Triggered Lightning Strike Forecasting.	Sufficient funding available to complete all work currently identified.