Flight Crew Operating Manuals (FCOM) Development Project Briefing Sheet

HeliOffshore
Safety Through Collaboration

Background and Introduction

There is industry-wide recognition that the sophistication of Automatic Flight Control Systems (AFCS), otherwise commonly referred to as 'Autopilot Systems' (AP), has improved substantially over the last decade. Modern helicopters are equipped with APs that accurately fly the majority of today's flight profiles in VFR and IFR flight environments. As the capability of aircraft equipment improves, biasing towards increased use of automation, so the capabilities of operating crews must also be improved to ensure that their effectiveness remains strong and their resilience enhanced. A sophisticated, but misunderstood AP system - not used as intended - can potentially reduce safety.

The main source of reference used by operators to generate their own standard operating procedures is the Rotorcraft Flight Manual (RFM). The publication of an RFM is a certification requirement and contains information on 'what to do' in terms of managing the helicopter's systems. As part of its overall Safety Strategy, HeliOffshore's Operational Effectiveness workstream is working with OEMs to develop helicopter Flight Crew Operating Manuals (FCOM) – manuals which expand beyond the 'what to do' and explain the 'how to do' elements of operating the helicopter, and in particular, focussing on the management of automation in modern helicopters.

As the FCOM concept is new to the rotary sector, the ***objective of this project is initially limited to offshore oil and gas operations***.

As helicopter operators function globally and can differ in a number of their procedures, the target focus in the FCOM will be those factors common to all operators. Where variance is sought or required, operators should customise their own manuals or procedures based on the information provided in the relevant FCOM.

A number of points should be clearly understood:

(1) OEMs must be allowed to create FCOMs in line with their existing organisational documentation management framework,
(2) OEMs cannot be expected to create FCOMs in isolation – there must be participative input from the operating community, and
(3) FCOMs will be 'live' documents that should be subject to routine review and their development will be iterative in nature, possibly requiring production of several revisions before being considered 'complete'.

This approach underlines the intent that whilst FCOMs are standalone documents, they are the source of key information for operators who may reference them in multiple ways and FCOMs may not necessarily (certainly in their earlier iterations) be adopted wholesale.

This Briefing Sheet lays out the desired scope for an OEM-generated FCOM for offshore helicopter operations. Whilst it is intended to be definitive in nature, the extent of the FCOM project is likely to

develop and may mature which will, in turn and with the agreement of all stakeholders, influence the contents of this document.

This Briefing Sheet is in two main parts:

- **Briefing Sheet: Part 1** covers automation which is the main priority for this project offshore operators due to a lack of information and guidance in current RFMs and associated documentation from OEMs;

- **Briefing Sheet: Part 2** covers the overall format of the FCOM which can follow the production of the automation information. Successful development of Part 2 should give flight crews a holistic document covering all aspects of operating the aircraft safely in an offshore oil and gas role.

Operators currently reference the core Rotorcraft Flight Manual (RFM) and then consult the Supplements to piece together the Normal Operating Procedures (NOPs), Emergency Operating Procedures (EOPs) and Limitations for their aircraft modified by the various equipment installed above the basic fit. It is envisaged that the aeroplane concept of the FCOM being a non-approved document, in a similar manner to Part 2 of the RFM, is a strong potential format to be adopted by the OEM. Part 1 of the RFM will still remain the document required by Part 29.1581 and there is no intention for the OEM to modify that.

It would be appropriate for the FCOM to address an agreed equipment standard, including the aircraft management software standard for both AFCS and FADEC: as a minimum the FCOM should cover an aircraft fitted with anti-icing systems (full and limited), weather radar, TAWS and TCAS I/II, since these systems have the potential to be associated with AFCS automation limitations. As many operators move towards the use of Electronic Flight Bags (EFBs), then the FCOM should ideally be available in an open source, searchable electronic format. Use of hyperlinks should be considered which will take the user from the text being viewed to relevant related information; for example, an EOP might incorporate a link for the user to a detailed description of the system.

Briefing Sheet Part 1: Automation

As discussed above, this element of FCOM should be given the highest priority as misuse and misunderstanding of automation has the potential to lead to accidents and serious incidents in both offshore and onshore operations.

Information on use of Automation information should come from 3 different perspectives as described below:

- **Perspective 1** - Describing the general philosophy of automation design and use on the type in question

- **Perspective 2** – Detailing how the AFCS should be used for optimum effectiveness, including (a) NOPs and (b) EOPs.

- **Perspective 3** – Containing more detailed technical information on automated flight control systems.

Perspective 1 - The general philosophy of Automation on this type

Points expanded in text within this section would include:

- How is the system designed?
- Why was it designed that way?
- How is the system interfaced by the pilot?
- How does the autopilot interface with other aircraft systems?
- How is it envisaged that the crew use the automation, in general terms, including recommendations for the 'best practice' use of automation such as:
    - vertical speed modes
    - altitude capture modes
    - Go-Around mode
    - any deceleration modes
    - any hover or low speed modes
- Issues associated with flying in 'mixed modes' including 3 axis/2Q
- Issues generated as a result of 'flying through' whilst upper modes are engaged.
- Details of any protection modes, warnings or safety systems discretely built into the AFCS.

Perspective 2(a) - Normal Operating Procedures Relating to use of Automation

The content in this section should recognise that several levels of automation are available and details on 'best practice use' of these modes should be expanded for the following phases of flight:

- On ground, including any pre-flight tests required.
- Take-off – onshore (PC1 and PC2) and offshore (PC2)
- Go-around – including how acceleration and climb are scheduled if GA is selected below Vy
- Cruise
- Descent
- Approach including:

- ILS [see example below]
- Onshore non-precision approach, including LOC, VOR, NDB and GPS/GNSS
- The anticipated behaviour of deceleration and automatic level-off modes
- Offshore OSAP/ARA using a combination of basic and upper modes
- Any proprietary approaches for the aircraft type

Example for Cat 1 ILS Approach guidance:

Autopilot Vertical Modes: During the initial approach the crew should use the altitude acquire mode to change levels during a descent in order to minimise the chance of a level bust.

Autopilot Lateral Modes: the arrival, holding and navigation to the Initial Approach Fix should be flown coupled to the FMS. When radar vectors are provided then the Heading mode should be coupled (Heading bug vs FMS Heading function).

Airspeed hold: the airspeed mode should be coupled from 'top of descent'. The ideal target speed envelopes for optimal AP performance throughout the Approach phase is 'xxx-xxx' kts.

RadAlt bugs should be set in accordance with the Company Operations Manual.

The MFDs should be configured to show the following information to ensure optimal operation by the PF and monitoring by the PM:……

On a closing heading to the localiser the ILS should be 'armed'. The glideslope function should only be 'armed' once the aircraft is established on the localiser and cleared for the approach.

At Decision Altitude for landing, the coupled Approach modes should remain engaged/be disengaged at point 'x':

Use of the Deceleration mode will result in the aircraft automatically levelling off at 'xx' ft. Indicated speed be reduced/left at the approach speed until the level off commences, etc.

Go-around: The GA function should be selected in combination with the following modes……

This part of Perspective 2 should also highlight any inappropriate level & combinations of automation – this is linked to the previous point on issues associated with flying in a 'mixed mode' (i.e. AP controlling some or all control channels and pilot controlling the rest manually). A matrix might be an appropriate way to show the recommended mode combination for each phase of flight and may address which modes should be used for Performance Class 1 and Class 2 operations, if the same combination is not valid for both.

If the AP system has Power Limiting, then:

- how is this information displayed to the pilots in terms of visual and aural warnings;
- what are the limiting parameters, (for example, the AP targets altitude at the expense of airspeed until Vy below which it reduces altitude to maintain airspeed);how is automation affected when emergency power or '*blowaway*' modes function?

Perspective 2(b) - Emergency or Autopilot Degraded Procedures Relating to Automation

This section should describe how the AP should be used when related aircraft systems or individual components degrade or fail, recognising that several levels of automation are available; for example, a cyclic pitch trim failure, an engine failure or a RadAlt failure during:

- Take-off
- Climb
- Cruise
- Descent
- Approach:
    - Onshore Non precision approach, including LOC, VOR, NDB and GPS/GNSS
    - Offshore approach (OSAP/ORA)
    - Any proprietary approach modes for the aircraft type
- Go-around

This section should clearly address which protection modes are lost or degraded following a partial degradation or complete failure of the AP and related systems and offer advice on 'best practice' when flying in 'mixed mode' configurations (i.e. 3 axis/2Q). As before, a 'best practice' mode combination matrix in degraded AP configurations may be an appropriate solution here.

Detailed explanation on the implications that a partially degraded system may have on the AP and other aircraft system(s) should be given. For example, a RadAlt fault/failure might have implications for some autopilot upper modes, but it may also have implications for TAWS and TCAS.

For aircraft equipped with an OEI Training Mode, what is the information 'sensed' by FADEC and how does it differ from what the avionics and crew 'sees'. If a Power Limiting case is reached during training, does the system revert to AEO, and if so, what are the protections built in, how is recovery to AEO achieved and what can the pilot anticipate in terms of information displayed in the cockpit?

Perspective 3 – Expanded and detailed technical information

This section would aim to provide detailed information on how systems work (expanding on the information currently provided in RFM Part 2 Section 1). It would primarily be aimed at trainers and technical pilots whose roles require this additional level of knowledge, but may also be of general interest to Line pilots. Of particular interest will be more detail on:

- Limitations on performance of the system, for example with Go-around coupled the system is limited to trimming at 'x' degrees/second.
- Protection modes – how do they work?
- What are the triggers resulting in one mode changing to another – for example, '*Decel*' mode to RA hold on an ILS, or the 'level off' function following an altitude change
- Interface with other aircraft systems.

A lot of this information may already exist in training material and maintenance manuals. The aim is to bring it into one place where pilots can access it from a single source.

Briefing Sheet Part 2: FCOM Format and Layout

Recall that the primary aim of the FCOM project is to complete Part 1 by generating reference material around how to use automation, so exploration of Part 2 – defining a layout for individual FCOMs – whilst necessary and if equal importance, should not detract from the objective of Part 1.

OEMs will determine how the FCOM complements the suite of existing documentation issued to operators. The overall layout of the FCOM could take one of several forms and the decision on how to format an FCOM should rest with the OEM, remembering the overall objective: to provide a single source reference on optimal use of automated functions of the AFCS to minimise Loss of Control events.

An FCOM structure may follow the general layout of the RFM, bearing in mind that crews will probably actively reference an FCOM more frequently than an RFM. Although a lot of the text from the RFM may ultimately be repeated in the FCOM, it would give the user a single source reference for their configured aircraft. It would generally be acceptable for the OEM to "copy and paste" text from the current RFM Part 1 and 2 into relevant sections of the FCOM, should the layout of the FCOM lead to an overlap of material already contained in the RFM, although the general principle of minimising the duplication of text in multiple documents is recognised.

An FCOM may, therefore, be sectioned as outlined below:

Section 1 – Limitations.

This section should cover the aircraft limitations specifically for aircraft with offshore equipment fitted, not the baseline aircraft. All Limitations, Cautions and Warnings from the relevant RFM Supplements relating to offshore-equipped helicopters should be displayed in this section.

Section 2 – Normal Procedures

This section would include an enhanced version of previously published Normal Operating Procedures (NOPs) incorporating the relevant use of automation in prescribed procedures, as appropriate.

Section 3 – Emergency Procedures

This section would include an enhanced version of previously published Emergency Operating Procedures (EOPs) incorporating the relevant use of automation in prescribed procedures, as appropriate.

Section 4 – Aircraft Systems

This section should contain detailed technical information on the aircraft systems. It is envisaged that an electronic form of the FCOM will make use of hyperlinks to allow the user to link from the overall description into deeper technical explanations, or links to relevant NOPs and EOPs.

The FCOM need not contain NOPs relating to operational phases not connected with AP usage (eg pre-flight inspection, start-up and taxi procedures), mass and balance data, or a copy of the (M)MEL; these items will remain operator specific and should be covered in the operators' Operations Manuals.

In summary, the FCOM will never fully replace either RFM or various forms of Operations Manuals, but will ultimately be presented as a document that can be referenced from either RFM or Operations Manual and can be used directly by crews in daily operations, where appropriate.

Think:

RFM = What to do

FCOM = How to do it!

For further information, please email info@helioffshore.org