

HEDGE – SOAP IFPP Paper

1 Introduction

The purpose of this paper is to provide the IFPP with information about the development of the helicopter specific SBAS Offshore Approach Procedure (SOAP) that have been flight trialled within the context of the HEDGE project.¹

The SOAP procedure has been devised to remove some of the hazards associated with current operations dependent upon the Airborne Radar Approach (ARA) procedure which is based upon flight crew interpreting weather radar returns to identify the destination facility in low visibility conditions. The SOAP procedure has been flight trialled and demonstrated within the North Sea oil fields.

SOAP as a new development does not have any design or obstacle assessment criteria associated with it. The IFPP is invited to determine whether such criteria are required and should be included within PANS-OPS.

2 Operational environment

The environment in which ARA procedures are currently used and for which SOAP is proposed is hostile compared to standard fixed wing operations. Typically the helicopters are operating in an obstacle strewn environment between different oil facilities that include fixed and mobile platforms and drilling ships.

Communication to ATC may be poor or non-existent and operations are typically beyond radar coverage. The approach procedures require approaches to facilities at heights above the surface of no lower than 250ft.

Preferential approach tracks to may be obstructed by supply ships in the vicinity that can be obscured from view in the low visibility operation.

3 ARA

The ARA procedure has been in use by helicopter pilots flying to oil fields since the early 1980s. The basis for the certification of weather radars has been on the requirements of FAA TSO-C63b² and TSO-C63c³. The use of weather radar to

¹ HELicopters Deploy GNSS in Europe (HEDGE) is a project commissioned by the European GNSS Supervisory Authority (GSA) and part-funded under the EU's Seventh Framework Programme (FP7). See <http://hedge.askhelios.com/>.

The aim of the project is to develop and demonstrate new helicopter approach procedures as well as other EGNOS applications for general aviation. The initiative builds on the outcomes of the GIANT project (Framework Programme 6). Most activities within HEDGE are directed towards helicopters, but the project also covers fixed-wing activities.

² Airborne Weather Radar Equipment

³ Airborne Weather and Ground Mapping Pulsed Radars

support the ARA approach was then approved with the publication of FAA TSO-C102⁴ on 2 April 1984.

The definition of ARA was eventually incorporated within the Joint Aviation Authorities' JAR-OPS 3.

Although some variations between operators exist as approved by national civil aviation authorities, the principle of the ARA remains the same and may be described as follows:

- The final approach track should be identified first and orientated substantially into the wind. The installation wind is passed to the helicopter by the installation radio operator.
- Vertical separation from obstacles is applied during the arrival, initial and intermediate segments, while horizontal separation is applied in the final and missed approach segments.
- The approach is usually flown with the weather radar in map mode.
- The maximum wind speed or relative wind directions for which the procedure is safe are not specified within current regulations.

The typical ARA approach is illustrated in the Appendix A.

4 SOAP

The SOAP procedure was developed to address some of the limitations of the ARA procedure and to take advantage of the RNAV capabilities that have been developed since. Vertical guidance is also provided to the flight crew by designing the procedure on SBAS. The procedure is constructed to provide an offset "straight-in" guidance enabling the helicopter to maintain a constant MDH prior to the MAP. The procedure and its component waypoints are calculated within the helicopter avionics to ensure that the selected approach direction can be flight crew selectable based on wind conditions at the time. This provides flexibility in approach whilst maintaining minimum separation from the facility.

The key SOAP procedure advantages over the ARA procedure are:

- Less reliance on the weather radar, which is not designed for final approach operations.
- Use of SBAS gives high navigation accuracy, not possible with the weather approach. The aircraft is delivered to a more accurate, repeatable location at the MAP.
- New approach allows a "straight line" procedure from final to missed approach. No need to fly at the rig and turn away.
- Positive guidance from SBAS signal gives much lower crew workload.
- SBAS vertical guidance is used and provides a cross-check against the existing altimeter source.

Unlike the ARA procedure, where the flight crew fly directly towards the facility until the radar return indicates a distance of 0.75nm, the guidance on the SOAP

⁴ Airborne Radar Approach and Beacon Systems for Helicopters

procedure is independent of the weather radar. This allows the weather radar and other on board equipment to be used for cross-check purposes removing sole dependency in the flight deck. The application of SBAS vertical and lateral guidance facilitates increased confidence in the procedure. Although in some situations flight crew workload may be increased, the situational awareness of the flight crew with respect to own ship position relative to the rig and height above the sea surface is improved.

A more complete description of SOAP is provided in Appendix B.

5 Concept validation

As part of the GSA funded HEDGE (Helicopters Deploy GNSS in Europe) project, the SOAP procedure has been trialled on an experimental avionics package that consisted of SBAS avionics, a flexible customisable cockpit display, interfaces to the aircraft systems and a control and data logging PC.

Validating flight trials have been completed on helicopters to an oil platform in the North Sea. It generated high quality SBAS enabled approach guidance to the offshore platforms displaying it to the flight crew through bespoke primary flight and navigation displays developed through consultation with active line pilots operating in the offshore environment. To increase situational awareness and safety on the approach, the flight crew were also provided with information about ship positions in the vicinity, including alerts for potential conflicts with the flight path through an integrated maritime AIS receiver.

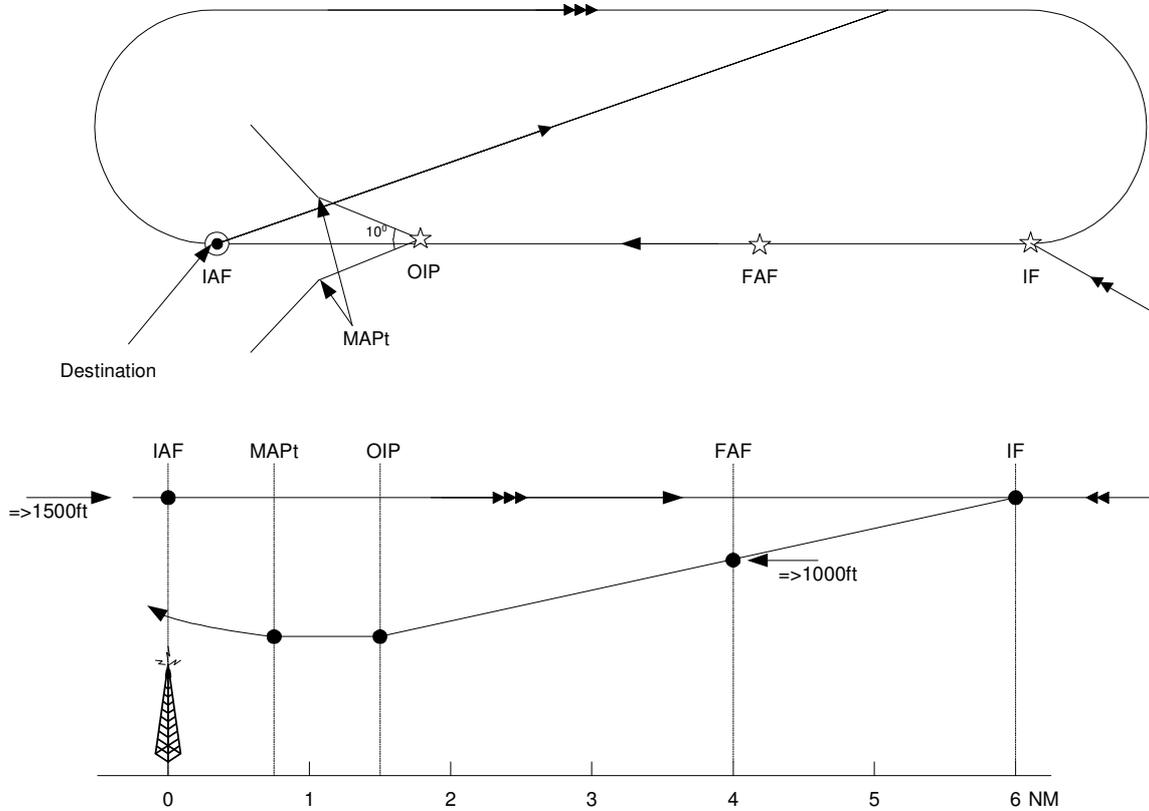
Initial commentary and pilot questionnaires have validated the assertion that guidance provided by SOAP is more precise than an ARA and the design limits are comfortable for passengers and flight crew alike.

6 Conclusions

The flight trials undertaken within HEDGE have demonstrated the viability of the procedure and support amongst helicopter operators. Given that the procedure design procedure will be encoded into the helicopter avionics and that operations are conducted in an environment in which the traditional obstacle is the landing zone, this paper invites the IFPP to determine whether additional obstacle and procedure design criteria should be applied with the context of PANS-OPS.

A Illustration of the ARA procedure

The orientation of the typical ARA approach is illustrated in the following plan and vertical views.



B Description and illustration of the SOAP procedure

B.1 General

The SOAP approach is definable from any direction and should be automatically generated based on an input of the target location and pilot selected final approach track. In cases where for example air traffic needs to be predictable, the approach direction(s) will be fixed and pre-published.

The approach will take the aircraft past the rig at the approved lateral separation without any turn or change of course.

The approach will be flown "straight in", with no course reversal, race track or arc procedure required.

The minimum lateral separation will be 0.25NM. Separation is defined as the distance from the approach track to the nearest part of the platform structure.

It consists of four segments, each of which is described separately below.

During the en-route phase the crew will enter the data required by the system to generate the approach, if required.

B.2 Arrival Segment

The Arrival Segment commences at the last en-route navigation fix and ends at the Initial Approach Fix (IAF).

During the Arrival Segment, the aircraft descends to 1500ft, the Minimum Safe Altitude (MSA), as indicated by the baro-altimeter, and prepares for the approach.

Standard en-route obstacle clearance criteria should be applied to the Arrival Segment.

B.3 Initial Approach Segment

The Initial Approach Segment commences at the IAF, and ends at the Final Approach Fix (FAF). The FAF is at a distance from the Missed Approach Point (MAP) which varies depending on the length of the descent segment.

The Initial Approach Segment should not be less than 2NM in length.

The Initial Approach Segment is flown at a constant altitude of 1500ft, the MSA as indicated by baro-altimeter set at the QNH.

The purpose of the Initial Approach Segment is to align and prepare the helicopter for the Final Approach. During the Initial Approach Segment, the aircraft should finalise its heading and decelerate to the final approach speed. The Final Approach airspeed should be between 60 and 80kts IAS.

The destination should be identified on the weather radar, and the Final Approach and Missed Approach areas generated by the system should be identified and verified to be clear of radar returns.

B.4 Final Approach Segment

The Final Approach Segment commences at the FAF. The Final Approach Segment ends at the MAP.

The Final Approach Segment consists of two parts: the descent segment and the level segment.

The Final Approach Segment will be protected against charted (fixed) obstacles by sloped Obstacle Assessment Surfaces (OAS) as for APV approaches.

B.4.1 Descent Segment

At the FAF, the aircraft enters the descent segment and begins to descend at a constant airspeed and a fixed descent angle of 4° until it reaches the Minimum Descent Height (MDH). A steeper descent angle of 6° may be used (e.g. to avoid obstacles) if the descent is flown at a groundspeed of 60kts.

At this stage vertical separation from the offshore fixed charted obstacle environment is maintained by the use of the OAS. Within the final approach area, the MDH will provide separation from the sea.

The MDH is defined as being the height of the helideck plus 50ft, with a minimum value of 200ft during daylight or 300ft during darkness, as indicated by the radar altimeter.

The length of the descent segment, and thus the distance from the FAF to the MAP, varies depending on the MDH.

Vertical guidance on the slope will be provided by EGNOS but with the radar altimeter and AVAD system providing an independent 'safety net'. As the aircraft approaches the MDH it starts to level off. Fairing of the level off will prevent an undershoot of the MDH.

Lateral guidance on the slope will be provided by EGNOS.

Vertical guidance sensitivity on the slope will be angular, with the glide-path originating from a point 200ft below the MDH, to give a constant vertical sensitivity at the level off point, and an angular splay of the Glide Path Angle over 4 (GPA/4) (see Figure 1 3). This point will move as the MDH of different rigs varies.

Lateral guidance sensitivity on the slope will be angular, focussed on a point on the approach heading 10,000ft beyond the rig, the lateral sensitivity focus, and an angular splay of 2° (see Figure 1 2).

B.4.2 Level Segment

The altitude of the level segment is the MDH. Both Lateral and Vertical guidance are provided by EGNOS.

Vertical guidance sensitivity on the level segment will be linear, fixed at the value at the level off point.

Lateral guidance on the level segment will have the same angular sensitivity as the slope, up to the point abeam of the rig, beyond which the scaling will be linear, fixed at a value of +/- 0.3NM (see Figure 1 2).

During the level segment, the crew will attempt to make visual contact with the rig. Once visual contact is made, a visual landing on the helideck is made.

If visual contact has not been made by the MAP, a go-around will be initiated.

The MAP is defined as the closest point to the rig from which it is safe to make a decision to land, and thus the distance from the MAP to the rig is the Minimum

Decision Range (MDR). Under normal circumstances the MDR will be 0.75NM, and the maximum groundspeed at the MAP will be 80kts. However the MDR may be shortened to 0.5NM (e.g. to avoid obstacles) if the groundspeed at the MAP is 60kts.

To achieve 60kts groundspeed at the MAP, decelerating from 80kts to 60kts along the level segment is possible provided all AFCS (Advanced Flight Control System) modes are available. In the case of AFCS degradation or limited AFCS functionality, the entire approach must be flown at 60kts groundspeed in order to use a 0.5NM MDR.

The angle between the approach track and the direction of the rig at the MAP is the maximum offset angle, 30°.

The length of the level segment is fixed at 0.75 NM regardless of the MDH.

B.5 Missed Approach Segment

The Missed Approach segment commences at the MAP and ends when the helicopter reaches MSA.

If visual contact is not made with the rig by the MAP, then a missed approach is initiated. A missed approach will also be initiated if any fault is detected with the approach guidance system.

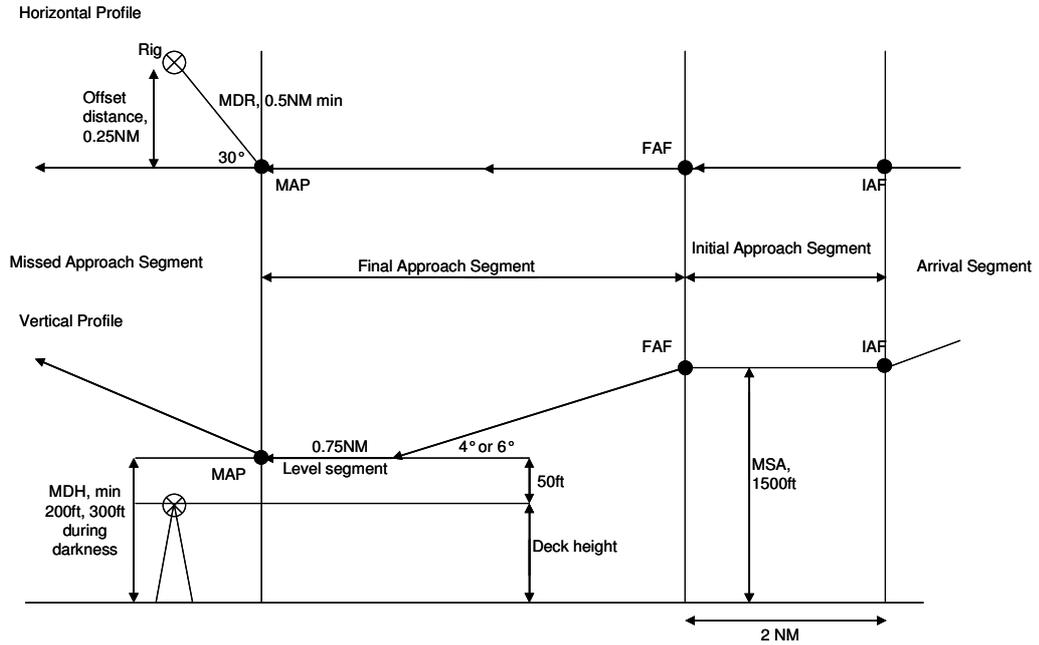
The missed approach manoeuvre is a “straight ahead, ‘wings level’ climb”. When a missed approach is initiated, the aircraft should climb at the steepest safe angle until it is above the MSA.

The missed approach area to be used should be identified and verified as a clear area on the radar screen during the Initial Approach segment.

The angular lateral guidance sensitivity of the Final Approach segment will continue to be used beyond the MAP until the point abeam of the rig, after which linear lateral guidance sensitivity will be used until the aircraft passes above the MSA.

B.6 Approach illustration

The typical SOAP approach is illustrated in the following plan and vertical views.



The lateral and vertical guidance provided to the flight crew is illustrated below.

