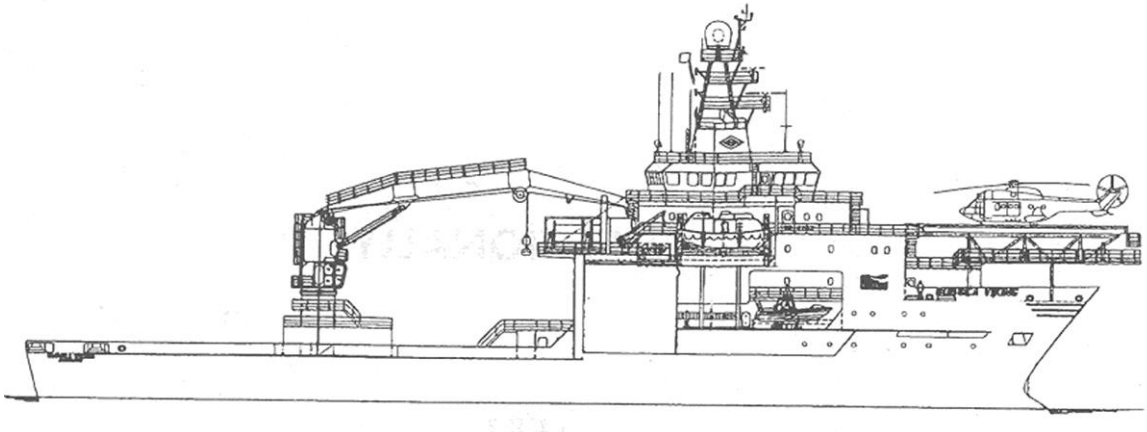
# Standard Measuring Equipment
## for
# Helideck Monitoring Systems (HMS)
## and
# Weather Data

## (Bristow Group, CHC, Offshore Helicopter Services, NHV, HCA, UK CAA)



**Contents**

## 1 Purpose and Intentions

The purpose of this document is to ensure adequacy and uniformity of readings/registration of helideck movement and weather conditions.

This standard represents an agreement between Bristow Group, CHC, Offshore Helicopter Services, NHV, the Helideck Certification Agency (HCA) and the UK Civil Aviation Authority (CAA) and shall apply to all moving helidecks operating in European waters.

Further intentions are to establish National and International standards based on the contents of this document.

## 2 Principles

Basic reference is made to:

- UK standards for offshore helicopter landing areas published in CAP 437.
- Norwegian Requirements published in BSL D 5-1.8.2.

The HMS shall accurately process and integrate information from sensors for helideck movement, wind and other meteorological data, which shall be located in optimum positions in order to provide the required information relating to the helideck.

The measuring equipment shall provide sufficient information to the operator to complete all applicable weather sections of the standard offshore weather/helideck report, provided to helicopter operators.

All information shall be numerically displayed in relevant locations on the vessel or installation for easy communication with helicopters in flight and the helicopter land operating base. The system shall facilitate transmittal of electronic data to the helicopter land base.

## 3 Definitions

**Moving Helideck:**

a helideck mounted on a floating installation such as a Vessel, Floating Production Unit, Semi-Submersible Rig or floating Jack Up Rig; other helidecks shall be considered to be ‘moving’ if the pitch or roll exceeds 1 degree either side of the vertical or if the vertical movement of the helideck exceeds 0.4 metres/second.

**Helideck Pitch:**

is the angle between the absolute horizon and the plane of the helideck measured along the longitudinal axis of the installation.

**Helideck Roll:**

is the angle between the absolute horizon and the plane of the helideck measured along the lateral axis of the installation.

**Helideck Inclination:**

is the largest angle between the absolute horizon and the plane of the helideck.

**Significant Heave Rate (SHR):**

is the average of the one-third highest values of instantaneous heave rate recorded during the previous 20-minute monitoring period. This can more conveniently be calculated by:

Significant Heave Rate m/sec = 2 x RMS (Root Mean Square) of the instantaneous heave rate.

The RMS heave rate is given by:

$$RMS_{hr} := \sqrt{\frac{1}{20min}\left(\int_{t-20min}^{t} hr(t)^2\,dt\right)}$$

where: hr is the instantaneous heave rate in metres per second

**Measure of Motion Severity (MMS):**

is the instantaneous value of the ratio of the total acceleration (i.e. including gravity) in the plane of the helideck divided by the component of the total acceleration normal to the helideck.

**Motion Severity Index (MSI):**

is the maximum value of MMS measured during the previous 20 minutes, converted to the form of a dynamic helideck slope in degrees, and then multiplied by 10 and rounded to the nearest whole number.

**Wind Severity Index (WSI):**

is the 10-minute mean free stream wind speed, corrected to a height of 10 metres above the helideck surface.

**Relative Wind Direction (RWD):**

is the 2-minute mean free stream wind direction relative to the longitudinal axis of a helicopter landed on the helideck.

## 4 Measurements

### 4.1 General

**Accuracy of measurements:**

The monitoring system (including related sensors) shall be checked and verified for accuracy and correct operation in accordance with the manufacturer's procedures

following installation - see Section 8.3. A verification report shall be provided to both the owner of the installation, the helicopter operator(s) and the Helideck Certification Agency.

The accuracy of the system shall be checked and verified whenever deemed necessary, as required by the manufacturer's procedures or every 2 years, whichever the sooner. A verification report shall be issued and distributed after each periodic control.

The accuracy of the data produced by the Helideck Monitoring System shall be:

- Pitch / Roll / Inclination: <± 0.1° RMS (Root Mean Square) in the range 0 to 3.5°.
- Heave Rate: < ± 0.1 m/s RMS (Root Mean Square) in the range 0 to 1.3 m/s.
- Helideck Accelerations (MSI): < ± 0.01 $m/s^2$ RMS (Root Mean Square) in the range 0 to 0.2 $m/s^2$.
- HMS Wind Speed: Under 10 kts: +/-1kt, over 10kts: 10%.
- HMS Wind direction (relative to magnetic North) overall accuracy of better than +/-10deg for wind speeds over 2kts. This will depend not only on the measurement accuracy of the wind sensor, but also on the accuracy of the orientation of the wind sensor relative to the vessel, and the accuracy of the vessel heading measurement relative to magnetic North.

*NOTE 1: For the purposes of calculating the MMS, the accelerometer package/motion reference unit (MRU) need not be exactly aligned with the vessel's longitudinal (x) and lateral (y) axes; this is because the signals from these components are combined into a single resultant acceleration in the plane of the helideck. However, it is important that the vertical acceleration is measured in the direction normal to the helideck, and that the alignment is as close as possible. The sign of the axes chosen (whether z is positive downwards or upwards) is not important since the absolute value is used in the calculation of the MMS.*

*NOTE 2: The MRU should be mounted on the helideck support structure. In addition:*

*a) If mounted within a hemisphere under the helideck of radius 4.0 meters centred at the centre of the yellow Touchdown/Positioning Marking circle, lever arm corrections will not be required and the accuracy of the MRU will be considered to be sufficient if it meets the requirements stated above.*

*b) If mounted outside of the hemisphere described in a) above:*
   - *lever arm corrections should be applied and the accuracy of the MRU increased appropriately, or*
   - *the MRU should be mounted at a location further from the pitch and roll axes of the vessel than the centre of the yellow TDPM circle (see figures below) and vertically within 3.0 metres of the surface of the helideck.*

*If the above criteria are not met, a sea trial shall be conducted to confirm that the MRU installation meets the specified accuracy by comparison with a*

*reference MRU located on the surface of the helideck at the centre of the yellow Touchdown/ Positioning Marking circle.*



The accuracy concerning meteorological data shall be in compliance with CAP 437 Standards for offshore helicopter landing areas published by the UK Civil Aviation Authority or equivalent national standards where applicable.

**Sample Rates:**

Sample rates shall be appropriate for capturing the phenomena being measured. For example, helideck motion parameters shall be sampled at a minimum of 2 Hz in order to capture the vessel pitch and roll motion periods (typically of the order of 5 to 15 seconds). Wind shall be sampled in accordance with CAP 437 Appendix E, i.e. at 4 Hz.

**Update Rate:**

The minimum update rate for all parameters presented on the HMS display shall be at least 0.1Hz (i.e. once every 10 seconds). For the avoidance of doubt, this means that new, up to date/time values for each parameter on the display must be measured and/or calculated at least once every 10 seconds.

*NOTE: If parameters are updated at a faster rate, the display may 'coast' using the last valid sample until the next 10-second update is due.*

**Helicopter Effects:**

The helicopter may generate noise in the helideck acceleration data measured by the MRU when the helicopter touches down. Where this occurs, it is recommended that MSI alerts be delayed by 30 seconds to ensure that they are not triggered by the helicopter while a landing is in progress.

*NOTE: If required, the delay shall be applied to the landing status indication on the HMS pre-landing display and the HMS repeater lights only. All other data/information shall be displayed normally.*

The helicopter will also generate vibration while landed on the helideck with the rotors running. This may generate an unwanted MSI alert but this is not considered to

be significant and will not be displayed as the HMS will be in on-deck mode during this period.

The rotor wash from the helicopter while landed on the helideck may affect the measurements provided by anemometers mounted close to the helideck. It is important that any such measurements are not used by the HMS for the relative wind monitoring (RWD) functionality.

### 4.2 Helideck Motion Parameters

**General:**

Displays of the relevant values (see below) of all motion parameters relating to the last 20 minutes shall be provided. These shall be derived from a moving 20-minute sampling ‘window’. In addition, graphical presentations of the displayed data covering the last 3 hours of these data shall be provided to assist the determination of trends. Displayed values shall be used for comparison with the helicopter landing limits detailed in Section 7, and shall be rounded as described below, consistent with their expected accuracy.

**Helideck Pitch:**

The equipment shall be capable of measuring helideck pitch in degrees up and down from zero, with zero being the absolute horizontal level. In maritime terms maximum pitch consists of trim + pitch. The values to be displayed and reported are the maximum pitch up and maximum pitch down occurring during the previous 20-minute period, rounded to one decimal point.

**Helideck Roll:**

The equipment shall be capable of measuring helideck roll in degrees left/port and right/starboard, with zero being the absolute horizontal level. In maritime terms maximum roll consists of list + roll. The values to be displayed and reported are the maximum roll left/port and maximum roll right/starboard occurring during the previous 20-minute period, rounded to one decimal point.

**Maximum Helideck Inclination:**

The equipment shall be capable of measuring the maximum helideck inclination in degrees to the absolute horizon. The value to be displayed and reported is the maximum occurring during the previous 20-minute period, rounded to one decimal point.

**Significant Heave Rate (SHR):**

The equipment shall be capable of measuring the rate of vertical movement of the helideck in metres per second. The value to be displayed and reported is 2 x the RMS of the instantaneous heave rate measured during the previous 20 minutes, rounded up to one decimal place.

In order to avoid frequent changes when the SHR is close to the limit, the helideck landing status (see Section 5.1c)) in terms of SHR shall be determined as follows:

*NOTE: The values of SHR used for determining helideck landing status shall be the displayed values, i.e. rounded up to one decimal place.*

- The helideck landing status (based on SHR) becomes red if:
  - the SHR is greater than the heave rate limit, and
  - all of the SHR records in the previous 2 minutes are also greater than the heave rate limit (or equivalently, the minimum SHR in the previous 2 minutes is greater than the limit).
- Once the helideck landing status is red, it becomes blue again only if:
  - the SHR is less than or equal to the heave rate limit, and
  - all of the SHR records in the previous 10 minutes are less than or equal to the heave rate limit (or equivalently, the maximum SHR in the previous 10 minutes is less than or equal to the limit).

**Measure of Motion Severity (MMS):**

The equipment shall be capable of measuring the instantaneous accelerations (total, i.e. gravitational and inertial) in the plane of the helideck and normal to the surface of the helideck. The equipment shall calculate the MMS from these measurements using the following formula:

$$MMS = \frac{\sqrt{a_x^2 + a_y^2}}{|a_z|}$$

where: $a_x$ is the total surge acceleration, in the plane of the helideck
$a_y$ is the total sway acceleration, in the plane of the helideck
$a_z$ is the total acceleration normal to the helideck

**Motion Severity Index (MSI):**

The equipment shall be capable of calculating the MSI. The MSI is defined as the maximum value of MMS occurring during the previous 20 minutes.

For display and reporting purposes, for the calculation of the MSI the MMS is to be converted to the form of a dynamic helideck slope in degrees, and then multiplied by 10 and rounded to the nearest whole number to avoid confusion with pitch, roll and inclination values. Hence:

$$\mathrm{MMS_{MSI}} = 10 \cdot \tan^{-1}\left(\mathrm{MMS_{meas}}\right)$$

*NOTE: $\tan^{-1}$ expressed in degrees, not radians.*

and:

$$\mathrm{MSI} = \mathrm{MMS_{MSImax}}\left(\mathrm{t} - 20\mathrm{min}, \mathrm{t}\right) \cdot \mathrm{R}$$

*NOTE: 'R' is a constant ≥ 1. It has been determined that this shall initially be set to R = 1, however it is recommended that systems incorporate a facility to enable authorised persons to update the value of R.*

### 4.3 HMS Wind Data

**General:**

Wind data presented on the HMS sections of both the pre-landing and on-deck displays shall be 'apparent' wind, i.e. the wind shall not be corrected for vessel speed and course.

HMS wind data shall be scaled to a height of 10m above the helideck surface using a power law approximation of a marine atmospheric boundary layer as follows:

$$U_{corr} = U_{meas} \cdot \left( \frac{H_d + 10m}{H_{meas}} \right)^{0.13}$$

where: $H_d$ is the helideck height in metres
$U_{meas}$ corresponds to the measured wind speed at a height $H_{meas}$ in metres

Where the primary anemometer may be obstructed for some wind directions, a second anemometer shall be installed that is unobstructed for those wind directions. The HMS shall automatically switch between the anemometers according to the prevailing wind direction.

With the introduction of the relative wind monitoring function, the anemometer used as the source for HMS wind data shall either be located away from the helideck (where it would likely be affected by rotor down wash), or the HMS shall switch to such an anemometer before the helicopter touches down. In case of lack of a suitable location (e.g. on small vessels), consideration should be given to employing a laser anemometer.

*NOTE: The most appropriate anemometer switching logic can vary depending on the number and location of the anemometers available, and the topsides of the vessel. Each vessel should therefore be assessed individually to determine the optimum solution and whether an additional anemometer is required.*

**HMS Wind Speed:**

Wind speed shall be displayed and reported in knots, rounded to the nearest whole number. Displayed wind speed shall be configurable to show either the 2-minute mean wind speed with gusts, or 10-minute mean wind speed with gusts. Gusts shall be calculated and displayed as the maximum of the 3 second averages of the wind speed (2min or 10min) samples.

**Wind Severity Index (WSI):**

The equipment shall be capable of calculating the WSI. The WSI is defined as the 10-minute mean 'apparent' wind speed measured in knots.

$$\mathrm{WSI}_{(\mathrm{t})} = \mathrm{mean}_{(\mathrm{t}-10\mathrm{mins})}\mathrm{U}_{\mathrm{corr}}$$

To avoid confusion between the WSI and the wind speed used by helicopter pilots (which includes gusts), the WSI shall be displayed as a percentage of the maximum limiting $WSI_{max}$ (i.e. the value of the WSI where the limit line intersects the axis at MSI=0) for the helicopter type selected. Hence:

$$\text{Displayed WSI}\,(\%) = \frac{\mathrm{WSI}_{(\mathrm{t})}}{\mathrm{WSI}_{(\mathrm{max})}} \cdot 100\%$$

and this shall be rounded to the nearest whole number.

*NOTE: The maximum limiting $WSI_{max}$ for the generic MSI/WSI limit is 43kts.*

**HMS Wind Direction:**

Wind direction shall be reported in degrees relative to magnetic North (from, as a three-digit number, North = 360). Displayed wind direction shall have the options to show the 2-minute mean wind direction and 10-minute mean wind direction. Where conversion from true to magnetic North is required, the angle of declination shall be automatically calculated and applied by the HMS.

**Relative Wind Direction (RWD):**

The equipment shall be capable of calculating the RWD for presentation on the 'On-Deck' display on entry of the helicopter's heading following touchdown.

The RWD shall be calculated from the instantaneous vessel heading, the helicopter heading immediately after touchdown (communicated by the pilot to the Radio Operator), and the 2-minute mean 'apparent' wind direction; all of these input parameters shall be referenced to magnetic North as a three-digit number, North = 360.

*NOTE: Vessel and helicopter headings are TO and wind direction is FROM.*
*The RWD is an angle difference, not a 360deg bearing, and therefore shall be calculated as +/-180deg relative to zero. It shall be displayed as an integer (i.e. rounded to the nearest degree) and with the direction represented by the sign, i.e. "Right" (positive) or "Left" (negative).*

**Marked Discontinuity (MD):**

With reference to CAP 746 para. 4.9 the marked discontinuity scheme shall be applied to the wind data displayed in the compass rose parts of the HMS display, with the display indicating the wind data being presented, i.e. 2-minute data or 10-minute data. It shall not be applied to the WSI which shall always be based on the 10-minute wind.

### 4.4 Meteorological Information

Meteorological information reporting functionality integrated with the HMS shall be in compliance with CAP 437 Standards for offshore helicopter landing areas published by the UK Civil Aviation Authority or equivalent national standards.

*NOTE: The wind speed and direction information presented on the HMS section of the pre-landing and on-deck displays is not intended for meteorological information reporting. CAP 437 offshore weather reporting meteorological information shall be grouped in a dedicated area of the display screens as shown in the examples in Section 5.*

### 4.5 Heading, Course and Speed of Helideck/Vessel

The heading and course of the helideck/vessel shall be stated in degrees relative to magnetic North as a three-digit number, using the same convention as for the helicopter heading. The speed of the helideck/vessel shall be stated in knots, rounded to the nearest whole number. Where conversion from true to magnetic North is required, the angle of declination shall be automatically calculated and applied by the HMS.

## 5 Displays and Indicators

These requirements define the information and selections that must be presented to the user via the displays. Although there is no reason to adopt any particular style or layout for the display, there are advantages to maintaining as much standardisation as possible between systems produced by different suppliers. It is therefore strongly recommended that the displays presented in this specification be followed as closely as possible unless there are compelling reasons to do otherwise.

Since the HMS operates in two distinct modes, ‘pre-landing’ and ‘on-deck’, two separate displays are required. The ‘on-deck’ mode is activated by entry of the helicopter heading (reported by the pilot) after touchdown; the system reverts to ‘pre-landing’ mode by operation of a ‘helicopter departed’ switch. It is recommended that the example displays below are followed in terms of layout, grouping of information, labelling, colour and presentation of numerical and graphical information.

### 5.1 Specific Design Requirements for the ‘Pre-Landing’ Mode Display(s)

The figures at the end of this section present the preferred displays for the system in ‘pre-landing’ mode. The information presented on this display shall be updated at least at 10-second intervals.

a) Vessel name, location coordinates, and Helideck Category (consistent with the helideck’s certification, as discussed later in Section 6.1) shall be displayed at the top of the display. Date and time (UTC in ISO 8601 format), and software version and helicopter landing limits designation and corresponding Helideck Limitations List Part C version (see Section 7) shall also be clearly displayed together with a timestamp for the last display update (UTC in ISO 8601 format) to assure the user that the display has not ‘frozen’.

b) User ‘inputs’ to be grouped and positioned prominently towards the top of the display shall include: Helicopter Type and/or Category, Day/Night display (NB: this ‘input’ is automatically set), Helideck Category. ‘Drop-down’ selection boxes are the preferred method for these data inputs. The helicopter type shall default to Category A at system start-up, on return from the on-deck mode to the pre landing mode or at any other time no helicopter type has been selected. Day/Night status shall be automatically set. The user input fields shall not be used for displaying anything other than input data except where detailed above.

*NOTE 1: Helicopter Type (and Category if desired) shall be displayed where a helicopter type has been selected. “Category A” shall be displayed when no helicopter type has been selected.*

*NOTE 2: In ICAO, "night" is defined as the hours between the end of evening civil twilight and the beginning of morning civil twilight or such other period between sunset and sunrise as may be prescribed by the appropriate authority. Civil twilight ends in the evening when the centre of the sun’s disc is 6 degrees below the horizon and begins in the morning when the centre of the sun’s disc is 6 degrees below the horizon. In mid latitudes, this civil twilight period is 30 to 45 minutes. For UK operations “night”, as defined in the Air Navigation Order 2016, means the time from half an hour after sunset until half an hour before sunrise (both times inclusive), sunset and sunrise being determined at surface level.*

*NOTE 3: In the event of GPS input failure or any other condition preventing the automatic setting of day/night, the HMS shall default to “night”.*

c) The Helideck Landing Status is the overarching parameter governing the pilot’s ‘land/do not land’ decision. It shall be presented at the top of the display as a ‘traffic light’ with red, amber and blue lights from top to bottom. The Helideck Landing Status will also be relayed to physical repeater lights on the helideck (see Section 5.3 below).

The Helideck Landing Status is defined as follows:

- Blue status (steady burning): safe to land based on pitch/roll/’processed’ SHR/inclination and MSI/WSI limits.
- Amber status (steady burning): MSI/WSI limit only exceedance (consider using modified operating procedures).
- Red status (steady burning): do not land (pitch, roll, ’processed’ SHR or inclination out of limits).

*NOTE: Amber MSI/WSI limit exceedances alert the flight and helideck crew to the potentially marginal helideck motion conditions and the need to consider mitigating action – see Appendix A2. Operations may only be lost during Amber Status if the flight and/or helideck crew are unable to take mitigating action or do not judge the mitigating actions to be sufficient for the prevailing conditions.*

d) The historical trend of the helideck landing status shall be available for selection when required and shall provide a graphical representation of the status clearly on a horizontal scale of time for the last 20 minutes (or 3 hours, consistent with the current requirements for the graphical representation of

displayed Pitch/Roll/Heave Rate and Inclination historical trends). When selected, the trend graph shall be positioned close to the landing status ‘traffic light’.

e) An MSI/WSI graph is required. It shall display the limit lines and the extent of the amber zone and shall show the trend of values in the previous 20mins (or 3 hours). The numerical MSI and WSI values (updated every 10 seconds) will also be shown. The MSI/WSI graph shall be grouped with the helideck landing status ‘traffic light’ and trend graph. Note that the WSI% value shall be displayed and reported rather than the WSI value and the length of the WSI axis shall be sufficient to cover up to the % equivalent to 60kts (140% for the generic maximum WSI limit of 43 knots).

   *NOTE: Unrounded MSI and WSI values may be used for the generation of the graph to improve resolution.*

f) ‘Reported Values’ are required and shall include the standard values reported by the Radio Operator (RO) to the helicopter pilot prior to landing (as defined in CAP437). The values shall be arranged from top to bottom or left to right in the order in which they are reported, namely: Pitch (Up/Down), Roll (Left/Right), Heave Rate (SHR) and Inclination.

g) Limits shall be clearly displayed adjacent to the associated reported values. Helicopter Category A Pitch, Roll, Heave Rate and Inclination limits shall be applied if no helicopter type has been selected. The generic MSI/WSI limit defined in Section 7.1 shall be used if no helicopter type has been selected or if no helicopter type-specific limit is available. Where limits are exceeded, this shall be clearly identified and highlighted visually e.g. red coloured text used to indicate the value(s) exceeding the defined limits.

   *NOTE: SHR shall be highlighted if SHR is generating a red status even if the SHR itself is below the limit – see Section 4.2.*

h) Graphical representations of deck motion parameter trends (20-minute maximum Pitch, Roll, and Inclination and 20-minute SHR) are to be provided for the last 20 minutes (or 3 hours) together with the corresponding limits. These shall be grouped together and time axes shall be aligned to enable an easy comparison with each other and the deck motion status ‘traffic light’ trend. Graphical trend data shall be grouped together with their associated reported values and arranged as defined in f) above.

i) Heave period and max heave are no longer required. ‘Max heave rate’ (previously calculated using the so called ‘Norwegian Method’) is now described as ‘Heave Rate’ (and will display Significant Heave Rate (SHR) values).

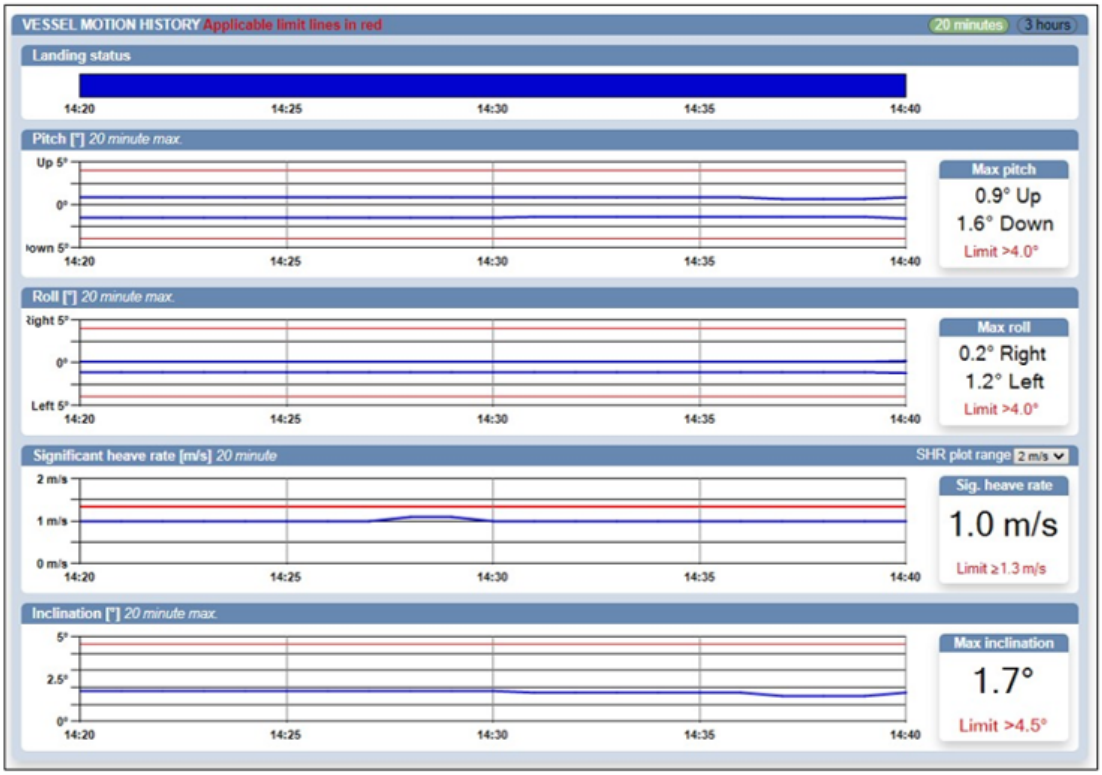
j) ‘Helideck Wind and Heading Data’ is required and shall include a compass rose which shall display:
   - ‘Magnetic North’, and corresponding compass directions as well as degrees. The compass shall be clearly marked to show segments of 10 degrees.
   - Wind Direction Vector shown as an arrow and clearly labelled.
   - The vessel depicted schematically in a manner that clearly identifies the bow or other reference direction (e.g. as an isosceles triangle or plan view

of the actual vessel), centrally located and clearly showing the vessel heading on the compass.

- The helideck depicted as an icon consistent with the design requirements for helidecks on vessels specified by CAP437, i.e. dark green background with a white outline and a white ‘H’ within a yellow circle. This supports consistency and familiarity with existing system designs on offshore vessels.
- The helideck icon shall be positioned centrally within the vessel icon, and centrally within the compass.
- ‘Wind and Heading Data’ shall include a numerical presentation of wind speed and wind direction values. Wind speed shall be presented as a two-digit number, wind direction shall be displayed as a 3-digit number, i.e. 001 to 360º. The display shall allow toggling between 2-minute or 10-minute mean values and shall clearly identify what wind speed/direction averaging is being displayed. By default, the displayed values shall be 10-minute averages.
- Vessel heading (and course when the vessel is under way) shall be displayed as a 3-digit number, i.e. 001 to 360º. Vessel speed shall also be displayed in knots, rounded to the nearest whole number when the vessel is underway. It is recommended that these three parameters be grouped together in the bottom right corner of the compass rose section of the display.

k) ‘Meteorological data’ specified by CAP 437 (or equivalent national standards where applicable) may be presented and be grouped together. It is recommended that the dedicated area of the display be clearly identified as being separate from the HMS displays, e.g. by using a different background colour.

l) A data entry field shall be provided in the user input section of the display for the helicopter heading reported by the pilot after touchdown and shall be clearly identified as a mandatory action. The helicopter heading must be entered into the system immediately after touchdown, i.e. as 001 to 360, relative to magnetic North. It shall not be possible to switch to the ‘on-deck’ mode unless and until a valid helicopter heading is entered into the system. The system shall automatically switch to the ‘on-deck’ mode once the helicopter heading has been entered on the ‘pre-landing’ display.


**'Pre-Landing' Mode Displays**

*Note that the above examples are based on a Rev.9b system and have not been updated to reflect the changes introduced at Rev.9c. The overall layouts remain representative, however, and the information content is broadly compliant. Where differences exist, the text in the standard represents the definitive requirement.*

## 5.2 Specific Design Requirements of the On-Deck Display

The figure at the end of this section presents a preferred display for the system in ‘on-deck’ mode. The information presented on this display shall be updated at least at 10-second intervals.

a) As with the pre-landing display, the Vessel name, location coordinates, and Helideck Category (consistent with the helideck’s certification, as discussed later in Section 6.1) shall be displayed at the top of the display. Date and time (UTC in ISO 8601 format), and software version and HLL limits designation shall also be clearly displayed together with a timestamp for the last display update (UTC in ISO 8601 format) to assure the user that the display has not ‘frozen’.

b) The helicopter heading at landing (reported by the pilot, relative to magnetic North, and entered into the HMS) is primary information and therefore shall be positioned at the top left-hand corner of the display. This information shall be editable in case of incorrect input but shall otherwise not be changed. The display shall provide a record of any heading correction and corresponding time stamp.

   *NOTE 1: A warning shall be provided to the user prior to the helicopter heading being used by the HMS if the heading entered will generate an amber or red RWD alert. This shall apply every time a helicopter heading is entered.*

   *NOTE 2: All trend plots shall refresh whenever the helicopter heading at touchdown is entered or corrected.*

   *NOTE 3: Whenever and for whatever reason a helicopter heading is entered, it must be the current heading of the helicopter at the time of entry obtained from the helicopter pilot. The HMS shall track the helicopter heading using the vessel heading and the relationship between the vessel and helicopter headings at the time of entry of the helicopter heading.*

c) Information pertaining to ‘RWD criteria’ is required and shall be grouped towards the top of the ‘on-deck’ display:

   - ‘RWD Status’ – to be arranged as a ‘traffic light’ with red, amber and blue lights from top to bottom. Location and arrangement to be consistent with ‘pre-landing’ helideck motion status ‘traffic light’ to promote familiarity with the system layout, and to be clearly labelled as ‘RWD Status’ (instead of ‘Helideck Motion Status’ in the ‘pre-landing’ display).

     The RWD Status is defined as follows:

     - Blue status (slow flash): relative wind direction within limits.
     - Amber status (fast flash): impending relative wind limit exceedance (investigate cause and identify appropriate mitigating action required – see Appendix A2).
     - Red status (fast flash): relative wind limit exceeded (take appropriate mitigating action – see Appendix A2).

     Changes in RWD status constitute an alarm; they shall be clearly shown and annunciated in a way that would help attract the attention of the RO.

An audible alarm may also be added. The RWD Status will also be relayed to physical repeater lights on the helideck (see Section 5.3 below).

*NOTE: In the unlikely event that the Helideck Landing Status is red at the time the on-deck mode is activated (i.e. when the helicopter heading at landing is entered), the RWD Status shall be set to Red until the system is switched back to the pre landing mode after the helicopter has departed.*

- Numerical values for RWD and 2-minute averaged wind speed.
- RWD/Wind Speed limits graph which shall show the limits lines, the extent of the corresponding (flashing) amber and red zones, and the trace of the RWD/wind speed data points since touchdown. This will be displayed near the RWD status 'traffic light'. The generic RWD limit defined in Section 7.2 shall be used if no helicopter type has been selected or if no helicopter type-specific limit is available.

d) 'Change Since Touchdown' data/information covering up to the most recent 30 minutes is required and shall include:

- RWD status trend – a graphical presentation of the RWD status over time since touchdown. The trend data shall be colour coded in accordance with the RWD status (red, amber, blue).
- Δ Vessel Heading – a graphical representation of the change in vessel heading over time since touchdown (using the same convention as for the RWD and showing the relative change as Left/Right). If there is a change exceeding10deg Left/Right, the numerical display shall be highlighted (e.g. coloured amber) while it persists, and exceedances may be permanently highlighted on the plots. The example display below presents the Δ Vessel Heading as a line chart to clearly identify deviation from the touchdown value.
- Δ Wind Direction – a graphical representation of the change in 'apparent' wind direction over time since touchdown (showing the relative change as Left/Right). If there is a change exceeding 30deg Left/Right, the numerical display shall be highlighted (e.g. coloured amber) while it persists, and exceedances may be permanently highlighted on the plots. The example display in the figure below presents the Δ Wind Direction trend as a line chart to clearly identify deviation from the touchdown value.

Grouping of information in this manner shall enable the user to assess if either of the vessel heading or wind direction change is more than expected and assist identification of the cause of any RWD alert.

*NOTE 1: The 'Change Since Touchdown' displays shall be reset on transition from the pre-landing mode to the on-deck mode.*

*NOTE 2: If the helicopter heading at landing has to be corrected, the 'Change Since Touchdown' displays shall be reset and based on the corrected heading.*

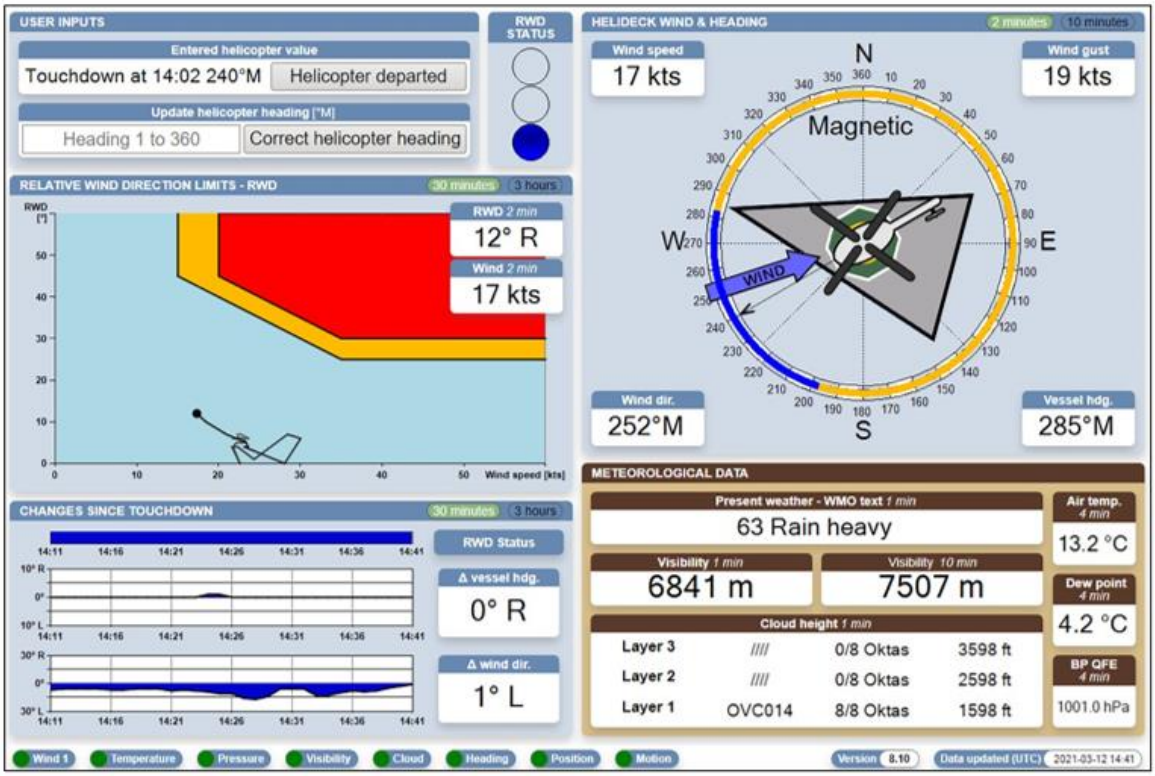
Should the vessel heading or wind direction change significantly after touchdown, and exceed the limits specified in Section 7.2, this shall be clearly identified. It is recommended that the y-axis scale is bounded (limits of +/-10deg for the change in vessel heading, and +/-30deg for the wind direction) to assist the interpretation of the trends. When any of the trends exceeds

these limits, it is proposed that the time segment when an exceedance has occurred is clearly marked to attract attention, e.g. using ‘reverse video’ flashing (background and text colours swap at an appropriate rate).

e) ‘Wind and Heading Data’, together with vessel course and speed when the vessel is underway, is required consistent with the ‘pre-landing’ display. The compass rose shall be consistent with the corresponding ‘pre-landing’ presentation, and also include a graphical representation of the helicopter, showing its heading and the width of the RWD blue and amber sectors, allowing a direct visual comparison with the wind direction vector. The wind direction vector shall also be coloured according to the RWD status, to reinforce the meaning of the RWD status. Excepting the meteorological information section of the display which shall be in accordance with CAP 437, all wind information presented on the display shall be the 2-minute mean values.

f) The meteorological data (optional) shall be presented in the same manner as for the pre-landing display.

g) The system shall revert to ‘pre-landing’ mode once the helicopter has departed. This shall be accomplished manually using a ‘helicopter departed’ switch.




**On-Deck Display**

*Note that this example is based on a Rev.9b system and has not been updated to reflect reflect the changes introduced at Rev.9c. The overall layout remains representative, however, and the information content is broadly compliant. Where differences exist, the text in the standard represents the definitive requirement.*

## 5.3 HMS Repeater Lights

A repeater light system indicating the helideck operational status shall be installed on the helideck to provide information directly to the helideck crew and helicopter flight crew. The operational status annunciated by the repeater lights shall be identical to that presented on the Helideck Monitoring System (HMS) 'Pre-Landing' and 'On-Deck' displays and shall comprise blue, amber and red lights. The lights are to be extinguished if the HMS is unserviceable.

The HMS shall provide a repeater light test function to allow all six states of the repeater lights to be checked. The test function shall be inhibited whenever any deck motion or wind limit is exceeded, i.e. when not at 'blue' status.

A detailed specification for the repeater lights is contained in CAP 437 from 9th Edition.

*NOTE 1: Where a helideck status light system is installed (see CAP 437 Chapter 4) the HMS repeater lights shall be automatically switched off when the status lights have been activated to avoid the possibility of conflicting and/or confusing signals to the helicopter pilots.*

## 5.4 HMS Serviceability

The HMS shall monitor and display the status of all sensor inputs. Sensor status may be self-monitored by the sensor and communicated to the HMS (e.g. using a failure bit in a serial data bus message), could be detected by the HMS using a 'check sum' in a serial data stream, using a time-out function, by applying data reasonableness checks (unrealistic rates of change – spikes) or through lack of change ('frozen' sensor) or any combination of these methods.

The expected HMS behaviour in the event of a sensor fault shall be:

a) The corresponding sensor fault light on the HMS display shall be illuminated at detection.

b) Data from faulty sensors shall not be used to populate data buffers or otherwise be presented on the HMS displays from the time of fault detection.

If the corresponding data buffer is insufficiently full (see NOTE 1 and NOTE 2 below), any associated parameters on the HMS displays shall be 'flagged' (e.g. 'greyed out') and shall be removed after 10 seconds, i.e. within one update at the minimum display update rate.

*NOTE 1: For motion parameters, up to 10 seconds of sensor data in any one 20-minute monitoring period may be missing corresponding to a data capture rate of approx. 99%.*

*NOTE 2: For wind measurements, a data capture rate of 95% is required as follows:*

- *Up to six seconds of data may be missing in any 2-minute period when generating the 2-minute mean wind.*

- *Up to 30 seconds of data may be missing in any 10-minute period when generating the 10-minute mean wind.*

If pitch, roll, inclination, heave rate, or any of the parameters required for the calculation of the MSI/WSI or RWD functions are inoperative/unserviceable then the HMS repeater lights shall be switched off and the status light displays shall be blank.

If any of the other parameters (e.g. Met information) are inoperative/ unserviceable then the HMS repeater lights and the traffic light display shall operate normally.

At least one HMS repeater light directly visible to either member of the flight crew with the helicopter landed on the helideck shall be operative for the HMS to be considered serviceable.

# 6 Classification of Helidecks and Helicopters

## 6.1 Helidecks

There is no official classification method available for this purpose. The proposed classification contains three categories based on the actual floating unit's size, configuration and motion characteristics. Limitations are defined by helideck pitch, roll heave rate and inclination. A prime requirement is that the installation has electronic measuring and monitoring equipment installed, and functional, in accordance with this document. Operations to those installations which either do not have the appropriate measuring or monitoring equipment installed, or whose equipment is inoperative, are limited to stable deck conditions, i.e. ≤1° Pitch & Roll and ≤0.4m/s SHR. Stable deck conditions may be established using an inclinometer mounted on the bridge of the vessel for Pitch and Roll, and by visual estimation of the heave rate (heave amplitude divided by half of the heave period) for SHR.

The category will be entered on the individual vessel/rig information plate in the North Sea Airway Manual or helideck plate and the Company Helideck Limitation List (HLL).

**Category 1**: Semi-submersibles including floating jack ups and all large vessels including FPSOs and tankers. All category 1 helidecks have the same day limits; different night limits apply to semi-submersibles versus other vessels. Category 1 shall therefore be subdivided into "Cat 1 Semi-Sub" and "Cat 1 Other".

**Category 2**: Small vessels, e.g. DSVs and seismic vessels, with a helideck that offers good visual cues. This would normally be a stern or midships deck offering a view of the structure of the vessel through at least 90° (assuming the vessel is steaming more or less into wind).

**Category 3**: Small vessels with poor visual cues, such as a bow deck or a deck mounted above the bridge superstructure with the landing direction facing forwards (bow deck) or abeam (high deck).

*NOTE 1: It shall not be possible for the user to change the categorization of Category 1 helidecks.*

*NOTE 2: Small vessels will be categorized 2 or 3 on inspection by the HCA and their helideck certificate and associated Jeppesen or equivalent data will reflect this (except that small vessels with midships decks will always be Category 2).*

*NOTE 3: Provision shall be included in the HMS to allow the operator to adjust the classification of Category 2 and 3 helidecks. The classification will be determined by the helicopter pilot based on the prevailing conditions. As a general guide, however:*

- *Category 3 vessels (bow mounted helideck) operating with the helideck downwind can be upgraded to Category 2.*
- *Category 2 vessels (stern helideck) operating with the helideck upwind should be downgraded to Category 3.*

*NOTE 4: Night operations to Category 3 vessels are not permitted in UK waters.*

### 6.2 Helicopters

Helicopters are classified as either Category A or Category B based on an assessment of their handling characteristics in relation to the landing (touchdown); on deck stability is addressed via the MSI/WSI/RWD limits. The current helicopter classifications are published in the Helideck Limitations List (HLL) Part C and are reproduced below.

**Helicopter Category A:**
Comprises the following helicopter types: S92, EC225, AS332 series, AW189.

**Helicopter Category B:**
Comprises the following helicopter types: AW139, S76 series, AS365 Series, B212, B412, EC135, EC145, EC155, EC175, AW169.

*NOTE: This does not constitute a helideck approval for a specific helicopter type on a specific helideck*.

## 7 Operational Limitations

### 7.1 Landing Limits

The maximum values of helideck pitch, roll, inclination and SHR permitted for landing are defined in the Helideck Limitations List (HLL) Part C and are reproduced in the table below.

For tanker mooring buoys (whose deck movement is measured by inclination rather than pitch and roll) the inclination limits are ±2° by day and ±1° by night regardless of helicopter category.

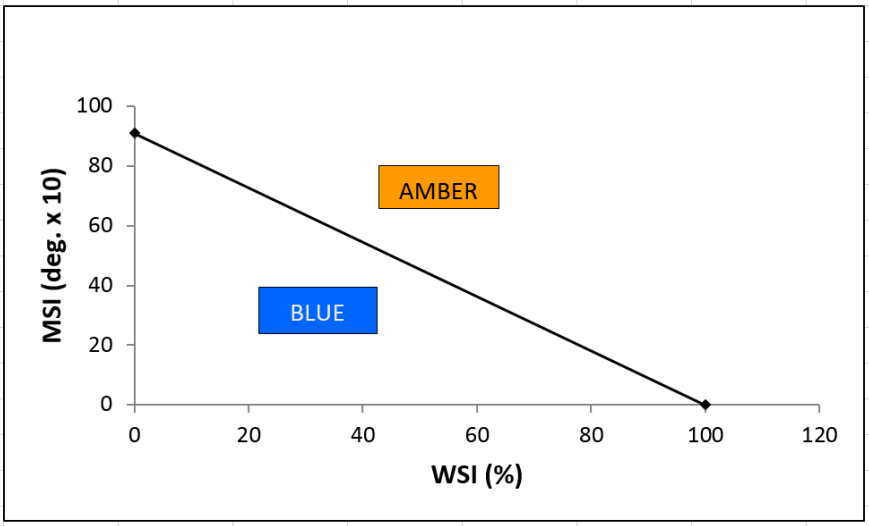
*NOTE: Always refer to HLL Part C on the HCA website for the current P/R/INC and SHR limits.*

| HELICOPTER CATEGORY | DAY / NIGHT | HELIDECK CATEGORY | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | | | 2 | | | 3 | | |
| | | P/R | INC | SHR | P/R | INC | SHR | P/R | INC | SHR |
| A | DAY | ±3 | 3.5 | 1.3 | ±2 | 2.5 | 1.0 | ±2 | 2.5 | 1.0 |
| | Night Semi-Subs | ±3 | 3.5 | 1.0 | Not Applicable | | | Not Applicable | | |
| | Night Other vessels | ±2 | 2.5 | 1.0 | ±2 | 2.5 | 0.5 | ±1* | 1.5* | 0.5* |
| B | DAY | ±4 | 4.5 | 1.3 | ±3 | 3.5 | 1.0 | ±3 | 3.5 | 1.0 |
| | Night Semi-Subs | ±4 | 4.5 | 1.3 | Not Applicable | | | Not Applicable | | |
| | Night Other vessels | ±3 | 3.5 | 1.0 | ±2 | 2.5 | 0.5 | ±1.5* | 2.0* | 0.5* |

* Night operations to Category 3 vessels are not permitted in UK waters.

Key:
**P/R** = Pitch and Roll (deg); **INC** = Helideck inclination (deg); **SHR** = Significant Heave Rate (m/s).

In addition to the above red ‘do not land’ limits, the amber MSI/WSI ‘caution’ detailed in the plot below shall be applied prior to touchdown.



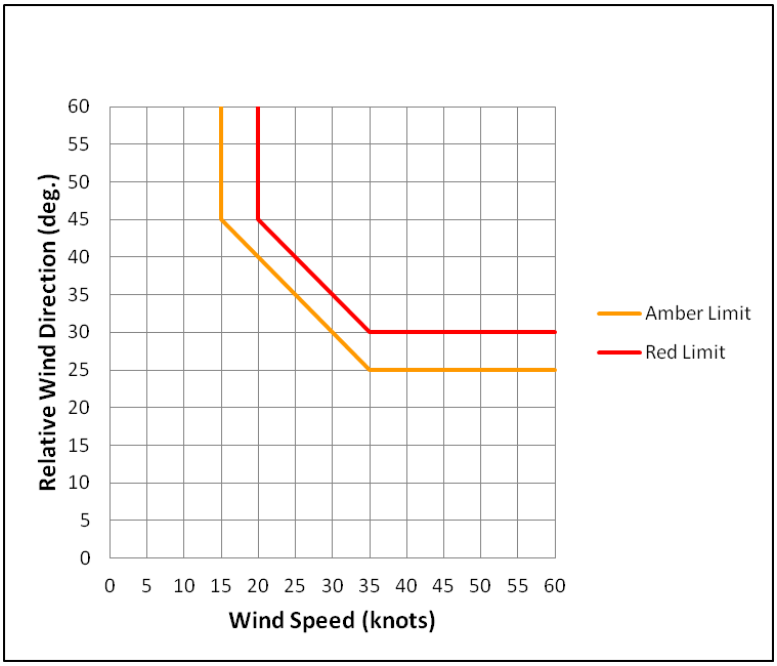

*NOTE 1: The coordinates of the line are (91, 0), (0, 100), where a WSI of 100% corresponds to the maximum WSI for the helicopter type selected or the generic maximum WSI limit of 43 knots if no helicopter type is selected.*

*NOTE 2: The MSI/WSI limit defined above is a generic limit to be applied to all helicopter types for which helicopter manufacturer validated MSI/WSI limits are not available, i.e. the HMS shall default to the above limit. The HMS shall include provision for the addition and selection of helicopter type-specific limits by authorised personnel.*

*NOTE 3: The colour blue is used to denote the 'helideck safe' condition to avoid confusion with the green helideck perimeter lights.*

### 7.2 On-Deck Limits

Following touchdown, the RWD amber 'caution' and red 'warning' limits detailed in the plot below shall be applied.




## 8 Miscellaneous Requirements

### 8.1 Data Transmission and Storage

The information presented on the pre- and post-landing displays shall be relayed to helicopter operators for flight planning and auditing purposes. It is recommended that an internet-based 'live' display is used (ideally refreshed at a rate of about once a minute). Alternatively, as a minimum requirement, pre-landing display data (e.g. screen print) may be sent by email to the helicopter operators in sufficient time prior to the helicopter's departure; this shall be streamlined for the user and ideally entail a single selection/button press. Vessel motion data shall also be included in weather information reports (e.g. Helimet for UK operations) as required by CAP 437.

*NOTE: Use of flashing symbology for highlighting any information accessed pre-departure from onshore (e.g. parameter exceedances) shall be avoided due to the potential for strobe effects with internet transmission.*

For quality auditing or incident investigation purposes, at least 30 days' worth of HMS data shall be stored and made available to helicopter operators or accident investigators. As a minimum, the data shall be sufficient to allow 'replay' of the HMS displays, i.e. a minimum update rate of 10 seconds. It is recommended that all the HMS parameters used to generate the HMS displays also be stored at an update rate of at least 2Hz in the event that a more detailed investigation of an incident is

required. Data may be stored on board the vessel (e.g. within the HMS) or may be transmitted to another site for retention (e.g. at the HMS Provider's (HP) facilities).

## 8.2 Training

Vessel operators shall ensure that all staff using the system are adequately trained and competent in the role and task. This shall include the operation of the HMS, the interpretation of the HMS displays, and the procedures to be employed during helicopter movements. The HPs' training courses/material shall be reviewed and accepted by the appropriate National Aviation Authority (NAA) as part of the certification process.

## 8.3 Certification and Maintenance

The HMS shall be tested by the HP, overseen by an appropriately qualified Independent Competent Person (ICP) to confirm compliance with this standard. The appropriate NAA and/or HCA will provide guidelines on the requirements for the verification/certification process, setting out the responsibilities of both the HP and the ICP. The guidelines will include certain 'mandated' elements/tests that the HP testing procedure shall include and that the ICP will independently check. These shall be common in scope and level of detail for all HPs and HMS products and shall cover:

- the detailed calculation from the raw data of the HCA limiting parameters of P, R, HR, INC, MSI/WSI, RWD,
- the correct presentation on the display of all HMS parameters to include display layout,
- checks that the latest limits are correctly implemented in the HMS software, and
- checks of other helideck site-specific data in the HMS.

The certification of the generic HMS and oversight of individual installations, including maintenance, will be performed by the appropriate NAA and HCA. The independent verification/certification process shall comprise the following main stages:

a) Factory Acceptance Test (FAT) planning:

   The HP prepares a generic FAT procedure during the design stage. The ICP reviews the HP's generic FAT procedure and checks that it is compatible with the verification requirements of the NAA/HCA. The FAT procedure shall include a section for mandated verification tests.

b) FAT testing of the generic product:

   The HP performs the FAT testing of the generic product. The ICP witnesses the testing and checks that the data provided by the HP demonstrate compliance with the HMS standard, including NAA/HCA guidelines and mandated tests on independent verification. The HP and ICP submit the appropriate documentation to the NAA/HCA for review. Following satisfactory completion of this process, the HMS generic product will be considered to have been 'approved'.

   *NOTE: This stage shall be re-visited when i) the manufacturer changes the design of the generic HMS product sufficiently to require a revision of the*

*generic FAT procedure, or when ii) NAA/HCA advise that any of the mandatory testing procedures has changed significantly, e.g. as part of a major update of the specification.*

c) Site-specific functional testing and Implementation audit:

For site-specific functional testing and auditing purposes, for practical reasons the ICP role is to be performed by an appropriately trained helideck inspector. The inspector checks that for each HMS installed on a moving helideck:

- An FAT has been carried out prior to dispatch from the HP and that the FAT complies with NAA guidelines – if the FAT procedure is the same as that of an approved generic product, the scope of the FAT checking will be focused on the site-specific elements only e.g. site-specific sensor voting logic or functionality.
- An SAT (Site Acceptance Test) has been carried out, to test the correct installation of the system in-situ.
- After both the FAT and SAT are complete, the inspector checks that:
  - The operational HMS limits and other parameters set in the HMS software at each site are correct and are up-to-date, consistent with the values set by the NAA/HCA.
  - Other site-specific information is correctly set in the HMS (e.g. wind sensor voting algorithms, wind sensor elevations above the helideck).
  - There is evidence of correct sensor installation (e.g. MRU deck alignment and calibration, wind sensor siting, see additional guidance section below).
  - There are provisions for historical HMS data for the site to be kept (for a period of at least 30 days) and that these can be accessed easily by the helicopter operators for audit purposes (e.g. processed HMS data accessed via the internet, preferably via a similar interface as that used for the HMS GUI). Detailed (raw measurement data) is to be kept by the HP and made available on request to NAA/HCA/AAIB if needed for an incident investigation.
  - There is planning in place for the HP to provide HMS training to ROs/HLOs at each site. This is to complement the MetOffice training already provided to ROs for the purpose of compiling meteorological CAP437 reporting data.

The inspector submits a report for each individual HMS installation to HCA. The status of the HMS will be recorded on the Helideck Information Plate.

d) In-service maintenance audits:

For each HMS installed, audits are carried out by the HCA every two years (ideally aligned with the helideck certification cycle) to check that:

- There is evidence that the sensors are maintained and verified/calibrated as required.

- Historical data for the site are kept and can be accessed easily for audit purposes.
- Records exist to prove that user training has been provided to ROs/HLOs at each site.
- User feedback is taken into account and issues are resolved promptly.

Any issues or concerns about the correct functioning of the HMS product are reported back to the HP and NAA/HCA, and improvements to the HMS standard/testing procedure are proposed as necessary.

Additional guidance may be provided in due course by the NAA/HCA to cover the detail of:

- The mandated verification tests for the HCA limiting parameters (current and MSI/WSI/RWD), and the format of input and output files for the timeseries tests.

  *NOTE: The UK CAA guidelines are presented in Appendix B.*
- Standards for MRU alignment/calibration, and wind sensor calibration/voting.
- Standards for sensor maintenance and verification.

e) Updates/modifications:

Any updates or modifications that could affect the correct functioning of the HMS shall be controlled. This includes both changes to the limits and the calculation methods. It shall not be possible to peform any updates to the HMS that have not been checked/verified by the HMS provider (HP).

Software version number(s) are included on the Statements of Compliance issued by CAA International (CAAi) following approval which will also be available to view on the CAAi website. The software version number presented on the HMS display (see Section 5.1a)) shall correspond to an approved software version.

## Appendix A – Guidance on operational use of HMS

### A1. Description of new HMS functions and procedures

1. The modified HMS comprises the following main functions:

   a) Measurement/monitoring of helideck ROLL, PITCH, INCLINATION and HEAVE RATE (as previously).
   b) Measurement/monitoring of the new helideck Motion Severity Index (MSI) and Wind Severity Index (WSI).
   c) Measurement/monitoring of relative wind direction (RWD) and 2min averaged wind speed.
   d) New HMS repeater lights are installed on the helideck. The status of the lights is determined automatically by the HMS, as explained below.

   The new procedures for helicopter landing are divided into two phases, and the HMS operates in two corresponding, distinct modes:

   - Pre-landing mode;
   - On-deck mode.

2. Pre-landing (lights are steady burning):

   The HMS repeater lights indicate the status of the helideck motion as follows:

    = safe to land (ROLL, PITCH, INCLINATION, HEAVE RATE and MSI/WSI all within limits).

   NB: The lights are blue rather than green in order to distinguish them from the green helideck perimeter lights.

    = **do not land** (ROLL, PITCH, INCLINATION or HEAVE RATE out of limits).

   ROLL, PITCH, INCLINATION and HEAVE RATE are relevant to the touchdown only and the existing limits apply.

   The MSI/WSI is a new scheme and relates directly to the stability of the helicopter while landed on the helideck. Exceedance of the MSI/WSI limit only is indicated by the HMS repeater lights as follows:

    = land with caution (MSI/WSI **only** out of limits). Consider employing revised helideck handling procedures (see guidance at A2).

3. On-deck (lights are flashing):

   Under the new scheme, the only function of importance after touchdown is the relative wind monitoring. After touchdown, the pilot reports the helicopter's heading to the RO who enters this into the HMS. This switches the HMS to 'on-deck' mode. The HMS then calculates the relative wind direction using helicopter heading at touchdown together with the real time vessel heading and wind direction, and monitors this against the wind speed-related safe operating limit.

The HMS repeater lights indicate the on-deck status of the helideck as follows:

 = slow blue flashing - HMS in ‘on-deck’ mode, relative wind direction is within limits.

The relative wind direction is then monitored against the limits that have been defined. Exceedances will be indicated by <u>flashing</u> the HMS repeater lights as follows:

 = fast AMBER flashing - relative wind limit approaching (within 5° and/or 5 kts of the limit).

Investigate cause and plan mitigating actions.

 = fast RED flashing - relative wind limit exceeded.

Carry out planned mitigating actions.

Note that the relative wind monitoring function is inhibited and no warnings will be generated at wind speeds less than 15 kts.

## A2. Modified deck handling guidance for “steady amber” HMS repeater light (MSI/WSI exceedence)

1. <u>General</u>

A “steady amber” alert indicates that the helideck motion and wind conditions relating to the on-deck stability of the helicopter are marginal. Operations may continue but mitigating actions should be considered. Operations should be cancelled if the flight or helideck crew are unable to implement appropriate mitigating actions or consider the prevailing conditions unsafe.

Mitigating actions include:

- At touchdown, take particular care to align the aircraft as closely as possible with the wind.
- Both pilots should remain in the cockpit, and operations should only be performed one at a time to ***minimise close up time*** should conditions deteriorate.
- Embarking and disembarking passengers should be swapped one or two at a time to ***maximise aircraft weight***.
- Avoid refuelling.
- Once operations are complete, one pilot may leave the aircraft to confirm its security prior to departure.

2. Mitigation for “flashing amber”/ “flashing red” deck motion light while on deck (relative wind direction exceedance)

- If the wind speed exceeds 15kts, pilots should align the helicopter head-on to the wind, as accurately as possible (within about +/-10deg).
- Flashing amber or flashing red warnings will occur if the wind direction relative to the helicopter exceeds the threshold. The acceptable threshold varies with wind speed to reflect the decreasing variability of the wind direction and increasing vulnerability of the helicopter as the wind speed increases. Below 15kts the system is inhibited and produces no warnings.
- Flashing amber or flashing red warnings can be triggered either:
  - at the time of touchdown due to incorrect alignment by pilot or incorrect reporting/entry of the helicopter heading into the HMS;
  - during the time on-deck, due to a vessel heading change or a wind change.
- If a flashing amber or flashing red warning occurs as a result of incorrect alignment at touchdown, the pilot may elect to take-off and re-align.
- If a flashing amber warning occurs at any time after touchdown, RO should investigate the cause:
  - If the warning is triggered as a result of a change in vessel heading, the RO should take action to correct vessel heading and/or the pilot should decide what mitigating action is required.
  - If the warning is triggered due to a change in wind direction, the RO shall advise the pilot of the changes in trend, and the pilot will decide what mitigating action is required.
- If the RWD continues to increase and the HMS repeater lights flash red, consideration should be given to performing a take-off and reposition, oriented into wind. If the lights flash red or the aircraft commander is at all concerned about the stability of the helicopter, all helideck operations should cease and preparations should be made for a safe and timely departure.
- Normal take-off procedures should be followed if a re-orientation into wind is required following landing.

3. Dealing with loss of equilibrium while on deck

Loss of equilibrium can take the form of tipping and/or sliding and will normally only occur as a result of exceeding RWD limits. On the basis that prevention is usually better than cure, exceedance of RWD limits should be avoided wherever possible by repositioning the helicopter into wind. This note is intended to provide handling guidance for the helicopter flight crew in the event that it is not possible to reposition the helicopter, or the change in conditions occurs too rapidly to permit repositioning the helicopter.

Tipping or sliding will normally be preceded by rolling away from the wind in the direction of the tip or slide. The best way to minimise the risk of a tip or slide is to oppose the roll as follows:

- Cyclic may be used to oppose the roll;
- ***Pedal input to turn the nose into wind should be avoided*** - this will not be effective with more than one wheel in contact with the deck and will generate a rolling moment in the direction of the roll, worsening the situation;
- ***Use of collective other than to lift off to reposition the helicopter should be avoided*** - increasing collective will reduce the reactions at the wheels increasing the probability of tipping or sliding.

## Appendix B – UK CAA guidance on certification

### B1. Background

It is accepted by the offshore helicopter stakeholders in the UK and Norway that the HMS system shall be tested and maintained to ensure that it fulfils its intended purpose and that it does not introduce additional risks by presenting false or misleading information to the personnel responsible for offshore helicopter landings (i.e. the Radio Operator (RO), Helicopter Landing Officer (HLO) and pilots).

The content of this appendix describing the verification/certification process represents the output of a consultation exercise with HMS Providers and other stakeholders. The verification/certification process is to be carried out by an Independent Competent Person (ICP) and is to comprise the following main stages:

1. Factory Acceptance Test (FAT) planning.
2. FAT testing of the generic product.
3. Site-specific functional testing and Implementation audit.
4. In-service maintenance audits.

### B2. Scope

The scope of this appendix is to provide further guidance on the HMS verification /certification process, with an emphasis on auditing the FAT testing of the generic HMS product. Site specific aspects (e.g. anemometer siting and voting, MRU alignment) are to be negotiated and agreed with HCA and other stakeholders on a case by case basis.

The purpose of the FAT testing of the generic product is to check that it complies with the HMS standard. The following topics are covered in this technical note:

- Responsibilities of the HMS provider and the Independent Competent Person (ICP).
- Recommended FAT testing contents and structure.
- Detailed, ‘mandated’ checks of the calculation of MSI/WSI/RWD and SHR parameters, using realistic time series of inputs and outputs.

To clarify, the above scope does not cover the reporting of meteorological information for pilots, nor any functionality supporting the Offshore Weather Reports and Helimet.

### B3. FAT testing guidance

#### B3.1. Responsibilities of the HMS provider and the ICP – FAT approval stage

The responsibility for the correct functioning of the HMS system rests with HMS provider who shall take all reasonable steps in designing their system to ensure accuracy, usability and reliability, and shall take action to resolve and/or disclose any concerns they may have, e.g. known weaknesses/limitations of the software/hardware, issues with sensors provided by third parties.

The role of the ICP is to:

- Provide independent oversight of the testing (in the absence of suitable test houses).
- Review the FAT test procedure in detail and provide recommendations for any changes/additions, with an emphasis on compliance with CAA/HCA mandatory tests.
- Check that the FAT testing has been carried out in accordance with the planned FAT procedure, and that any follow-up actions are recorded and followed up in a clear and unambiguous way.

The ICP cannot (and shall not be expected to) guarantee that the system is 100% compliant or error free as a result of the independent verification.

### B3.2 Recommended FAT contents and structure

It is recommended that the FAT testing covers the following main functionality themes:

1. Data Inputs.

1.1 Generic interface with the meteorological & vessel motion sensors - collating data and creating input 'instantaneous' datafiles.

As a first step, the HMS is expected to collate all raw sensor data and produce processed 'instantaneous' datasets, with all the information needed to calculate the Helicopter Limitations List parameters (existing HLL limits and new limits associated with the new MSI/WSI/RWD parameters).

These datasets are expected to include the following parameters, and it is recommended that these are saved as 'instantaneous' datafiles, based on clearly stated units/conventions:

- Time stamp (UTC).
- Wind speed (knots), Wind direction (North as 360°, From, Magnetic [1]), for each sensor. Wind corrected for height to standard 10m AMSL (Note: This shall be corrected later to 10m above helideck height by the HMS). At this stage any a) sensor sheltering adjustment, if applicable/known, b) voting logic to calculate the most representative free-stream value [2], shall also be applied.
- Deck motion sensor data – Roll, Pitch, Inclination (deg.), Heave rate (m/s), total accelerations X, Y, Z ($m/s^2$).
- Vessel gyro - vessel heading (North as 360°, To, Magnetic and True).
- Status of each parameter value (e.g. OK, missing/not OK)

Note: It is not necessary that all data should be stored synchronised with each other (i.e. with identical timestamp for all variables). The instantaneous data for each of the groups above can be provided as separate files. However, where data is combined from different sensors to produce a single output for the list above (e.g. using voting

[1] Although only Magnetic is needed for the purposes of the HMS, True could also usefully be included since, e.g. the met data reporting of wind direction (i.e. for the Offshore Weather Report and Helimet) require True.
[2] This is a site-specific aspect, since it depends on the number of anemometers in situ and their siting.

from different wind sensors), the instantaneous file shall give the combined output and its corresponding timestamp.

It is recommended that the FAT includes at least the following types of checks to ensure the integrity of the instantaneous files:

- Check expected types of sensor I/O.
- Check units (e.g. knots vs m/s) and unit conversions.
- Check conventions of directional parameters, e.g. wind direction/vessel heading – North as 360°, behaviour at crossing point between 360° to 1°, To/From, Magnetic/True.
- Voting logic, and other wind sensor data corrections.

Corrections to raw vessel data, e.g. to refer to centre of helideck from the measurement location. Check sign conventions (e.g. right-handed coordinate system with z-axis pointing downwards and x-axis aligned with the vessel longitudinal axis).

1.2 Site-specific data inputs.

The FAT shall include checks relating to setting and storing site-specific parameters:

- Helideck category and HCA helideck certificate parameters (e.g. height of helideck).
- Height of wind sensors – needed for wind speed corrections.
- Assumptions for wind sensor voting logic and other corrections – dependent on the siting of each sensor.
- Checking how the location of the vessel affects Day/Night calculations (if automated) and True to Magnetic conversions (via magnetic declination calculation).

2. HMS reported parameters.

Instantaneous data derived from the sensors together with site-specific inputs and user inputs (see below in 2.1) are then processed to calculate all the parameters that are presented on the HMS displays, the ‘reported’ parameters. The FAT shall include checks to cover each of the steps needed to calculate the reported parameters, as discussed in more detail below.

2.1 User / operational inputs.

The FAT shall list all user inputs into the HMS, ensure that they are correctly recorded by the HMS interface (as a datafile), and that values can be amended in case of user input error. There are two sets of user input data to consider, as follows:

Pre-landing:

- Helicopter type (entered by user and checked remotely by helicopter operator onshore). This is then then converted to HCA helicopter category (Category ‘A/B’).
- Day/ Night (preferrably calculated automatically, or input by user).
- Helideck category (set in accordance with HCA certificate, editable by the user for Category 2 and 3 helidecks).

On-deck:

- User inputs of helicopter heading and associated timestamp.

2.2 HLL limiting values.

Check method for calculating HLL limiting values as a function of helicopter type [A/B] and helideck category [Cat 1/2/3]:

- P, R, SHR, INC.
- MSI/WSI limits line (MSImax, WSImax).
- RWD/wind speed AMBER and RED limits lines.

2.3 HLL limiting parameters – P, R, SHR, INC, MSI, WSI, RWD.

Consider steps needed to calculate each parameter from the instantaneous datafiles and report them at a given sampling rate (at least once per minute). Mandatory test files (discussed later in A3.3) will also check these:

- P, R, INC (20min maxima).
- SHR.
- MSI (including forward prediction 'R' factor set by CAA).
- WSI (10min mean, and as reported in the form of $\%WSI_{max}$).
- RWD.

Notes:

1) There are two types of angle calculation/reporting: a) directional angles (using the aviation convention of 360° to 359°), and b) differences of angles, e.g. ∆Vessel heading change from touchdown, RWD (including the averaging of wind direction changes) which shall be calculated as +/- 180° and displayed as 'Right' (positive) or 'Left' (negative).
2) All calculated limiting parameters shall be rounded according to the expected accuracy, i.e. P, R, SHR, INC to one decimal place, MSI/WSI rounded to the nearest digit. This rounded value shall be displayed and used in the helideck status calculation (see below).

2.4 HLL helideck status calculation:

As a minimum, use mandatory test files to check:

a) The method for calculating limit exceedances for each parameter:
   - P, R, INC.
   - SHR (including damping).
   - MSI/WSI.

b) The method for calculating helideck status (steady or flashing light status), based on the limit exceedances above and sensor status.

2.5 Calculation of all other parameters displayed by the HMS:

The FAT shall also check the calculation of all other (non-HLL status related) parameters displayed by the HMS, as well as:

a) Relayed data.

   Check correct format and functionality for HMS display via the internet to onshore helicopter operation planning teams.

b) Stored data.

Ensure all parameters displayed as numbers on the HMS display (including user inputs) are stored in datafiles for archiving purposes. It is recommended that these datafiles include all the input and reported parameters (as per the mandatory test datafiles - see Annex 2).

3. HMS display

The FAT shall describe the intended HMS display design, e.g. provide a screenshot of all the main displays prior to the FAT, with a list of the intended variables, and their locations shown on the display to aid checking.

The checks of the HMS display shall include:

- Single values – e.g. P, R, SHR, INC, vessel location, other met data.
- Plots – MSI/WSI, RWD/wind speed, wind vessel direction diagrams.
- Trends – time series plots.
- Alerts during HLL limit exceedances.

In addition to the HMS provider's own tests of the HMS display, the ICP will also supply a realistic time series dataset for testing the HMS functionality and display (see 'mandatory tests' in Section A3.3 below). The intention is to 'feed' the input timeseries through the HMS and to use this to observe and check the response of the HMS display and output datafiles. This is discussed in more detail in Section A3.3 below.

4. HMS overall functioning

The FAT shall include tests to check:

- Correct booting up.
- Correct pre- and post- landing sequence is displayed and triggered appropriately.
- Pages on other tabs can be accessed as required.

5. Output driving HMS repeater lights

The FAT shall include tests to check that the output from the HMS drives the repeater lights correctly, e.g. correct colour, and steady vs slow/ fast flashing.

### B3.3. 'Mandatory' HCA/CAA checks

In addition to checking that the FAT is structured clearly and that it covers each of the steps of the HMS functionality as discussed above, testing with realistic time series data shall also be incorporated in the testing to help ensure that the new SHR, MSI/WSI and RWD/wind speed functionality is correctly implemented and displayed by the HMS.

The proposed approach is that the ICP provides 'instantaneous' input data files to:

a) Allow the calculation of SHR, MSI/WSI, and RWD/wind speed, and helideck status shall be checked, by feeding in sets of 'instantaneous' data through the HMS.

b) Drive the display of the HMS reported information, so that this can be checked as follows:

- All HMS parameters are displayed correctly and clearly, in the correct location and within the correct grouping, and with appropriate legends;
- The helideck status is displayed correctly (including situations where sensors malfunction or are inoperable), and that appropriate alarms (visible and/or audible) are triggered.

c) Check output datafiles (i.e. those archived as per the HMS specification).

Sample mandatory test datafiles will be provided by the ICP as described in Annex 2. These datafiles will include all the essential inputs that drive the HMS (user inputs and processed instantaneous sensor data), as well as all the mandatory outputs calculated and displayed by the HMS. Note also that these test datafiles calculate rounded numbers for the limiting parameters and use these for the comparison with the limiting values.

The ICP will also check the following aspects:

- HLL helideck limits: there is a clear and effective mechanism in place for selecting them correctly and keeping them up to date.
- For the instantaneous timeseries files used as input for the HLL parameter calculations: the interface between the generic system and site-specific inputs is transparent and easy to check at the SAT stage or to update later, e.g. by keeping a clear record of editable parameters to site-specific inputs:
  - Helideck category and height.
  - Height of wind sensors – needed for wind speed corrections.
  - Wind sensor voting logic and other corrections – dependent on the siting of each sensor.

### B3.4. SAT test plan

The HMS provider shall produce a generic SAT plan as part of the FAT which shall be audited by the ICP and submitted to the NAA/HCA for review. This shall include a log of all HMS functionality not tested during the FAT due, for example, to variable sensor interfaces. The SAT plan shall provide a high-level description of the functions to be tested and how the testing is expected to be performed. It is anticipated that the generic SAT plan will be used as the starting point for each specific installation and will be customized as required.

It is expected that the SAT test plan will include the following aspects:

- MRU alignment & lever arm corrections.
- Anemometer siting and voting.
- Interfaces/connections with sensors/vessel systems also known as Site Integration Testing (SIT).
- Any other site-specific customisation and/or calibration.
- Functioning of internet link/capability to generate screen print for emailing to helicopter operator.
- Correct overall functioning of the installed/integrated software.

ANNEX 1 – List of HMS parameters and location on display

**List of Pre-landing display variables**
*Legend: [ ] variable, “ “ legend, *user input, ( ) graphic element*

**Inputs:**
*[Helicopter Type]
*[Day/Night]
*[Helideck Category]
"On touchdown, Input helicopter heading (ºM)" - Magnetic, To, N=360, XXX
*[Helicopter Heading] *(Button) - *record time at landing [t.land]

**HLL status:**
[HLL status (t)] "HLL status"- (light) Blue/ Amber /Red

**On deck stability limits– MSI/WSI**
{MSI/WSI Graph} [MSI(t)], [WSI(t)],
(Limits line) - based on [MSImax], [WSImax]
Trace: [MSI(t-Dt... t) – rounded end= present time], [WSI (t-Dt...t)]
*Toggle - [Dt=trend duration], 20min / 3hrs]

HMS repeater light trend plot - [Helideck status (t-Dt ....t]

**Touchdown limits** –
Max Pitch [P up] [P down] [P limits] - display in red when exceeded
Max Roll [R up] [R down] [R limits]
SHR [SHR(t)] [SHR limits]
Max Inc [INC(t)], [INC limits]
*trend buttons -> time traces

**Wind and vessel heading**
[Wind speed], [Wind Gust] - 2min ave, @helideck height+10m
[Wind direction] @helideck height+10m, Magnetic, From N=360, XXX
[Vessel Heading] Magnetic, To N=360, XXX

**Helideck wind and heading – toggle to display 2min or 10min averages**
(Helideck and Vessel image - [Vessel Heading]) (wind dir. arrow - [Wind direction])
(Compass point graphic - cardinal points and subdivisions, N=360º)

**Vessel position – GPS convention with decimal units:**
N DD°MM.MM’ E DDD°MM.MM’

**Timestamp:** according to ISO 8601
[Last Update]: YYYY-MM-DD HH:MM:SS UTC

**Meteorological data (optional)**

**Sensor status:**
[Deck Motion], [Gyro], [Wind]
Optional: [Air Pressure], [Air Temp], [Humidity], [Temp], [Cloud], [Visibility] [Hs]

**List of On-deck display variables**

*Legend: [ ] variable, “ “ legend, *user input, ( ) graphic element*

**Inputs:**

**Helicopter heading** - Magnetic, Towards N=360, XXX
*[HH input] *BUTTON "Correct helicopter heading"
[Helicopter Heading (tLAND)] "At touchdown"
*BUTTON "Helicopter departed"
[Helicopter Heading (t)] - could also be displayed as an option

**RWD status:**

[RWD status (t)] "HLL status"- (light) Blue/ Amber /Red “fl.”

**Relative Wind Direction monitoring – RWD**

[RWD(t)] “RWD” - in deg, from Left / Right
(limits line RED / AMBER)
(trace) [RWD(t-[t.land]...t) – dot at present time
(trend plot) [RWD status (t-.land..t]

**Helideck wind and heading —toggle to display 2min or 10min averages**

[Wind speed], [Wind Gust] - 2min ave, @helideck height+10m
[Wind direction] -, @helideck height+10m, Magnetic, From N=360, XXX
[Vessel Heading] Magnetic, To N=360, XXX
(Helideck and Vessel image - [Vessel Heading]) (wind dir. arrow [coloured according to RWD status]- [Wind direction]) (Compass point graphic - cardinal points and subdivisions, N=360º)

**Vessel position, Timestamp, Meteorological data, sensor status** - as per pre-landing display. [NB: It is noted that the status of the motion (MRU) is not strictly necessary for the functioning of the on-deck display].

ANNEX 2 – Mandatory time-series test files

Time-series test files will be provided by the ICP to carry out a check of:

a) The calculation of the new HMS parameters SHR, MSI/WSI, and RWD.

b) The calculation of HLL status based on these parameters together with R, P, INC.

c) The reporting of the parameters on both the main HMS displays (pre-landing and on-deck), at any given time, t.

**Pre-landing HMS display test files:**

Inputs:

1. HLL limits based on operational inputs:

Helicopter type (e.g. H225), Helicopter category (A/B), Day/Night, Helideck Cat (1/2/3), Semi Sub (Y/N), Helideck height, HLL limits: LimR, LimP, LimINC, LimSHR, MSImax, WSImax.

2. Processed instantaneous data from sensors:

- Motion.
- Wind.
- Heading (Gyro).

Required HMS outputs for checking:

a) Pre-landing output datafile: Calculated HMS parameters at a sampling rate of 1min (coincident with timestamp minutes to allow a direct comparison).

b) Inspection of the HMS display corresponding to any time t of the test record during the FAT testing.

**On-deck HMS display test files:**

Provided inputs:

1. User input of helicopter heading and time stamp.
2. Processed instantaneous data from sensors (same format as per pre-landing) plus helideck height (from pre-landing inputs).

Required HMS outputs for checking:

a) On-deck output datafile: Calculated HMS parameters at a sampling rate of 1min (coincident with timestamp minutes to allow a direct comparison).

b) Inspection of the HMS display at any requested time t during the FAT testing.